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Productivity

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Organisational Commitment in Public Sector

Functionally Dependant Stressors

Capital Output Ratios

Appropriate Technology for Farmers

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Food Legume Processing Techniques

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Feature

Organisational Commitment of Public Sector Managers

Baldev R. Sharma & Poonam Chauhan

This paper is an attempt to assess the level of motivation and morale of public sector managers and also to find determinants thereof. While there are many ways to define and measure employee motivation and morale, the authors use 'organisational commitment' as a measure of motivation. The authors also assume that highly motivated employees or those with high morale feel more committed to their organisation than those who are less motivated.

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The public sector occupies, to use a cliche, commanding heights in the Indian economy. While it is common knowledge that many public sector enterprises (PSEs) are not doing well in terms of financial performance, there are a few that have performed remarkably well. The PSEs as a whole are said to have turned the corner in 1980-81 with a net profit of Rs.446 crores and, since then, their profits have been going up year after year (Prasad, 1990). Despite this, however, the pubic sector in India has come under widespread criticism largely because of their not-so-good economic performance. This is how the Draft Approach Paper to the Eight Five Year Plan has summed up the overall performance of the public sector in India :

> ***"The public enterprises having failed to use resources efficiently and to generate the expected surpluses despite substantial price revisions for their products and services, even the moderate growth of public investment has had to be financed mostly through borrowings from the public and from the Reserve Bank."***

This is indeed a serious indictment of the public sector. Low morale of officers and workers and lack of proper work culture are cited as some of the reasons for the poor performance of PSEs (Ramaswamy, 1989).

While there is definite need to tone up the economic performance of the PSEs, to blame the management or the manpower of PSEs for their poor performance may not be wholly justified. Much of the criticism is prompted by a comparison of the performance of the public sector with that of the private sector. No such comparison is justified as enterprises within the two sectors operate under altogether different conditions, pursue different goals, and cater to different markets. Profit-making, which justifies the very existence of a business organisation in the private sector is nowhere listed as an objective of a PSE. How

does one determine the price of a product like uranium mined and processed by UCIL and sold to the government of India? Or of a fighter plane manufactured by HAL and sold to theMinistry of Defence ? Or of a naval ship built by HSL and sold to the Indian Navy? And, to give just one more example, how can we talk of profit for NFL if fertilizer is required to be sold at a price lower than its cost of production?

The public sector is accountable to the public for anything and everything that happens within it. Operationally, this means the creation of a number of statutory and parliamentary bodies as watch-dogs besides various administrative control mechanisms. For example, the department of public enterprises (DPE) has issued some 400 guidelines which every PSE is required to follow in carrying out its day-to-day activities. No organisation in the private sector is required to operate under any of these constraints or controls. Hence, it is not quite justified to compare the public and private sectors using "profit" as a yardstick to assess their effectiveness.

If morale of officers and workers is indeed low and if that is one of the causes of poor performance of PSEs, low morale may be due, among other things, to a plethora of "guidelines" and "controls" under which PSEs are required to operate. Organisational climate marked by excessive controls is bound to reduce the area of discretion and curb the initiative of high-achievers. On the other hand, those who are non-performers may find such climate as haven for conformity and strict adherence to procedures with little or no concern for results.

In this paper, an attempt has been made to assess the level of motivation and morale of public sector managers and also to find determinants thereof. While there are many ways to define and measure employee motivation and morale, we have decided to use "organisational commitment" as a measure of motivation. In doing so, we have assumed that highly motivated employees or those with high morale would feel more committed to their organisation than those who are less motivated.

Review of Literature

Like many constructs in the field of organisational behaviour, organisational commitment too has been conceptualised and measured in a variety of ways, even though practically all of these measures are based on employee attitudes and perceptions. Broadly, the measures of commitment can be divided into the following three groups in terms of their thematic emphasis : (a) affective attachment, (b) perceived cost and side-bets and (c) moral obligation (Mayer & Allen, 1987). These three types of measures are briefly described below :

a) Affective Attachment : Herein, commitment is viewed as an emotional attachment to the organisation such that the highly committed person identifies with and enjoys his membership of the organisation. Researchers who have employed this approach in studying organisational commitment include : Buchanan (1974); Mowday, Steers & Porter (1979); Porter, Crampon & Smith (1976). Porter, Sleers, Mowday & Bonliaan (1974). A similar approach was followed in Great Britain by Cook & Wall (1980) who viewed commitment as having the following inter-related components :

   (1) pride in the organisation and internalisation of its goals;

   (2) willingness to invest personal effort for the sake of the organisation; and

   (3) affection for and attachment to the organisation and a wish to remain a member thereof.

(b) *Perceived Cost and Side-Bets :* Becker (1960) viewed commitment as a tendency to continue to engage in an activity resulting from recognition of the "cost" (i.e., lost side-bets) associated with the discontinuance of that activity. Similarly, Kanter (1968) defined "Cognitive Continuance Commitment" as that which appears when there is a payoff associated with continuance and a cost associated with discontinuance.

(c) *Moral Obligation :* Herein, commitment is viewed as a belief about one's "responsibility" towards the organisation. Thus, Wiener (1982) defined commitment as the totality of internalised normative pressure to act in a way which meets organisational goals and interests. Others who have argued that personal norms are important contributors in influencing behaviour such as continuance or discontinuance of employment with the organisation include Prestholdt, Lane & Mathews (1987), Schwartz (1973) and Schwartz & Tessler (1972).

All three approaches outlined above have a common point of reference, namely, desire to remain a member of the organisation. The three approaches reflect different *motives* all of which lead to the same end result. Thus, employees with strong affective commitment continue because they *want to,* those with "cost and side-bets" orientation continue because they *need to*, while employees with strong *normative* commitment continue because they *ought to* (Allen & Meyers, 1990). Why do employees

differ from one another in terms of their level of commitment? According to Mowday *et al.* (1982), the antecedents of affective commitment to the organisation can be classified into four categories : (1) characteristics of the individual, (2) characteristics of the job, (3) organisational experiences and (4) characteristics of organisational structure. The relationship between age and organisational commitment has been studied by Steers (1977), Stevens *et. al.* (1978), Morris & Sherman (1981) and Alvi & Ahmed (1987). Age is usually found to be positively related to commitment. On the other hand, level of education is found to be *negatively* related to commitment by some researchers (Steers, 1977; Morris & Sherman, 1981).

Job tenure, another age-related variable, is also found to be *positively* related to commitment (Sheldon, 1971; Alutto, Hrebiniak & Alonso, 1973; Farrell & Rusbult, 1981; Alvi & Ahmed, 1987). Turning to personality traits, organisational commitment has been found to be *positively* related to both "need for achievement" (Steers, 1977) and "Protestant work ethic" (Blau, 1987, Singh, 1990). Several other studies have also shown that pre-employment attitudes and expectations of an employee are powerful determinants of organisational commitment (Bem, 1967; Buchanan, 1974; Salancik & Pfeffer, 1978; O'Reilly & Cadwell, 1981; Bateman & Strasser, 1984).

Those who have found a positive relationship between commitment and job characteristics (e.g., job challenge and job discretion) include Buchanan (1974), Steers (1977) and Fukami & Larsen (1984). In related studies, job stress is found to be *negatively* related to commitment (Hrebiniak & Alutto, 1972; Morris & Sherman, 1981; Fukami & Larsen, 1984). Turning to organisational experiences, commitment has been found to be *positively* related to "wages and rewards" (Grusky, 1966; Bhagat & Chassie, 1981; Farrel & Rusbult, 1981). Likewise, "supervisory relations" and "interpersonal trust" are found to be positively related to commitment (Cook & Wall, 1980; Fukami & Larsen, 1984). On the other hand, Alutto & Acito (1974) found a *negative* association between "decisional deprivation" and commitment.

Some Indian scholars too have studied the relationship between organisational climate (OC) and commitment. Padaki & Gandhi (1981) have found a positive relationship between OC and identification with the organisation. Singh (1988) found two dimensions of OC ("grievance handling" and "safety & security") to be positively related to organisational commitment. In another study, Singh (1990) found commitment to be *negatively* associated with "perceived inequality" and *positively* with organisational characteristics like "supportive leadership", "professional management", group cohesion" and "standardisation".

It should be clear from the foregoing review that organisational commitment, like other aspects of employee behaviour, is influenced by a large number of personal and situational factors. This calls for the use of multivariate analysis so as to isolate from amongst a variety of personal and situational factors those which are most critical in influencing the level of organisational commitment.

Sample and Methodology

The study on which this paper is based was carried out with the help of a specially-designed questionnaire completed by 5184 junior and middle level managers belonging to 30 public sector enterprises (PSEs). A list of the organisations covered is given in Annexure I. The sample was drawn from all departments and functions and represented over 10 per cent of the junior and middle level officers upto and including the rank of Manager. The backgrounds of the respondents are given in table 1.

Table 1 : Background of the Respondents.

Sl. No.	Background Characteristics	Mean Scores		
		Lowest Ranking Company	Highest Ranking Company	Overall Mean of 30 Cos.
1.	Age (Yrs)	37	47	41
2.	Level of Education (Yrs)	14	16	15
3.	Promotees from the Ranks %	28	81	56
4.	Total Work Experience (Yrs)	14	24	19
5.	Experience as Officer (Yrs)	7	14	11
6.	Monthly Emoluments (Rs.)	3268	4838	4072

The research team visited each of the 30 PSEs and got the questionnaire completed in the presence of one or more members of the team. The officers were collected in groups and, after a brief introduction, were asked to complete the questionnaire there and then. No one was required to give his name or reveal his identity. It took about 25 minutes to complete the questionnaire. No difficulty was faced in the collection of data as each organisation was visited after taking prior approval of the top management who fully cooperated in the course of the study.

In the present study, we have employed "affective attachment" as an approach to study organisational commitment. We used a five-item scale to measure

commitment, each item having a four-point rating scale mentioned below :

0 = not at all true
1 = a little true
2 = a good deal true
3 = very much true

For a person who considered all five statements to be "not at all true" the overall score of commitment would "0" whereas someone who considered all five statements to be "very much true" would obtain a score of 15. Thus, the scale had a score range of 0 to 15. The higher the score of a person, the more committed he would be to his organisation and vice versa. Here is the list of five statements used to measure commitment :

(1) If a friend of mine is considering joining this company, I will encourage him to do so.

(2) The goals and values of the organisation are in perfect harmony with my own goals and values.

(3) I feel a sense of pride when I am introduced to a stranger as a member of this organisation.

(4) If I were to start my life all over again, I will not mind joining this company.

(5) In my overall assessment, this is one of the best organisations to work for.

The inter-item and item-to-total corelations and coefficients of reliability for the 5-item scale of organisational commitment are given in table 2. It may be pointed out that these calculations are based on in-depth analysis of 481 cases carefully chosen as a sub-sample out of the larger sample :

Table 2 : Inter-Item and Item-to-Total Correlations for the Scale of Organisational Commitment

Item	1	2	3	4	5	Item to Total
1	1.00	0.59	0.57	0.65	0.63	0.85
2		1.00	0.58	0.49	0.56	0.78
3			1.00	0.54	0.51	0.77
4				1.00	0.67	0.83
5					1.00	0.83

Cronbach Alpha = .86 Split-Half Reliability = .89

Organisational commitment will be examined in this paper in relation to 25 independent variables, which have been classified into four broad clusters : (a) Individual Background (6 variables); (b) Personality Traits (4 variables); (c) Job Characteristics (3 variables); and (d) Organisational Climate (12 variables). A list of these variables is given in Annexure II. Except for the six individual background factors, all other variables were measured with the help of multi-item scales.

Whereas basic information generated through the questionnaire is obtained from *individuals* who completed the questionnaire, *we are not using individual as the unit of analysis.* Instead, we have aggregated data from each company and then used *organisation* as the unit of analysis. This is what makes it a comparative study of 40 organisations, something that one rarely comes across in the area of social sciences research.

Aggregation of data across individuals is justified only if there is adequate agreement among respondents who provide data regarding a given variable. Unfortunately, criterion for determining an acceptable level of such agreement has yet to be developed. Meanwhile, the method suggested by Roberts, Hubin and Rousseau (1978) provides a workable solution to the problem on hand. According to these authors, inter-rated agreement can be considered to be adequate if *between*-group variance is significantly higher than within-group variance. Using this approach, we carried out one way-analysis of variance for each of the 26 variables selected for this study and the results thereof are presented in the last column of Annexure II. As F-ratio is statistically significant in each case, we may conclude that there is adequate inter-rater agreement to justify aggregation of data for each of the 30 organisations covered by this study.

The Findings

Table 3 presents in a summary major findings of this study in terms of mean score, standard deviation, and mean score converted into percentage for each of the selected variables. A look at the last column of the table will show that there is wide variation in the ratings given to different variables, ranging from *as low* as 34.55 per cent (delegation of authority) to as high as 74.58 per cent (conscientious). Using these two extreme points as the lower and upper ends of the continuum, all mean scores shown in table 1 (except those relating to individual background) were ranked into *low, medium* and *high* categories as per the following break-up of mean scores :

Means Score as %		Rank
30% - 45%	....	Low
46% - 60%	....	Medium
61% - 75%	....	High

Using the classification procedure described above, we find that "organisational commitment" (with a mean score of 56.58 per cent) falls into the *medium* category. This suggests that the junior and middle-level officers working in the public sector are only *moderately* committed to their respective organisations. A closer look at the mean scores of 30 companies under study revealed the following trend :

Mean Commitment Score	No. of Companies
Low (30% - 45%)	6
Medium (46% - 60%)	12
High (61% - 75%)	12
Total	30

Turning to independent variables (except those relating to individual background), we find that most of them can be ranked either "medium" (N = 6) or "low" (N = 9), whereas only four variables fall in the high-ranking category.

A list of these variables alongwith their relative ranks is given in table 4.

TABLE 3 : Mean Score, Standard Deviation and Mean Score Converted into Percentage for Each of the Selected Variables

Var No.	Name of Variable	Mean Score	Standard Deviation	Mean Score as % *
1.	Organisational Commitment	8.487	1.477	56.58
	Individual Background			
2.	Age (years)	41.084	2.791	-
3.	Level of Education (years)	15.274	0.472	-
4.	Promotees as Per Cent	55.609	14.888	-
5.	Total Work Experience (years)	18.568	3.023	-
6.	Experience as Officer (years)	11.007	1.968	-
7.	Monthly Emoluments (Rs. in '00)	40.715	3.982	-
	Personality Traits			
8.	Liberal	4.830	0.560	53.66
9.	Outgoing	3.865	0.216	64.42
10.	Conscientious	4.475	0.200	74.58
11.	Aggressive	2.704	0.249	45.06
	Job Characteristics			
12.	Work Technology	6.926	0.635	57.71
13.	Delegation of Authority	10.365	1.792	34.55
14.	Relationships at Work	5.880	0.382	65.34
	Organisational Climate			
15.	Scope for Advancement	3.731	0.916	41.45
16.	Grievance Handling	3.183	0.777	35.37
17.	Monetary Benefits	3.814	1.128	42.39
18.	Participative Management	3.672	0.713	40.80
19.	Objectivity & Rationality	4.019	0.685	44.66
20.	Recognition & Appreciation	4.087	0.772	45.41
21.	Safety & Security	4.966	0.971	55.18
22.	Training & Education	4.273	1.010	47.47
23.	Welfare Facilities	3.346	1.022	37.18
24.	Lateral Trust	4.758	0.508	52.87
25.	Bureaucracy	3.415	0.314	56.90
26.	Relative Deprivation	5.674	0.923	63.05

* Each mean score was converted into percentage by dividing it by the upper limit of its score range and then multiplying by 100. The score range of each variable is given in ANNEXURE II.

TABLE 3 : List of the Variables and their Relative Ranks.

			$\bar{X}$ Score
	HIGH RANKING		
1.	Conscientious (V-10)	....	74.58%
2.	Relationships at Work (V-14)	....	65.34%
3.	Outgoing (V-9)	....	64.42%
4.	Relative Deprivation (V-26)	....	63.05%
	MEDIUM RANKING		
5.	Work Technology (V-12)	....	57.71%
6.	Bureaucracy (V-25)	....	56.90%
7.	Safety and Security (V-21)	....	55.18%
8.	Liberal (V-8)	....	53.66%
9.	Lateral Trust (V-24)	....	52.87%
10.	Training and Education (V-22)	....	47.47%
	LOW RANKING		
11.	Recognition and Appreciation (V-20)	....	45.41%
12.	Aggressive (V-11)	....	45.06%
13.	Objectivity and Rationality (V-19)	....	44.66%
14.	Monetary Benefits (V-17)	....	42.39%
15.	Scope for Advancement (V-15)	....	41.45%
16.	Participative Management (V-18)	....	40.80%
17.	Welfare Facilities (V-23)	....	37.18%
18.	Grievance Handling (V-16)	....	35.37%
19.	Delegation of Authority (V-13)	....	34.55%

Barring just two exceptions, the low-ranking variables pertain to the organisational climate (OC) of PSEs. As many as seven dimensions of OC that seem relatively neglected are :

(a) grievance handling
(b) welfare facilities
(c) participative management
(d) scope for advancement
(e) monetary benefits
(f) objectivity and rationality
(g) recognition and appreciation

To the list of seven may be added another dimension of OC called "relative deprivation", which being one of the four high-ranking variables indicates lack of objectivity and fair-play in the implementation of personnel policies. Thus, eight out of the 12 climate dimensions are found to be negatively evaluated by the respondents. This should be a matter of urgent concern for the management of PSEs as it reflects poorly on the human resource management (HRM) function of the public sector.

The remaining two low-ranking variables are (a) *delegation of authority* (a job characteristic) and (b) *aggressive* (a personality trait). With an overall mean score of just 34.55 per cent, "delegation of authority" has emerged as the lowest-rated variable. This is partly beause a fairly large proportion of junior and middle-level managers working in the public sector are managers in name only. Many of them have been designated as managers but have either no subordinates whose activities they are supposed to coordinate or no real authority to supervise them. The remaining *low*-ranking variable is one of the personality traits. The junior and middle level officers manning the PSEs are *not* very "aggressive", as revealed by this study.

The six medium-ranking variables include the remaining four dimensions of OC (bureaucracy; safety & security; lateral trust; training & education) plus one job characteristic (work technology) and one personality trait (liberal). It should be clear from this evidence that the public sector climate is perceived by its officers either quite negatively or only moderately well. Surprisingly, not a single dimension of climate has been described as really good. The three variables getting a *high* positive rating are two personality traits and one job characteristic. The junior and middle level officers of PSEs consider themselves as highly "conscientious" and "outgoing" and are reported to have many opportunities for "interpersonal relationships" with their colleagues.

To sum up, the typical junior and middle level manager in the public sector is 41 years old, holds a college degree or its equivalent qualification, has total work experience of 19 years (out of which eight years were in a non-executive category) and his total emoluments come to Rs. 4072 per month. In terms of personality traits, the typical manager is highly "conscientious" and "outgoing", only moderately "liberal" and not very "aggressive". Insofar as job characteristics are concerned, he finds plenty of opportunities for interpersonal relationships, his job content (work technology) is only moderately rich and he enjoys very little authority over his subordinates or independent decision-making.

The various personnel policies and practices affecting junior and middle level mangers offer much scope for further improvement. "Monetary benefits" and "welfare facilities" are the tangible dimensions of organisational climate that are negatively perceived by the public sector managers. But their criticism is not confined to matters relating to bread-and-butter alone. Several intangible issues like "recognition", "objectivity", "advancement", "participation" and "grievance handling" too have received a poor rating. This clearly suggests that the weak spots of the public sector are to be found largely in the sphere of personnel policies and practices. This could be an important reason for the low morale of the public sector managers, as revealed by the moderate level of their organisational commitment.

Analysis of Data

Through descriptive analysis of data, we have identified certain strengths and weaknesses of the public sector. Let us now compare the 30 organisations under study to indentify the factors that explain as to why the level of commitment is found to be higher in some than in others. As a first step towards this goal, "organisational commitment" was cross-tabulated with each of the 25 independent variables. The results of this bivariate analysis are presented in table 5.

Fifteen out of the 25 variables selected for this study (60 per cent) are significantly related to organisational commitment. But the most remarkable thing emerging from this table is that *individual* characteristics are more or less unimportant while *situational* factors are most vital as correlates of organisational commitment. Thus, whereas *none* of the six individual background factors and only *one* of the four personality traits are found to be significantly related to commitment, 14 out of the 15 situational factors relating to job and climate are significantly related to commitment.

Among the situational factors, however, organisational climate appears to be far more important than job characteristics in influencing level of commitment among the public sector managers.

The existence of 15 statistically significant relationships between organisational commitment and other vari-

Table 5 : Zero-Order Correlations Between Organisational commitment and Each of the Independent Variables

Sl. No.	Independent Variable	Var No.	Correlation Coefficient	T-value (df=28)	P (2-tail)
1.	Scope for Advancement	15	+.895	10.62	P<.001
2.	Grievance Handling	16	+.888	10.22	P<.001
3.	Training & Education	22	+.865	9.12	P<.001
4.	Objectivity & Rationality	19	+.853	8.65	P<.001
5.	Recognition & Appreciation	20	+.851	8.57	P<.001
6.	Participative Management	18	+.827	7.78	P<.001
7.	Safety & Security	21	+.810	7.31	P<.001
8.	Lateral Trust	24	+.810	7.31	P<.001
9.	Welfare Facilities	23	+.773	6.45	P<.001
10.	Monetary Benefits	17	+.751	6.02	P<.001
11.	Work Technology	12	+.624	4.23	P<.001
12.	Relative Deprivation	26	-.527	3.28	P<.01
13.	Delegation of Authority	13	+.501	3.06	P<.01
14.	Liberal	8	-.488	2.96	P<.01
15.	Relationships at work	14	+.416	2.42	P<.05
16.	Level of Education	3	-.349	1.97	n.s.
17.	Bureaucracy	25	+.346	1.95	n.s.
18.	Experience as Officer	6	-.336	1.89	n.s.
19.	Conscientious	10	+.276	1.52	n.s.
20.	Outgoing	9	+.162	0.87	n.s.
21.	Monthly Emoluments	7	+.128	0.68	n.s.
22.	Proportion of Promotees	4	+.097	0.52	n.s.
23.	Age	2	-.096	0.51	n.s.
24.	Aggressive	11	+.089	0.47	n.s.
25.	Total Work Experience	5	-.053	0.28	n.s.

Notes : (1) The correlations are presented in a descending order for easier comprehension.
(2) "n.s." stands for "not significant".

ables does not mean that commitment is necessarily *caused* by each of those 15 factors. In social science research, the so-called *independent* variables are often not really independent from other variables but highly inter-correlated. This problem of multi-collinearity makes it difficult to interpret one-to-one relationships presented in table 5 and call for the use of multivariate analysis. Only such analysis can help study the behaviour of different *combinations* of independent variables on the basis of which it is possible to identify a set of factors that are more critical than the rest in explaining variation in the dependent variable.

Further analysis was carried out using step-wise multiple regression technique. With the help of this analysis, we were able to identify the following four factors which together explain 94 per cent of the variation in organisational commitment :

(a) Scope for Advancement (V-15)	R^2 = .9688
(b) Monetary Benefits (V-17)	R^2 = .9385
(c) Lateral Trust (V-24)	R^2 = .9287
(d) Liberal (V-8)	$F_{4,25}$ = 95.41 p,.001

Having identified the best combination, let us now examine (a) the relative *contribution* of each predictor, (b) the *direction* of its contribution and (c) whether the same is statistically *significant*. The following evidence will throw light on each of these issues :

Var. No.	Variable	Zero-Order Correlation	3rd-Order Partial Correlation	Individual Contribution
15.	Advancement	+.895***	+.650***	.3623
17.	Money	+.751***	+.756***	.2652
24.	Trust	+.810***	+.572**	.2399
8.	Liberal	-.488**	-.477*	.0711
			Total (R^2)	= .9385

*P>.05 **P<.01 ***P<.001

It may be concluded from the above evidence that the combination of four factors that has emerged as the best prediction equation is indeed quite robust and reliable. Together these four factors explain a very large amount of variance (94 per cent) in organisational commitment. The individual contribution of each predictor is statistically significant and in the expected direction. All three climate dimensions (advancement, money and trust) have a *positive* influence on commitment, whereas "liberalism" has a *negative* influence. These relationships are illustrated in figure 1.

After identifying the best predictors of organisational commitment, the relative importance of the remaining 21 independent variables was examined. The fourth-order partial correlations showed that, when the effect of the four best predictors is controlled, *none* of the remaining 21 variables has any significant relationship with organisational climate. This shows, once again, that the said four predictors can be relied upon as the most critical determinants of organisational commitment.

Conclusion

Using organisational commitment as a measure of employee motivation, this paper has attempted to examine the level of motivation and morale of junior and middle level managers working in the public sector in India. With an all-India average score of 56.58 per cent, organisational commitment has secured only moderate rating. This suggests that the morale of public sector managers is certainly not very high. If the 30 PSEs under study are arranged from "low" to "high" in terms of their mean commitment scores, the emerging picture will be as shown in figure 2.

Since implementation of policies of management and achievement of organisational goals depend largely on the

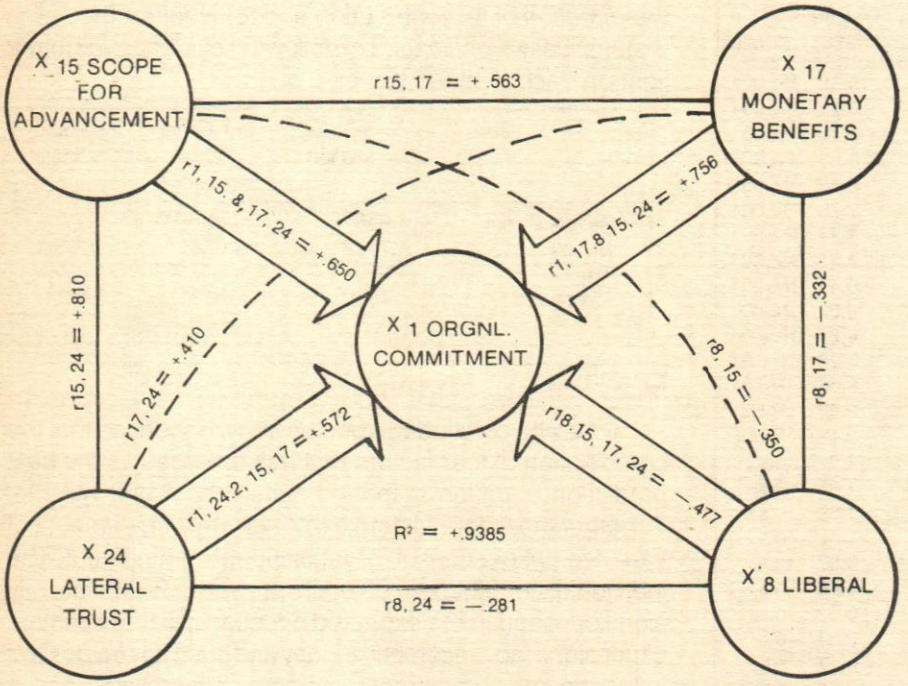

FIG. 1 : RELATIONSHIPS AMONG VARIABLES IN THE BEST EQUATION

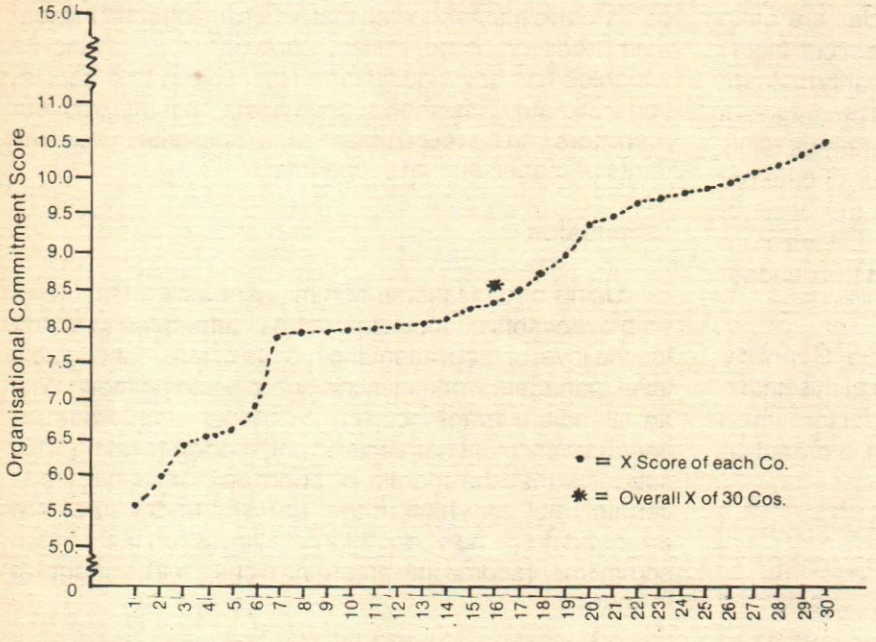

FIG. 2 : COMPANIES ARRANGED IN ASCENDING ORDER IN TERMS OF LEVEL OF COMMITMENT

active involvement and motivated behaviour of junior and middle level managers, their moderate level of commitment should be a matter of concern to the corporate management of PSEs as well as the government. If the managers are not highly motivated, it is unlikely that they can inspire and motivate the workers below them to put in greater effort for the improvement of organisational performance.

What can be done to improve the level of commitment of public sector managers? While a precise answer to this question calls for a different type of analysis of data, separately for each company, a general answer for the public sector as a whole can be given. Three out of the four determinants of commitment identified in this paper relate to organisational climate. As already pointed out, organisational climate affecting the public sector managers has secured quite "low" ratings and, therefore, offers much scope for improvement.

Two dimensions of climate that are upper most in the minds of public sector managers these days are (1) the pending wage revision that is long overdue and (2) introduction of a rational promotion policy. The Officers' Associations throughout the country are spending most of their time and effort in pursuing these two issues at various levels. It is not surprising, therefore, that "advancement" and "money" should emerge as the two most powerful determinants of commitment. Of the four predictors in the best equation, these two climate dimensions together explain as much as 63 per cent of the variation in commitment in 30 PSEs. That there is much scope for improvement in these two areas is clearly suggested by data presented in table 1.

The third predictor of commitment is "lateral trust" which refers to the presence of mutual trust, understanding and cooperation among the managers them-

selves. Organisations in which lateral trust is high, the level of commitment is also high, and vice versa. Lateral trust leads to group cohesiveness which can be a great asset for an organisation. It is not known whether the corporate managements of PSEs have tried to harness this valuable resource. On their part, the junior and middle level managers seem to have utilised it quite effectively by forming and running officers' associations.

The fourth and final predictor of commitment is "liberalism" which is *negatively* related to organisational commitment. A person scoring "high" on the scale of liberalism used by us is the one who feels that the government is neither doing all that it can nor moving fast enough in solving the problems of workers and lower classes. Such a person also feels that workers and lower classes do not have enough influence in central/state legislatures. With an all-India average score of 53.66 per cent, we can say that roughly every second person in the population of junior and middle level managers is a "liberal". A liberal or radical person's mind is often in a state of agitation and tension as he feels frustrated with the existing social order. Inability to change the social order leads to alienation which, then, is manifested in a variety of behavioural tendencies. Low level of organisational commitment is only one of the manifestations of such alienation.

To conclude, the level of organisational commitment of public sector managers is only moderate and calls for serious efforts on the part of both corporate management and the government to remedy the situation. This paper has tried to highlight the strengths and weaknesses of the PSEs and has made several suggestions to help improve the prevailing situation. Improvement of organisational climate through better personnel policies and practices is likely to lead to an improvement in the level of motivation and morale of public sector managers. Needless to say, if the managers are not highly motivated and committed, it is unlikely that the PSEs can be effective in the achievement of their goals.

Acknowlegement

The Authors are grateful to Frederick Eberrt Foundation for their liberal financial support for a larger study.

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Annexure I

List of Companies Studied

A. Steel

1. Mishra Dhatu Nigam Ltd., Hyderabad (A.P.)
2. Alloy Steels Plant, Durgapur (West Bengal)
3. Bhilai Steel Plant, Bhilai (Madhya Pradesh)
4. Bokaro Steel Plant, Bokaro (Bihar)
5. Durgapur Steel Plant, Durgapur (West Bengal)
6. R & D Centre for Iron & Steel, Ranchi (Bihar)
7. Rourkela Steel Plant, Rourkela (Orissa)
8. Salem Steel Plant, Salem (Tamil Nadu)

B. Minerals & Metals

9. Hindustan Zinc Ltd., Udaipur (Rajasthan)

C. Petroleum

10. Cochin Refineries Ltd., Cochin, (Kerala)
11. Indian Oil Corporation Ltd., New Delhi (U.T.)
12. Lubrizol India Ltd., Bombay (Maharashtra)
13. Madras Refineries Ltd., Madras (Tamil Nadu)

D. Chemicals, Fertilizers & Pharmaceuticals

14. Fertilizers and Chemicals Travancore Ltd., Cochin, (Kerala)
15. Indian Petrochemicals Corporation Ltd., Baroda (Gujarat)

E. Heavy Engineering

16. Bharat Heavy Plate & Vessels Ltd., Visakhapatnam (Andhra Pradesh)
17. Heavy Engineering Corporation Ltd., Ranchi, (Bihar)
18. Triveni Structurals Ltd., Allahabad (U.P.)

F. Medium & Light Engineering

19. Indian Telephone Industries Ltd., Bangalore (Karnataka)
20. Instrumentation Limited, Kota (Rajasthan)
21. Hyderabad Allwyn Ltd. Hyderabad (A.P.)

G. Transportation Equipment

22. Bharat Earth Movers Ltd., Bangalore (Karnataka)
23. Cochin Shipyard Ltd., Cochin (Kerala)
24. Hindustan Aeronautics Ltd., Kanpur (U.P.)
25. Hindustan Aeronautics Ltd., Lucknow (U.P.)
26. Hindustan Shipyard Ltd., Visakhapatnam (A.P.)

H. Consumer Goods

27. HindustanPhoto Films Manufacturing Company Ltd., Ootacamund (T.N.)

I. Trading & Marketing

28. Minerals & Metals Trading Corporation of India Ltd., New Delhi (U.T.)

J. Technical Consultancy Services

29. Engineers India Ltd., New Delhi (U.T.)
30. MECON (India) Ltd., Ranchi (Bihar)

□

ANNEXURE II : List of Variables and Their Psychometric Properties

Var. No.	Variable	No. of Items	Score Range	Cronbach Alpha*	Between Co. variance (df=29)	Within Co. variance (df=5154)	F Ratio **
			Dependent Variable				
	Organisational Commitment	5	0-15	.86	347.50	14.09	24.67
			Independent Variables				
1.	Individual Background						
2.	Age	1	-	-	1082.89	72.77	14.88
3.	Level of Education	1	-	-	31.41	2.13	14.77
4.	Promotees as Per Cent	1	-	-	31.77	2.44	13.05
5.	Total Work Experience	1	-	-	1256.34	84.05	14.95
6.	Experience as Officer	1	-	-	1282.49	42.48	30.19
7.	Monthly Emoluments	1	-	-	2770.30	77.72	35.64
			Personality Traits				
8.	Liberal	3	0-9	.76	48.03	5.02	9.56
9.	Outgoing	2	0-6	.48	6.29	1.97	3.20
10.	Conscientious	2	0-6	.48	9.91	1.76	5.64
11.	Aggressive	2	0-6	.53	9.45	2.02	4.69
			Job Characteristics				
12.	Work Technology	4	0-12	.78	55.78	6.72	8.31
13.	Delegation of Authority	10	0-30	.76	505.71	28.00	18.06
14.	Relationships at Work	3	0-9	.54	25.51	3.65	6.99
			Organisational Climate				
15.	Scope for Advancement	3	0-9	.73	137.86	3.52	39.15
16.	Grievance Handling	3	0-9	.76	102.97	3.90	26.42
17.	Monetary Benefits	3	0-9	.83	190.09	4.58	41.52
18.	Participative Management	3	0-9	.68	81.39	3.77	21.58
19.	Objectivity & Rationality	3	0-9	.68	80.82	4.17	19.40
20.	Recognition & Appreciation	3	0-9	.79	99.51	4.39	22.67
21.	Safety & Security	3	0-9	.47	161.97	3.06	52.92
22.	Training & Education	3	0-9	.77	161.20	3.49	46.23
23.	Welfare Facilities	3	0-9	.65	177.07	3.14	56.37
24.	Lateral Trust	3	0-9	.79	84.00	3.17	26.52
25.	Bureaucracy	2	0-6	.55	20.87	2.04	10.30
26.	Relative Deprivation	3	0-9	.54	162.14	3.75	43.28

* Cronbach Alpha shown in this column was calculated on the basis of in-depth analysis of data from a sub-sample of 481 junior and middle-level managers carefully chosen out of the larger sample.

** All values shown in this column are statistically significant (P<.001).

Feature

Indian Scientists and their Work Climate

Sunil K. Dhawan & Santanu Roy

The work environment of R&D Organisations involves a high degree of uncertainty. Managing R&D calls for a great amount of tolerance of 'creative individualism', besides being unable to arrive at the economic impact of R&D on the society. R&D managers must understand, influence and assess their organisations in terms of resources, goals, reward systems and beliefs about the importance of the individual's work to the organisation; argues this paper.

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Research regarding the examination and evaluation of work climate in understanding organisational functioning has enabled us to formulate strategies that can not only improve the behavioural aspects in institutional functioning, but also, result in more effective organisational performance. While sufficient studies exist on the examination of work climate for industrial, service and allied sectors (Johnston, 1976; Guion, 1973), relatively few researchers have considered Research and Development (R&D) institutions as their unit of study. Notable exceptions are the 'idea flow project' of Rubenstein (1975), 'changes in project life cycle and organisational climate' of Barndt et al. (1977), research reported by Barth et al. (1976), and the exploratory work of Manners and Barth (1978). This assumes significance as there are certain distinct characteristics of R&D institutions that make them different from business and service organisations. Firstly, the work environment of these organisations involves a high degree of uncertainty surrounding the projects which could be a result of pushing the state of the art or could be because of changes in the projects' direct cost, priorities, etc (Baillie, 1980). Secondly, the management of R&D and expenses involved therein have a substantial amount of 'risk' element. Thirdly, there is a certain amount of, what one can say 'sheer faith' in ideas and initiatives of the scientists involved. Fourthly, managing R&D calls for a great amount of tolerance of 'creative individualism' and finally, it is not always possible to work out the productive benefits or impacts of R&D on the society in simple economic language.

Sufficient evidence exists in the literature to indicate that examination of work climate in an R&D set-up is as important as in any other type of organisations (Gaddis, 1959; Goodman, 1967; Steward, 1965; Avots, 1969;, Wilemon and Cicero, 1970; Cleland, 1967). Barndt et al. (1977) for example, while writing about the role of R&D managers, suggested that one of the major tasks before them is the establishment of a work climate that allows adequate interaction, cooperation, compromise and bargaining necessary for satisfactory job completion among people. Some studies have taken the view that better work climate in an organisation will minimise the conflicting

situations that arise as a result of say lack of team participation in decision-making, lack of team spirit, job insecurity, etc., (Murphy, Baker & Fisher, 1974). Wilemon's study (1971) also revealed that greater the diversity of expertise among the team members, greater would be the potential for conflict to develop which in turn can affect the overall climate in an organisation. Sherman (1986) probed into the relationship between factors in the work environment and turnover propensities among engineering personnel and found that approximately 30 per cent of variable (R) in turnover propensities is explained by factors in the immediate work environment. Factors such as autonomy and goal congruence (with one's superior) were found to have a great influence. Another interesting study by Tuttle et al. (1987) focussed on assessing the job satisfaction of research scientists.

Most of the studies reported have been conducted for scientists working in R&d units in developed countries. Scientists working in research laboratories of developing nations like India have found limited acknowledgement in literature. The studies conducted in India, though limited in number, have focussed their attention on say planning of R&D (Rahman, 1976), developing priorities in R&D (Valluri, 1976), measuring performance of R&D units (Nagpaul,1985), training in R&D (Dhawan, 1985) or on similar aspects.

Work Climate : The Concept

To begin with, let us examine how work climate has been defined by researchers in literature. Some theorists have argued in favour of splitting "Organisation Climate" into individual-focussed and organisation-focussed separately (James and Jones, 1974). They defined climate in terms of organisational attributes, "psychological climate", and individual attributes. Hellreigel and Slocum (1974), by contrast, treated climate as a more unitary phenomenon, defining it as "...a set of attributes which can be perceived about a particular organisation and/or its subsystems, and that may be induced from the way that organisation and/or its subsystems deal with their members and environment". However, one thing common to both the definitions is that climate must be divided into two parts : firstly, related to the members or groups and secondly, related to overall organisational system. Schneider and Snyder (1975) defined climate as "a global (multidimensional) impression of what the organisation is". However, as it is defined, "climate" refers to a systematic phenomenon that pervades an organization and its parts. In addition, climate is a perceived phenomenon, knowledge of which is usually gained by administering and scoring a questionnaire. Here we must mention that we, in our study, have also used a questionnaire to measure work climate.

When we look at some of the important researches related to work/organizational climate, we find that it has been conceptualized mainly in three ways : as an independent variable, as an intervening variable, and as a dependent variable. As an independent variable, one reviewer of research found that in terms of interpersonal relations, group cohesion, task involvement, etc., climate was significantly contributing to job satisfaction/dissatisfaction (Hellreigel and Slocum, 1974). It was also found to be contributing to performance of the organisation. That is to say, if members perceive the work climate to be supportive, then there are greater probabilities that they will feel satisfied with their jobs. Similarly, if the work environment is healthier, performance is likely to be better.

Climate as an intervening variable is usually found when human relations training or leadership have been used as the independent variable (Hellriegel and Slocum, 1974). In one study, a president's leadership style in a business game was varied and three climates were introduced : authoritarian, friendly, and achieving. The achieving condition produced the highest performance level, but the democratic-friendly conditions resulted in greater satisfaction; the authoritarian climate produced low satisfaction and low innovation and productivity (Litwin and Stringer, 1968). Nagpaul and Gupta (1984) in their study of about 600 research units in India measured their work climate in terms of four dimensions : job satisfaction, morale, autonomy and involvement. Other researchers looked at climate as a dependent, or measurable end-result variable. Hellreigel and Slocum (1974) reviewed a number of studies that illustrated this point of view. One aggregate finding is that one's perception of climate varies according to the position held. Sensitivity-training programmes can also be responsible for changes in climate. Such programmes allow persons to try new behaviour and see themselves as others see them.

One of the major thrusts in recent organizational behaviour literature has been the contingency approach, not only for leadership, but also for climate. Thus, climate and performance and their relationship to each other are probably affected by certain other variables—technology, process development, or structure of the organisation. There are no clear contingency factors related to climate in a universal way.

The present study on work climate is in line with research on how to maintain a creative environment within an R&D organisation (Allen et al. 1980; Baillie, 1980; Suojanen et al. 1977). Of interest is Tecklenberg's argument that to achieve this end, R&D managers must understand, influence, and assess their organisations, and

among the aspects to be assessed are perception of time and resource constraints, orientation towards goals of a discipline and goals of the organisation, perception about how the organisation's reward system works and beliefs about the importance of the individual's work to the organisation.

Methodology

The study was part of a research programme of our Institute, "Scientific Culture and Laboratory Functioning : Case of an R&D Organisation". The R&D organization under consideration was the Council of Scientific and Industrial Research (CSIR) which has in its fold about forty research laboratories working on different disciplines of science and technology.

A pilot study was conducted in a research laboratory of CSIR using a questionnaire. The data obtained from the pilot work were analysed to check the reliability and other types of results that may emerge from the study. Thirty scientists had participated in this phase. Based on the results of the pilot study, a modified form of the questionnaire was developed and printed for use in the main study. Three research laboratories belonging to different Coordination Councils of CSIR, namely Central Food Technological Research Institute (Mysore), Regional Research Laboratory (Hyderabad) and National Chemical Laboratory (Pune) were selected for the main study. The sample of scientists were chosen using systematic random sampling with every third scientist from the standard random list. The questionnaires were distributed to the scientists in small groups and the objectives, scope, outcome of the study and the questionnaire itself were explained to them. Two days were given to the participants and from the third day onwards each scientist was contacted personally. In these meetings, the emphasis was to collect reliable information and as such considerable amount of time was spent in explaining them how to fill the questionnaire. The first part of the questionnaire was related to the work climate of the research laboratory. There were nineteen questions related to eight factors : human resource primacy, communication flow, decision-making practices, technological readiness, senior scientists' influence, junior scientists' influence, goal clarity and motivational conditions. Each question was on a 5-point scale with one indicating presence of the item to a very little extent and 5 indicating presence to a very large extent. The respondents were asked to put 'P' against the number which they considered reflecting the existing or present situation. The second part of the questionnaire was on work group processes containing nine questions related to eight factors : coordination, making group decisions, knowledge of the job, information sharing, motivated to achieve objectives, and group adaptability. Here also each question was on a similar 5-point scale and the respondents were asked to put 'P' against the number which they considered reflecting the existing or present situation. In all 208 scientists from the three R&D laboratories had participated in the study.

Focus

Our effort in this study is purely analytical and exploratory. We have not developed any hypothesis regarding the climate in an R&D set-up. Our focus is on the following relationships/issues :

i. degree of satisfaction of the scientists with various aspects of organisation such as communication flow, decision making practices, goal clarity, etc;

ii. relationship of the background information of the respondents with the organisation-related variables;

iii. examination of the motivational conditions and its related factors;

iv. degree of satisfaction of the scientists with various factors of groups processes such as coordination, information sharing, confidence and trust, etc;

v. relationship of the background information of the respondents with the factors of group processes; and

vi. examination of the overall satisfaction with the group and the factors contributing to this satisfaction.

Analysis

For the first part of the questionnaire, i.e. questions related to organisational climate, means and standard deviations were calculated for the eight factors to understand the degree of satisfaction with the organisation-related factors. Pearson correlations were then calculated to examine the extent of relationship between the background information of the respondents such as age, length of service, service in the laboratory and organisation-related factors. Finally, for this part of the questionnaire cluster analysis was used to determine those organisational factors that form a cluster with motivational conditions. The aim was to find out significant factors that need to be tackled alongwith motivation so as to get optimum level of satisfaction.

For the second part of the questionnaire also, i.e. questions related to group processes, means and standard deviations were calculated to find out the degree of satisfaction of the respondents with their group. Pearson correlations were calculated to determine the extent of relationship between background data of the respondents and the eight factors of work group processes. Finally, stepwise regression was carried out to find key factors that contribute significantly to the overall satisfaction with the work group.

Comparative Picture of the Three Laboratories : Total Sample

Table 1 presents the key background information of the respondents. There is not much difference in the average age of the respondents. It is also clear that the participants had sufficient experience (17-21 years) of which a significant part is in the laboratories (14-18 years). Overall, respondents of Lab-3 had comparatively less average age, less total service record and less service in the laboratory. It seems that a large number of members have started their career in their respective laboratories only.

Table 1. Background Information of the Respondents

	Background Data	Lab-1 (N1=64)	Lab-2 (N2=62)	Lab-3 (N3=82)
1.	Age	(Years)	(Years)	(Years)
	Mean	45.13	43.95	41.53
	S.D.	7.49	8.25	9.45
2.	Length of Service			
	Mean	21.02	18.74	16.91
	S.D.	7.72	8.76	9.83
3.	Service in the Laboratory			
	Mean	17.92	16.44	14.39
	S.D.	8.52	8.79	9.84

Table 2 presents the means and standard deviations of the eight factors of work climate (three laboratories separately). The three laboratories were found similar on the factors 'motivational conditions' and 'technological readiness'. Perhaps the general climate in the laboratories of this R&D institution provide similar opportunities to scientists which activate them towards work. The average score for this factor further suggests that these opportunities exist only to some extent. Responses to technological readiness which included questions like 'how quick is your laboratory to use improved work methods?' etc., again indicate that the general policies of the R&D institution with respect to technology updating is similar for its different research laboratories and that such policies exist only to some extent (average score is about '3'). Another significant point in the table is that a majority of the mean scores

Table 2. Responses to the Factors of Work Climate

Sl. No.	Factors	Lab-1 (N1=64) M.	Lab-1 (N1=64) S.D.	Lab-2 (N2=62) M.	Lab-2 (N2=62) S.D.	Lab-3 (N3=82) M.	Lab-3 (N3=82) S.D.
1.	Human Resource Primacy	2.96	0.81	2.68	0.82	2.71	0.72
2.	Comm. Flow	2.92	0.83	2.58	0.83	2.70	0.77
3.	Motivational Conditions	3.03	0.82	2.90	0.84	2.95	0.70
4.	Decision-making Practices	2.73	0.76	2.37	0.74	2.61	0.78
5.	Technological Readiness	3.05	0.83	2.85	0.83	2.85	0.76
6.	Jr. Scientists' Influence	2.41	0.95	1.73	0.77	2.05	0.85
7.	Sr. Scientists' Influence	2.90	0.95	4.08	1.04	2.91	0.93
8.	Goal Clarity	3.34	0.92	3.05	0.90	3.06	0.86

are either around '3' or below '3'. The exceptional factors are 'senior scientists' influence' for Lab-2 and 'goal clarity' for Lab-1. This raises a fundamental issue as to why did the scientists covered in the study perceive their organisational climate as average or low. It may emanate from low level of satisfaction with various aspects of laboratory functioning. It could also result from inadequate knowledge about what is happening in the laboratory particularly in the other divisions. We will examine this at a later stage of our discussion. Yet another interesting feature is that the factor 'junior scientists' influence' has received low scoring from the respondents in the three laboratories. As far as the factor 'senior scientists' influence' is concerned, we found that it was rated high for Lab-2 whereas for the other two laboratories the score was average. Thus, one cannot hypothesize that in R&D laboratories, the power to influence follows a bureaucratic structure. However, low power to influence both at junior and senior levels suggests that the power structure might be 'autocratic' in nature, with few hands enjoying maximum of power.

Decision Making Practices

Related to this is the factor 'decision-making practices'. All the three laboratories have perceived it as low on the satisfaction scale. One must analyse decision-making in relation to the structure of the R&D organisation in general and the laboratory in particular. It is to be noted that all major decisions in the research laboratories are taken in the Research Advisory Committee (now called the Research Council) or the Executive Committee (now called the Management Committee) of the laboratory. Further, there are several other advisory committees in the laboratories. Thus, only those scientists who are members of these committees can assume a sense of participation in decision-making. However, from earlier discussions, we

find that even these scientists have little influence over what is going on in the committees. Perhaps this is why the respondents have scored low on decision-making practices.

'Communication flow', yet another important factor in laboratory functioning was scored low by the respondents of Lab-2 and Lab-3, whereas for Lab-1, the respective score was just average. The items included in this factor were : receptivity of ideas, knowledge of what is happening in other organisations and updating of knowledge in one's own field of research. Low scoring for these is an indication that it is the scientist himself who develops his own method of communication or interaction with other parties and though the formal channels of communication exist, they do so only to a limited extent.

Table 3 relates the background information of the respondents with the eight factors of organisational climate. We did not find any significant correlations for the first four factors, viz. human resource primacy, communication flow, motivational conditions and decision-making practices, when all the three laboratories were taken together. Technological updating was perceived as improving with increase in age, length of service, and service in the laboratory for Lab-1. Goal clarity and senior scientists' influence was also seen as improving with increase in age and service record in Lab-1. For Lab-2 only one significant correlation was obtained between age and technological updating with a negative sign. Thus, technological updating deteriorate in this laboratory over a period of time. This seems to be a serious issue if the laboratory wishes to go in for developing new technologies for the society and in the frontier areas of research.

Table 3. Correlation Between climate factors and the Background Information

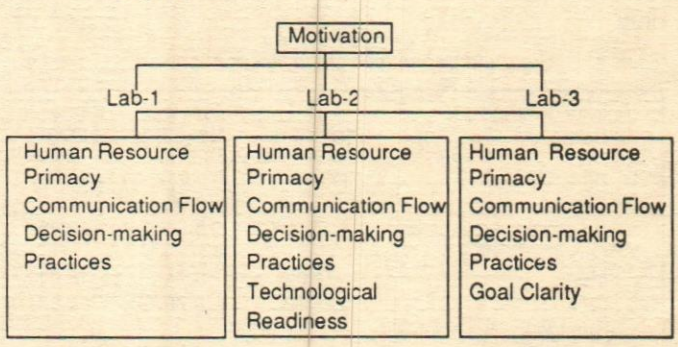
Sl. No.	Factors	Background Data		
		Age	Total Service	Service In Laboratory
1.	Human Resource Primary			
2.	Comm. Flow			
3.	Motivational Conditions			
4.	Decision-making practices			
5.	Technological Readiness	Lab-1(+) Lab-2(−)	Lab-1(+)	Lab-1(+)
6.	Jr. Sc. Influence			
7.	Sr. Sc. Influence	Lab-1(+)	Lab-1(+)	Lab-1(+)
8.	Goal Clarity	Lab-1(+) Lab-1(+)	Lab-3(+)	Lab-1(+)

Goal clarity has been seen as improving with increase in age and length of service for Lab-3. To understand clearly the goals and objectives, it requires a sufficient degree of maturity on the part of the scietist which perhaps come with increase in service record. However, we find that not many factors of climate are related to background data of the respondents, and if we see the variation in respondents' demographic data as a time series growth, we may conclude that perhaps the climate in these three laboratories are "static" in nature with not much alterations in communication systems, decision-making practices, motivational conditions, etc. The "set-culture" in laboratories, perhaps has overpowered the value system of scientists and they have "coveraged" into the given system.

Cluster Analysis

Figure 1 presents the results of the cluster analysis with motivation as the central factor (three laboratories separately). Our aim in this analysis was to understand the factors and forces which are necessary to provide a climate which will motivate the scientists. The three factors found common in the three laboratories are : human resource primacy, communication flow, and decision-making practices.

Figure 1. Motivation and Related Factors - Results of Cluster Analysis



The first factor, human resource primacy contained three items - "to what extent are work activities properly organised in this laboratory?", "to what extent does this laboratory have a real interest in the welfare and happiness of those who work here?" and "how much does this organisation try to improve the working conditions?".

The factor "communication flow" also included three items - "how adequate for your needs is the amount of information you get about what is going on in other relevant organisations?", "how receptive are those above you to your ideas and suggestions?" and "to what extent are you told what you need to know to do your job in the best possible way?".

Decision-making practices contained four items - "to what extent are decisions made at the right levels in this laboratory?", "when decisions are being made to what extent are the persons affected asked for their ideas?", "to

what extent do you feel that relevant information are being used at all levels while making decisions?" and "how are objectives set in this laboratory?".

One may try to generalise that in case the management of R&D institution wishes to activate the efforts put in by its scientific staff then they must develop a suitable system of decision-making which involve scientists at all levels. They must also develop a system of proper communication both upward and downward and parallel across the organisation. And finally they must take into consideration the welfare aspects of the scientific community.

Communication Systems

Better communication systems can help scientists to update knowledge in their area(s) of interest and can improve productivity. Better awareness will be useful for overall effectiveness of the laboratory functioning. Combined with better communication, decision-making practices in the laboratory are vital for mental satisfaction of scientists. We may recall our earlier result where we have hypothesized that the management practices in the laboratories may be 'autocratic' in nature and as such participation in decision-making will be poor. Now we may suggest that if the management of these laboratories wish to motivate their scientists then decentralisation of the decision-making system and developing a climate where people feel free to participate at least on those issues which affect them becomes critical.

Many social scientists have been concerned with better working conditions as a factor of motivation for industrial and service sectors. This factor has been found to be important in the R&D set-up as well. In addition to these three factors, goal clarity has found a place in Lab-2 and Lab-3, and technological readiness in Lab-2. It is surprising that items related to the organisational policies, work itself, etc., have not been observed as motivational forces. Perhaps the scientists are satisfied with these factors or they do not consider these to be important in activating themselves towards the performance of their task.

Perceived Climate

We now move towards the climate that has been perceived within work groups of the scientists. Table 4 presents the means and standard deviations of the eight factors of Work Group Processes. Overall for all factors in the three laboratories, the average score is above average indicating that scientists' satisfaction level with the group is higher at least compared to their satisfaction with organisation-related factors. For the factor 'overall satifaction' with the group, mean scores are quite high which confirms this hypothesis.

Table 4. Responses to the Factors of Group Processes

Sl. No.	Factors	Lab-1 (N1=64)		Lab-2 (N2=62)		Lab-3 (N3=82)	
		M.	S.D.	M.	S.D.	M.	S.D.
1.	Coordination	3.52	0.94	3.10	0.86	3.16	1.00
2.	Making Group Decisions	3.43	0.97	3.13	0.79	3.31	0.94
3.	Knowledge of Job	3.59	0.82	3.18	0.85	3.30	1.05
4.	Information Sharing	3.33	1.00	3.00	1.00	3.08	1.09
5.	Motivated to Achieve Objectives	3.05	0.83	2.85	0.83	2.85	0.76
6.	Group Adaptability	3.43	0.82	3.31	0.81	3.28	0.85
7.	Confidence & Trust	3.81	0.73	3.42	0.98	3.76	0.87
8.	Overall Satisfaction	3.53	0.73	3.31	0.89	3.61	0.87

The three laboratories are found to be similar on the factors 'motivated to achieve objectives', and 'confidence and trust'. The mean scores are quite high for these factors. With around average score, the three laboratories were also similar on the factor 'information sharing within the group'. We may tentatively hypothesize that the scientific community is highly motivated to achieve group objectives and have high degree of confidence and trust in their team members who work with them. The group objectives perhaps indicate the project or area objectives in which the scientists are working and as such they show greater enthusiasm in achieving their targets. High level of confidence with the group members is an indication that the team spirit is sufficiently adequate and the scientists trust each other while working within the group.

Information sharing within the group is average and this is where we should be careful in analysing group dynamics among the scientists. Indications are that though there exists a high level of confidence and trust in group members, sharing of important issues related to projects or otherwise among themselves exists only to some extent. The two results are slightly contradictory of each other. As one moves from independence to interdependence in research efforts sharing of information among team members assume importance and might severely affect team functioning if this factor is low on the agents. Like in other organisations, scientists of research laboratories perhaps do have high power motives, which emanates from information they come across and as a result of which they do not go in for sharing it that freely.

Table 5 presents the correlation between the eight factors of group processes and the key background information of the respondents. All the three laboratories have shown positive and significant correlations with background data with respect to overall satisfaction with the group. This indicates that with increase in age, length of service and service in the laboratory, the overall satisfaction with the group also goes up. The implications of this result is that scientists wish to remain in the same group as far as possible because their satisfaction increase with longivity within the same team.

Scientists of Lab-1 and Lab-3 have significant relations between their background data and the factor 'making group decisions'. Thus, with increase in life within the group, members start contributing to the decision-making and perhaps get a feeling of satisfaction that they are contributing something meaningful towards their job and their group.

Table 5. Correlation Between Group Process Factors and the Background Information

Sl. No.	Factors	Background Data		
		Age	Length of Service	Service In the Lab
1.	Coordination	Lab-1	Lab-1	Lab-1
2.	Making Group Decisions	Lab-1	Lab-1	Lab-1
		Lab-2	Lab-3	Lab-3
3.	Knowledge of Job	Lab-1	Lab-1	Lab-1
4.	Information Sharing	Lab-1	Lab-1	Lab-1
5.	Motivated to Achieve Objectives			
6.	Group Adaptability	Lab-1	Lab-1	Lab-1
7.	Confidence & Trust	Lab-1	Lab-1	Lab-1
8.	Overall Satisfaction	Lab-1,	Lab-1	Lab-1,
		Lab-2	Lab-2	Lab-2
		Lab-3	Lab-3	Lab-3

Limited significant correlations between large majority of group process factors and the background data indicate that within the group, the situation is somewhat "static". Likewise, howsoever they are motivated in their work system, their objectives remain constant. Same is the case with group adaptability and confidence and trust among group members.

Regression Analysis

Finally, to understand the factors and forces that contribute significantly to the overall satisfaction with the group, step-wise regression was carried out and results are presented in Table 6 (Three laboratories separately).

Scientists of Lab-1 have perceived three key factors-information sharing, group adaptability, and making group decisions as explaining the variance in overall group satisfaction. Therefore, if any action to increase the team spirit of group effectiveness among these scientists are being considered, then the management must develop a system in which the relevant information is shared with the concerned scientist(s), group decisions are made in a participative style, and some sort of training in group adaptability be imparted to them. For Lab-2, the significant factors are : confidence & trust, group adaptability, and making group decisions. A new factor for this laboratory is confidence and trust among the group members. Thus, the scientists desire that for effective performance of the group a higher degree of trust leading to high degree of cooperation among them is a must.

Table 6. Factors Contributing to the Variation in Group Satisfaction Level of the Respondents : Results of Step-wise Regression

Significant Factors	R-SQ	R-SQ Change
Laboratory-1		
Information Sharing	0.62	
Group Adaptability	0.76	0.14
Making Group Decisions	0.84	0.08
Laboratory-2		
Confidence & Trust	0.49	
Group Adaptability	0.61	0.12
Making Group Decisions	0.70	0.09
Laboratory-3		
Confidence & Trust	0.62	
Coordination	0.79	0.17
Making Group Decisions	0.86	0.07

Yet another new factor for Lab-3 is coordination among various functions of the group. This is understandable as the multi-disciplinary nature of R&D requires an adequate amount of coordination among scientists of different fields, different divisions or even different institutions.

Work Environment

The main objective of the study was to understand the work climate in R&D laboratories. Work climate has been seen as consisting of two parts : one related to the organisational variables and the second related to the group variables. The results of the study indicate that the scientists have shown somewhat greater satisfaction with the groups in which they are working than with the organisation-related factors. For example, there exists a greater amount of coordination, confidence and trust, motivation to achieve objectives, etc., in the group functioning, but when we examine such factors for the organisation as a whole, the satisfaction level is found to be considerably low particularly on items like decision-making practices, communication flow, general participation in decision-making, etc.

To understand these differences, one must examine the special characteristics of R&D institutions and particularly the environment in which the scientists perform their activities. The task environment of scientists involve a high degree of uncertainty and a greater amount of risk element. One must tolerate creative individualism on the part of the scientists. When a scientist has to perceive the organisational functioning he must possess some skill in understanding inter-group and inter-departmental functioning and also the degree of uncertainty and risk present in the functioning of all groups. He must be conversant with the work of coordination among various departments of the research laboratory, user agencies and other related organisations. The other side of the coin is that despite the unique characteristics of R&D organisations, the management of such institutions are perhaps controlling and running them in the traditional ways of management by level or authority—hierarchy system, rigidity in following rules and regulations and so on. That is to say that management practices are promoting a climate which may not be matching with the value system of the scientists.

Limited satisfaction with the organisation-related factors, therefore, could be explained as a result of either low level of expertise among scientists while dealing with inter-group functioning and maintaining coordinated efforts with other departments or it might reflect the management techniques being practised in R&D institutions. It is found that seven out of eight factors of group processes are significantly related with the background information of the respondents whereas only two out of eight organisational variables are significantly related with the background information of the respondents. Thus, with increase in age, length of service and service in the laboratory, group cohesiveness goes up whereas among organisational variables, only two factors reflect this trend - technological readiness and senior scientists' influence.

An Important Question

It raises an important question— why does the satisfaction level within the group go up with increase in the time-span? Studies have shown that research scientists should try to coordinate their skill with scientists of other disciplines so as to satisfy the basic requirement of the present day need - multidisciplinary approach to R&D. Even for a single project, the climate differs at different phases of the project life cycle (Barndt et al. 1977). Our speculation is that Indian scientists prefer to remain within a group which perhaps gives them confidence and opportunity to deal with uncertainty and carry on with their task. Further, their experience with the organisation does not produce any major change in the perception of scientists regarding working conditions, communication flow, decision-making practices, etc. Exceptions are the factors like technological upgradation and influence of senior scientists. A major area for R&D manager in improving overall climate, therefore, lies in improving the organisation-related factors so as to motivate them to better performance. Motivational condition is found to form a cluster with four factors - human resource primacy, communication flow, decision-making practices and technological readiness. Any attempt, therefore, to increase motivation levels of scientists should include improvements in working conditions of the scientists, better communication systems, regular upgradation of technology and adopting decision-making practices that should involve scientists at all levels. One might call this a package programme to improve motivational conditions for the scientific community. In the study mentioned earlier by Nagpaul et al. (1984) the influence on decision-making exercised by scientists was found to have a significant effect on their perception of the working climate. Other studies have similarly emphasized the significance of a proper decision-making system operating in the organisation. Participation is assumed to improve general satisfaction and morale (Morse and Reimer, 1956). Patchen (1970) has studied the relationship between participation in decision-making and job satisfaction on the one hand and job enrichment and organisational integration on the other. His research suggests that alongwith other consequences, increased participation in institutional decision-making leads to greater job satisfaction. It is also seen that increased employee participation provides the organization with previously untapped energy or perhaps redirected energy. Pelz and Andrews (1968) have shown that the performance of the scientists increases when decision-making and goal-setting are shared by members of various ecnelons in the research organisation.

Final analysis of step-wise regression indicates three significant factors that contribute to the variation in overall satisfaction of respondents with their group. These are - information sharing, group adaptability and making group decisions. Thus to built team spirit among a group of scientists due weightage must be given to these three variables. One can expand this result for improving general climate in the laboratory. Better information sharing among various groups, adaptability of the group with changing priorities of the laboratory and general participation of scientists in decision-making might also help the management in improving the overall climate within laboratory.

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Feature

Functionally Dependent Stressors : Effect on Managerial Performance

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This paper examines managers of five functional areas, Personnel, Marketing, Finance, Production and Maintenance in terms of the stress they experience. Managerial stress is viewed as being functionally dependent (i.e., dependent on the department to which the manager belongs). The paper suggests that stress should not be viewed as having the same causes and consequences for all managers. Seven function-related stressors have been identified and are described. Their effects on managers of different functional areas are examined. Effects of each stressor on managerial performance and productivity is also discussed.

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Stress in organisations has finally been recognized as something to be actively dealt with. Stress is not only harmful to the manager concerned but also to the organisation to which he belongs. Adverse effects that stress can have on an individual range from mental health problems such as anxiety, tension, psychological fatigue, depression (Beehr et al., 1976; Caplan & Jones 1975; Ivancevich & Matteson, 1980), to physiological ailments such as coronary heart disease (CHD) (House, 1974) ulcers, (Cooper & Arbos, 1984) and even cancer (Sklar & Anisman, 1981).

What makes an executive a high performer ? Parsons, Bales and Shils (1953) hold that solving four system problems (a) adaptation (b) goal attainment, (c) integration and (d) tension management leads to effective performance. Singh (1990) using these performance indices found that managerial performance was negatively related to presence of stressors such as role conflict. Several negative stress-performance/productivity relationships have emerged out of previous research. Consequences of stress appear in reduced motivation to work (Zalenzik, Ket de Vries, & Howard, 1977), reduced performance (Anderson, 1976), lowered productivity (Zalenzik, Ket de Vries, & Howard, 1977), low job satisfaction (Beehr, Walsh, & Taber, 1976), etc., all of which result in economic costs to organisations. Thus stress is seen to have an overall negative effect on organisational effectiveness. For these reasons today organisations are concerned about the mental health of their employees and implement organisation wide strategies aimed at reducing stress.

Most studies dealing with managerial or executive stress used the general category "managers" or "executives" as a unit for their analysis (*e.g.* Cooper & Arbos, 1984). A few studies look at different managerial levels in terms of junior, middle and top level managers with the aim of identifying or understanding the different causes of stress that act on them (e.g. Singh, 1990). Other studies on job stress focus on the occupational differences in stressors (Smith et al., 1978). Very little attention has been

focussed on the functional aspects of managerial stress. It is true that "managers" as a broad class perform the same functions, i.e., planning, organizing, controlling, directing, etc. However each department has its own particular problems.

In this paper differences in the degree to which stressors act on managers of different functional areas are examined. The focus is on :

* Identifying stressors that are functionally dependent.
* Comparing their effect on managers of different functional areas (departments).
* Examining how these stressors would have an effect on managerial performance and productivity.

According to Cooper and Marshall (1977) while the universe of potential stressors is vast, for any group of individuals with common characteristics it can be reduced to a manageable number of critical dimensions. The usefulness of such an approach as stated by Cooper and Marshal is that :

(1) It provides a sufficiently detailed picture to form the basis of considered action at a group level and also reveals repeated themes which suggest pressures of more general relevance.

(2) It has methodological implications, suggesting that diagnosis of stress within an organisation should be at the level of distinguishable subgroups rather than that of the general organisational member.

What then are these stressors or combination of stressors that are more stressful to managers of one functional area than another ?

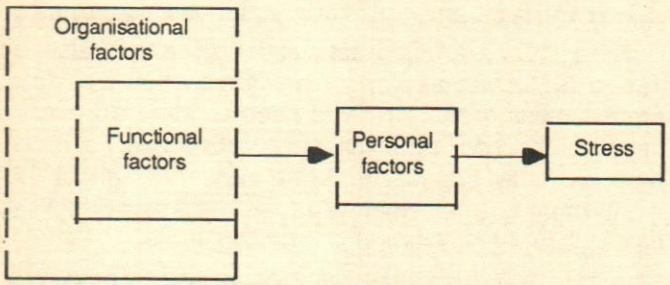

FIG.1 : A MODEL OF ORGANISATIONAL STRESS SHOWING THE FUNCTIONAL FACTORS

These stressors must be directly role related and to a great extent task specific. However, since task specific stressors would not be easily generalizable and will depend on the industry we prefer to leave them out in the present discussion and address only what we consider stressors more directly related to role in the organisation.

Table 1: Seven Stressors

The seven stressors that will be discussed here are as follows :

Role ambiguity

The individual's feeling of uncertainty about his organisational role obligations and/or the means to fulfil them.

Pressure for performance

Being in a situation where one is pushed to do more than what time or ability permits.

Responsibility

Managerial positions involve having responsibility. This may be responsibility for people or for things.

Travel as part of the job

Having to make frequent work related trips out of town or get transferred from the place of work.

Being on the interface

Having to deal frequently with people of other departments (functional areas) in the organisation.

Crisis situations

Having to deal with numerous crisis situations.

Status of the department

The position of the individual as a result of his department in terms of his authority/influence.

Figure 1 illustrates the general model followed in this discussion. Table 1 describes the stressors to be discussed.

Role ambiguity is costly for the person and for the organisation in which he works. The organisation requires its employees to maintain high performance levels and increase productivity through goal-directed behaviour. Efficient goal-directed behaviour is based on predictability of future events. To the extent to which a person can realistically anticipate events beyond his control, he can direct his behaviour towards producing more rather than fewer favourable outcomes. Clarity and predictability are thus required for effective movement towards goals. Role ambiguity in essence is the absence of this clarity. Ambiguity is particularly acute in managerial positions, which tend to be far less concrete in nature and require more abstract thinking and decision making than do blue-collar positions. Role ambiguity is negatively correlated with effort towards quality and involvement in the job (Beehr, Walsh, & Taber, 1976). Prolonged periods of role ambiguity can often lead to feelings of futility, poorer job performance, increased anxiety, and general job dissatisfaction among employees. Such feelings can ultimately lead to withdrawal from organisational activities, psychologically if not physically (Kahn et al., 1964)

In organisations there are several frequently encountered areas of ambiguity which people often find stressful.

(a) All too often people do not know what they are supposed to do.

(b) When people know what to do they do not always know how.

(Such uncertainties may arise because the expectations defining the role are themselves vague and inconsistent.)

(c) People may also be uncertain as to whose expectations they are required to meet.

(d) Doubts about the consequences of actions.

(e) Doubts about how others evaluate the work a person does.

(f) The ambiguity of a given position may result from the fact that the required information is not available anywhere in the organisation, or

(g) The information may be available at some point in the organisation but not to the person who requires it.

A few factors are seen to be function specific and will be more stressful to managers in one functional area than to those in others, while other ambiguities may be a result of the organisation structure and processes. For example, managers of the finance departments have a more standardized set of duties to perform when compared to the personnel managers i.e., the finance manager may be clearer as to the scope of his job and know the consequences of actions whereas the personnel manager has more uncertainties regarding the scope of his jobs. These uncertainties are inherent in his function. If the manager is uncertain about his goals and how to reach them his productivity level would be low. Thus role ambiguity would have an adverse effect on executive performance.

Pressure for Performance

In certain departments managers work under extreme pressure for performance. French and Caplan (1970), speak of quantitative and qualitative overload. Quantitative means simply having too much to do; qualitative means that the work is too difficult.

The pressure of having too much to do or at least the feeling that one has too much to do would seem to be a fairly obvious stressor. In another study overload was significantly related to a number of indicators of stress reactions : excessive drinking, low motivation to work, low self-esteem, and absenteeism (Margolis, et al.. 1974).

Role overload is a situation in which managers feel they are being asked to do more than what time or ability permits. Working under time pressure is especially stressful. People are anxious when they have a lot to do before a deadline; as time runs out a feeling of impending disaster increases (Albrecht, 1979). Two particularly interesting studies have been conducted on the impact of role overload on job stress. One study was done with tax accountants approaching the April 15th deadline (Friedman, Rosenman, & Carroll, 1958). The other was done with medical students before an impending examination (Dreyfus & Czaczkes, 1959). In both studies physiological symptoms of stress increased dramatically prior to the time deadline, and decreased sharply after the deadline had passed. The general adaptation system activates itself as the threat of time deadlines draws near, and the body returns to equilibrium after the threat is over.

In all organisations of today "time is money" but there are some departments in which managers are under extreme pressure to meet deadlines (e.g., the production manager). According to Cooper and Arbos (1984) time pressure and deadlines is a stressor that affects performance. Many managers (perhaps certain personality types more than others) react to overload by working longer hours (Uris, 1972). For example, in the reports on an American study it was found that 45% of the executives investigated worked all day, in the evenings, and at weekends, and that a further 37% kept weekends free but worked extra hours in the evenings.

Some ways in which managers feel the overload is when :

(a) they feel that they are not being able to do the work properly as they would like to because their deadlines do not permit it.

(b) they frequently have to work after office hours.

(c) they have to take their work home often.

(d) they have to tackle work that is much too difficult for them to manage.

For some jobs and workers, stress comes from role underload. It is the condition in which employees have too little work to do or too little variety in their work. Sales people in a store with no customers standing around all day with nothing to do, could be said to experience role underload.

Managers experience underload when :

(a) they find they have a lot of free time.

(b) they find that their work is routine; there is no variety in their job.

Ironically role underload can lead to many of the same problems as role overload; low self-esteem, increased

frequency of nervous symptoms and complaints increased health problems. One of the most disturbing outcomes of role underload is passivity. Employees with role underload report they feel both physically and psychologically weary; even when they are not at work, they do not show much interest in social activity or physical exercise (Katz & Kahn, 1978). Such problems lower performance levels of the managers concerned.

Responsibility

A differentiation is made between "responsibility for people's" and "responsibility for things" (equipment, budgets, etc.). Wardwell, Hyman and Bahnson (1964) found that responsibility for people was significantly more likely to lead to CHD than responsibility for things. Increased responsibility for people frequently means that one has to spend more time interacting with others, attending meetings, etc. Pincherle (1972) also found in his study of 2,000 executives attending a centre for medical check-up. Of the 1,200 sent by their companies for the annual examination, there was evidence of physical stress being linked to age and level of responsibility; the older and more responsible the executive, the greater the probability of the presence of CHD risk factors or symptoms. French and Caplan (1970) report that responsibility for people must play some part in the process of stress, particularly for clerical, managerial and professional workers. They found that responsibility for people was significantly related to heavy smoking, diastolic blood pressure, and serum cholesterol levels—the more the individual had responsibility for things as opposed to people the lower were each of these CHD risk factors.

Frequently experienced responsibilities that managers find stressful are :

(a) The amount of control they have over careers of those below them.

(b) Having to make decisions regarding the promotions, transfers, etc., of their juniors.

(c) The knowledge that by misjudging a person they could affect his life and career adversely.

(d) Having responsibility for the smooth functioning of the plant machinery.

(e) Knowing that any setbacks in the production flow will have organization wide repercussions.

Considering the diverse nature of the tasks performed by managers in different departments, it is obvious that in certain roles stress may result from having responsibility for people and in others stress may be because of responsibility for things. A large amount of stress that acts on managers of the personnel department may arise from the responsibility that they have for people. On the other hand the production and maintenance managers have more responsibility for things, and that would be a major stressor to them. This has important implications in terms of stress reduction programmes, and what they should be aimed at.

Travel as Part of the job

In certain departments the manager's job involves a lot of travel. This can be stressful (Cooper & Arbos, 1984). Travelling can be either frequent tours or transfers. There is not much literature on the first aspect.

As regards transfers geographical moves create stress because they disrupt the routines of daily life. Everything in the executive's life is in flux. Home conflicts become particularly critical in relation to managerial relocation and mobility. Constant moving can have profound effects on the life styles of the people concerned—particularly on the relationships with others. Staying only two years or so in one place, mobile families do not have time to develop close ties with the local community.

A few travel related problems managers must face are :

(a) Managers who are constantly on the move have their daily routine disrupted and often have to make sudden changes in their plans.

(b) They must face a disruption in their family life because of constant touring.

(c) Arguments with spouse or other family members may result because of frequent trips out of town.

(d) In the case of transfers, settling down in a new work environment has a host of problems.

(e) Transfers also cause endless trouble for the manager and his family in terms of moving into a new place of residence, finding new schools for the children, etc.

From the company's point of view, the way in which a wife adjusts to her new environment can affect her husband's work performance. Guest and Williams (1973) illustrate this by example of a major international company who on surveying 1800 of their executives in 70 countries, concluded that the two most important influences on overall satisfaction with the overseas assignment were the job itself and, more importantly, the executives' wives adjustment to the foreign environment. Once again a

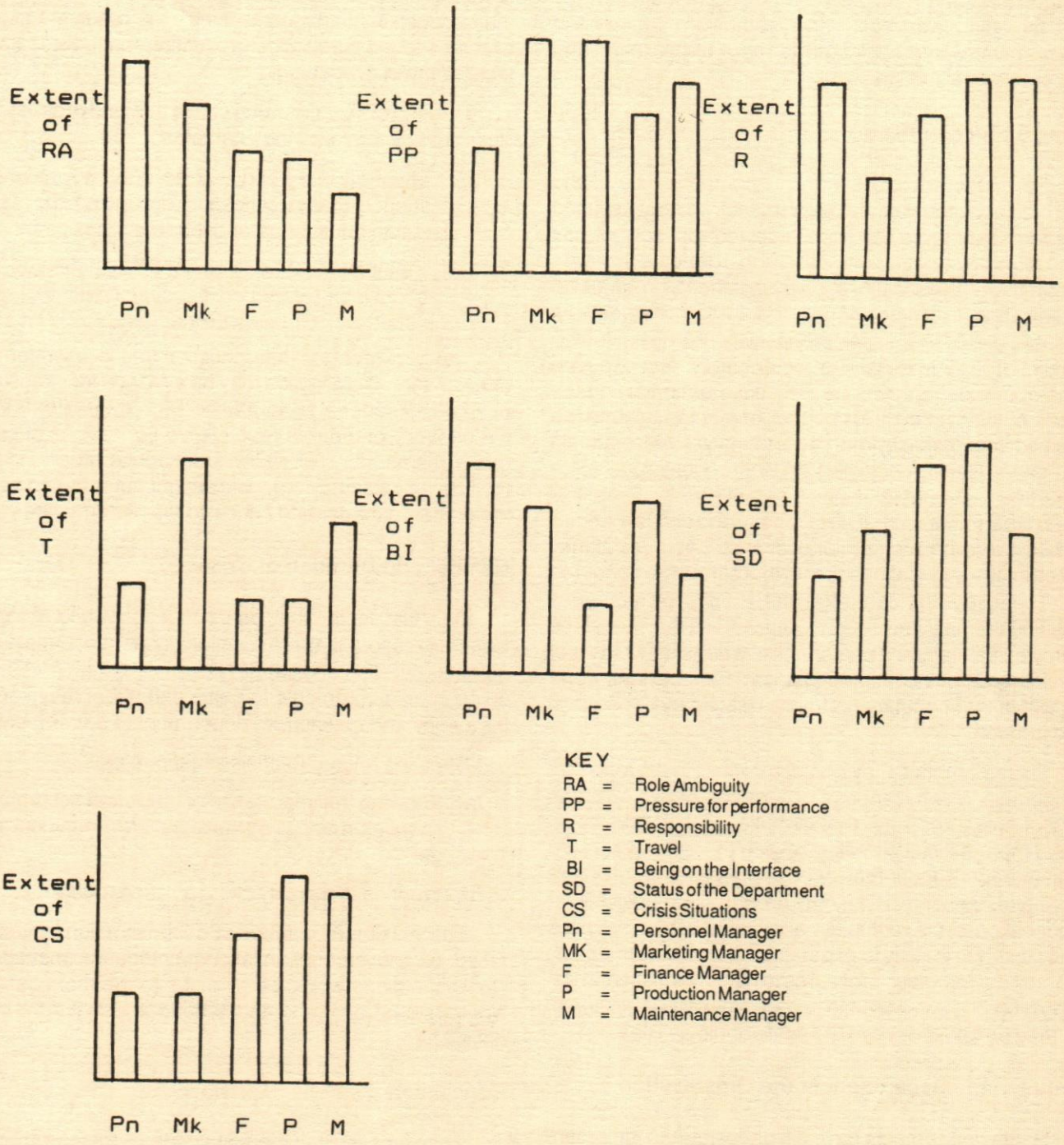

FIG. 2 : BAR DIAGRAMS RELATING STRESSORS AND FUNCTIONAL AREAS

[The bar diagrams in figure 2 show hypothetical relationships with the various stressors considered in this paper and 5 major functions in the organisation. The relationships are based in part on previous findings reported in literature and on information obtained through discussions with managers and other experienced persons.]

comparison can be made. A marketing manager would have more cause to travel than a production manager and hence travel would contribute to more of the marketing manager's total job stress.

Being on the Interface

If a manager's position in his company was at the interface between various departments, he may be faced with formidable role conflict. Perceived role conflict has been found to correlate with some consistency with organisational variables such as job satisfaction, perceived organisational climate, negative attitudes towards role senders, and even lowered productivity (Van Sell, Brief, & Schuler, 1981). In satisfying the demands and expectations of one department, he may have been sowing the seeds of his own destruction : for one set of actions are deemed acceptable by one department yet unacceptable by another. Having contacts with people outside one's own department creates a special sort of stress. People in other departments do not always have an adequate understanding of jobs outside their own areas. As a result they are more likely to make requests that cannot be honoured or set deadlines that cannot be met. Production managers may find themselves in such a situation as they are at the mercy of maintenance personnel as well as, have to meet the demands of the marketing department besides working within the monetary restraints defined by the finance department.

Such a situation may create a conflict in the manager concerned. A simultaneous occurrence of two or more, sets of pressures such that compliance with one would make more difficult compliance with the other. Pressure from one role sender may oppose pressures from one or more other senders. But it may be virtually impossible for the focal person to complete all of them within the given time limits. He is likely to experience a conflict of priorities; he must decide which pressures to comply with and which to hold off. If it is impossible to deny any of the pressures, he may be taxed beyond the limits of his abilities.

Status of the Department in the Organisation

Some departments have a higher status in the organisation than the others. Because of this even if two managers have the same position, one wields more power and authority as compared to the other because he belongs to a "higher status" department. This can be most frustrating to the manager who belongs to the "lower status" department. His requests or demands are met only after the higher status department manager's requests or demands are met. Often (though not always) it is seen that the production manager is "king". All other managers occupy second place. The production manager is given first priority in everything.

The kind of situations that cause this kind of stress are illustrated by the following examples :

(a) A manager may find that he does not have the influence that a colleague occupying the same position but in another department has.

(b) He may find that he does not have the status and recognition he deserves because the kind of work he does is not immediately apparent.

The kind of status differentiation that is unwritten but often observed in practice may be a reason for stress and reduced managerial performance. High status stems from the capacity of the role to influence the actions of other group members. This ability to influence others, to get them to do what they otherwise might not is the power of the leader/manager and critical to his performance.

Number and Duration of Crises

One last factor that bears mention while trying to isolate stressors that are functionally dependent are the number, duration and intensity of crisis situations. Crises occur in all departments to some extent but they vary in frequency and extent from department to department.

Stresses related to crisis situations are :

(a) Knowing the importance of quick and accurate responses in dispelling the situation of imminent danger.

(b) Working in a highly charged atmosphere.

The maximum number of crisis situations must be faced by the production and maintenance managers. Crisis situations would be stressful to the manager and would require him to keep his head and make the right decisions.

Conclusion

It can be seen that there are certain stressors that are more important to managers of one department than of another. The reasons for this lie in the inherent differences in the activities and features of the different departments. Lowered productivity levels and reduction in the quality of managerial performance result when managers experience stress due to the various factors discussed. The

organisation should once again look at the stressors acting on managers of the various departments in order to make suitable changes aimed at reducing managerial stress and maximizing managerial performance and productivity.

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Feature

Capital-Output Ratios in India : Some Issues

Bhaskar Majumdar

The phenomenon of rising rates of investment with rising rates of saving dissociated with an accelerating industrial growth has been the feature of economic development since planning started in India in 1951. One explanation for this goes in terms of high and rising capital coefficient. This paper stresses not only on the coefficient but also on the generation of the ratio by an unchanging product-technology mix which the policy-makers accepted for Indian economy. This may help in setting the problem which seems to emanate from the coefficient.

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The phenomenon of rising rate of investment and rising rate of saving dissociated with an accelerating industrial growth has been a feature of planning in India (Shetty & Menon, 1980). A hypothesis has been offered that high and rising accelerator (coefficient) offsets the translation of high and rising investment rate into high and accelerating industrial growth (Desai, 1981; Rangarajan, 1982). We know, a sizeable segment of this investment takes the form of public assets (Eapen, 1982). This public sector investment has been largely in production of capital goods and infrastructure. It is also known that the post-1966 decleleration in Indian industrial growth has been prominent particularly in capital goods industries.

Capital-Output Ratio Revisited

For macroeconomy, the behaviour of incremental capital-output ratio (ICOR) is confusing. Let us see the ratio by aggregates in table 1. At 1970-71 prices the ratio increased during each plan from 1951-66. A cyclical variation is seen in the ratio and not a monotonic increase relative to the previous peak. Study by Chandra (1982) taking truncated medium periods from 1950-51 to 1977-78 at 1970-71 prices confirms cyclical variations in capital-output ratio in the post- 1966 period compared to a monotonic increase in the pre-1966 phase. Chandra's study confirmed that the second decade of planning had higher incremental ratio (total and fixed) than the first

Table 1 : Incremental Gross Capital-Output Ratio, at 1970-71 Prices

Period	Capital-Output Ratio
First Plan (1951-56)	3.2
Second Plan (1956-61)	4.1
Third Plan (1961-66)	5.4
Annual Plans (1966-69)	4.9
Fourth Plan (1969-74)	5.7
Fifth Plan (1974-79)	3.9

Source : Sixth Five Year Plan 1980-85 (Planning Commission).

decade. The high ratios are visible particularly during the first half of sixties and the first half of seventies, the latter being marginally higher than the former. According to Raj (1984) the Second Plan (1956-61) was a period of peak ratio both for gross and net. The highest ratios are visible during the first half of seventies (1970-75). Decade wise it was a case of monotonic increase in the ratio. Following Rao (1983) at 1960-61 prices, ICOR oscillated sharply during both pre-1965 and post-1965 periods. The ratio reached its peak during the early seventies (1970-74). No doubt, the post-1965 ratios by quinquennial averages, both average and marginal, were higher than the respective pre-1965 ratios.

International Comparison

Let us compare the capital-output ratios during different medium periods for selected groups of countries in the World economy at 1975 prices in table 2.

Table 2 : Incremental Capital-Output Ratios in the World Market Economies, at 1975 Prices

	1960-65	1965-70	1970-75	1975-80	1960-70	1970-80
1. World Market Economies	4.1	4.7	7.1	6.4	4.4	6.7
2. Developed Economies	4.3	5.1	8.3	6.7	4.7	7.4
3. Developing Economies of which	3.2	2.9	3.8	5.4	3.0	4.6
High Income	2.8	2.6	3.6	6.1	2.7	4.8
Middle Income	2.8	3.3	3.8	4.4	3.1	4.2
Low Income	6.1	3.5	4.9	4.6	4.3	4.7
4. Least Developed	4.1	6.1	5.2	4.0	5.1	4.4
5. Capital Surplus Energy Exporting	0.9	1.0	1.9	13.3	1.0	5.2
6. Agricultural Product Exporters	4.8	3.8	5.2	5.7	4.2	5.5

Source : Raj, (1984)

Our observations on ratios in Indian economy at 1970-71 prices confirm that India behaved in a way not much different from the select market economies. It is evident that India experienced the highest ratio during early seventies (1970-75) along with world market economies, developed countries and agricultural product exporters as groups. This obviously excludes the developing countries (Raj, 1984)[1]. It is a matter of serious doubt if technology transfer from developed market economies and capital-surplus energy-exporting countries led to an upward movement of the ratio for Indian economy during early seventies. This doubt is pertinent particularly in a situation when the share of the energy sector in Indian public sector outlay rose sharply from 11.0% during the First Plan to 24.08% during the Fifth and 30.05% during the Sixth (upto Aug. 1983). This latter phenomenon, in turn, is dependent on energy-intensity of Indian industries, as revealed by table 3.

International comparison of capital-output ratio may help more in concealing the problem than revealing it, since identical historical time horizons for countries by no means imply identical stages of industrialization. Hence capital-output ratios for industrial-technological leaders of today, even if were high relative to those in India, cannot be taken as a standard to justify our high ratio.

Table 3 : Energy Use in Selected Industries in India and Advanced Countries, Million Kcal/tonne

	Steel	Cement	Pulp & Paper	Fertilizer
India	9.50	2.00	11.13	11.25
Italy	4.03	0.89	-	9.92
Japan	4.18	1.20	-	-
Sweden	5.02	1.40	7.56	-
U.K.	6.07	1.30	7.62	12.23
U.S.A.	6.06	0.95	9.70	11.32
W. Germany	5.21	0.82	-	-

Source : Raghuraman, (1988).

Any general lesson on this ratio, however, may not be possible at this stage when the outcome is based on a number of factors, e.g., the age-distribution of plants, time- phasing selection and implementation of projects, changing price of capital goods, in addition to being a derivation from international technological integration.

Industry of Use

Following ASI data, capital coefficient, measured by the ratio of fixed capital to value added, shows variability with respect to the age-distribution of factories. A correspondence between input-intensity and age-distribution of factories in Indian economy is considered in table 4.

Pre-plan factories are the least capital-intensive, while Second Plan period showed the highest capital-intensity. The factories beginning production during sixties had been considerably less capital-intensive. The seventies was a period of rising capital-intensity. If a high capital-output ratio during the Second Plan and the seventies as confirmed from table 4 is a problem then one has to look at the product-technology mix adopted at that point of time, e.g., installation of heavy steel plants, etc. *via* import of technology (Mundle, 1980, Dastur, 1978) and an investment

1. It is interesting to observe that capital-output ratio for the capital-surplus energy-exporting countries was very low during 1970-75 at 1.9 and jumped to the peak at 13.3 during 1975-80.

pattern in favour of products having high capital-cum-energy intensity during the seventies. This needs, however, additional insight into the phenomenon.

Defining ICOR as gross capital formation as a ratio of the change in value added (table 5) presents the time-behaviour of the ratio by industry of use at 1970-71 prices.

Table 4 : Age-Distribution of Factories and Capital Intensity

Year of Initial Production	As Percentage of 1978-79				
	No. of Factories	Fixed capital	Productive capital	Employment	Value Added
1950 and Before	13.8	17.4	19.9	36.6	36.4
First Plan (1951-55)	4.8	6.2	6.7	-	6.3
Second Plan (1956-60)	8.2	37.7	32.5	15.7	18.5
1971-78	33.6	21.2	19.8	19.9	12.4

Source : Shetty, (1982).

Table 5 : Incremental Capital-Output Ratios, at Constant 1970-71 Prices, 1950-1978

	1950-51 to 1955-56	1955-56 to 1960-61	1960-61 to 1965-66	1965-66 to 1970-71	1970-71 to 1975-76	1975-76 to 1977-78
1. Agriculture	2.0	2.1	+	1.3	3.9	4.3
2. Mining & Quarrying	3.9	2.1	4.9	13.0	8.9	40.9
3. Manufacturing	4.0	5.8	4.9	11.5	12.2	4.7
4. Electricity, Gas & Water Supply	17.2	15.2	18.4	16.6	20.9	23.4
5. Railways	19.6	16.0	18.4	22.4	11.6	5.0

+ Value Added Declined.
Source : Desai, (1981).

The areas exhibiting high capital-output ratios since the launching of planning were electricity, gas and water supply, and railways, i.e., major infrastructure sectors. In the case of manufacturing not only did we find pre-1966 high ratios but also a rise in the ratio for post-1966 decade, while agriculture maintained low ratios during any medium period we have taken. The other area that showed high ratios particularly during post-1966 period was mining and quarrying. The capital-output ratios by industry of use at 1980-81 prices during 1951 to 1989 following the study by the NPC Research Section are presented in table 6. Here ICOR is defined as the ratio of gross capital formation to change in the Gross Domestic Product, the period being the same for both. The major areas exhibiting high capital-output ratios during the 1951-1966 phase were infrastructure (basically electricity and transport) and manufacturing. The areas exhibiting low ratios were agriculture and allied activities, construction, etc. The problem is related not much to an upward movement of the ratio but to an initial high ratio, particularly in the infrastructure. The problem then is related to the nature of the product and associated technologies (involving scale economies, etc.) initiated during the launching of projects and plants.

Table 6 : Incremental Capital Output Ratios for Indian Economy (1951-1989), at 1980-81 Prices

	1951-55 to 1955-56 (First Plan)	1956-67 to 1960-61 (Second Plan)	1961-62 to 1965-66 (Third Plan)	1966-67 to 1968-69 (Annual Plans)	1969-70 to 1973-74 (Fourth Plan)	1974-75 to 1978-79 (Fifth Plan)	1980-81 to 1984-85 (Sixth Plan)	1985-86 to 1988-89 (Seventh Plan)
Agriculture & Allied Activities	1.36	2.50	9.51	2.20	5.48	3.33	2.78	5.77*
Mining & Quarrying	3.50	1.81	4.08	8.14	17.72	12.05	7.79	Very high
Manufacturing	3.77	5.65	5.27	7.84@	6.90	5.48	5.68	4.67*
(a) Registered	7.00	7.86	6.86	9.32@	7.65	7.37	5.81	5.25
(b) Unregistered	0.82	1.56	1.82	4.91@	5.45	3.02	5.34	3.19*
Electricity, Gas & Water Supply	19.60	16.17	19.15	15.72	24.91	15.81	20.51	18.59*
Construction	1.29	1.60	1.69	1.49	–Ve @@	1.37	3.16	2.92*
Trade & Commerce	1.57	1.45	0.89	2.48	3.68	2.75	4.21	3.94*
Transport, Storage* Communication	13.45	13.64	16.80	14.32	13.89	8.37	7.69	8.70*
Finance & Real Estate	10.37	11.65	9.66	9.78	7.17	5.42	5.71	3.79*
Community, Social & Personal Service	5.41	6.73	4.59	4.06	5.27	4.85	4.26	4.02**
Total	3.89	5.28	5.23	5.66	7.72	5.15	4.96	4.33

* For the period 1985-86 to 1987-88.
@ For the period 1966-67 to 1969-70.
@@ GDP in the Sector during this period shows a decline.
** Relates to Public Administration & Defence Excludes other services.
Source : NPC Research Section, (1990).

In fact, a right decision on technology was needed during the beginning of the planning process as one identifies at a relatively late phase a high and/or rising capital-output ratio as being responsible for the post-1966 Indian industrial decceleration. Given the inter-industry structural differentials in capital-labour employment-value added relation (Shetty, 1982, P. 1610; 1665-67)[2] a reorientation of product-cum-technology mix perhaps still is needed.

Capital-Output Ratio in Public Sector

Concentrating on public enterprises (Departmental and Non-Departmental) as distinct from public sector (which includes government administration in addition to productive public enterprises) we find that the problem is not basically one of rising capital-output ratio as is of initial high ratio, particularly in commodity producing sector. It may be mentioned that the capital structure got gradually weighted in favour of commodity producing sector as opposed to the tertiary sector within public enterprises (Dholakia, 1980, P. 58, 104). These aspects, we think, are related to the nature of products and hence investment in public enterprises. This may be seen from table 7. As we see, the pattern of investment in public enterprises producing and selling goods are weighted in favour of products known to be capital-intensive and also often import-intensive, either in final product or in technology, e.g., steel, power, petroleum, chemicals, fertilisers, pharmaceuticals etc. The products that captured a less percentage of investment were consumer goods, textiles and agro-based products. Incidentally the latter group of products never experienced high and accelerating growth. The pattern of growth of industries then cannot be delinked from the pattern of investment in public enterprises. Simultaneously the behaviour of capital-output ratio in public enterprises cannot be seen in isolation from the nature of capital-intensity of products, huge percentage of investments under construction and delayed terminal years of selected projects undertaken for construction.

Table 7 : Pattern of Investment in Public Enterprises as on 31.3.1984

Cognate Group	Number of Enterprises	Investments (Rs. Crs.)
1. Enterprises under Construction	4	1747.18
2. Enterprises producing and selling of which	146	28116.17(100.00)
(i) Steel	6	5717.24(20.33)
(ii) Minerals & Metals	13	2936.79(10.45)
(iii) Coal	5	4068.82(14.47)
(iv) Power	2	2510.71(8.93)
(v) Petroleum	12	2510.71(8.93)
(vi) Chemicals, Fertilizers & Pharmaceuticals	25	3774.21(13.42)
(vii) Consumer Goods	14	2992.74(10.64)
(viii) Agro-based	10	801.36(2.85)
(ix) Textiles	13	36.20(0.13)
(x) Others	46	860.07(3.06)
3. Enterprises rendering services	55	5426.53
4. Insurance Companies	7	121.00
Grand Total	214	35410.88

Source : Lobo, (1986).

By definition, capital-output ratio (V) is division of capital-labour ratio (K/L) by productivity of labour (Q/L).

$$V = \frac{K}{Q} = \frac{K}{L} \cdot \frac{L}{Q} = \frac{K/L}{Q/L} \quad \ldots\ldots (1)$$

Taking log in (1) and differentiating with respect to time (t) we get :

$$\frac{\dot{V}}{V} = \frac{\dot{k}}{k} - \frac{\dot{Q}_L}{Q_L}, \text{ where } k = \frac{K}{L}, \; Q_L = \frac{Q}{L}, \quad \ldots\ldots (2)$$

We have $k = K/L$ ..... (3)

Taking log in (3) and differentiating w.r.t. time (t), we get :

$$\frac{\dot{k}}{k} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L} \quad \ldots\ldots (4)$$

Thus, from (2) and (4), we get :

$$\frac{\dot{V}}{V} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L} - \frac{\dot{Q}_L}{Q_L} \quad \ldots\ldots (5)$$

$\dot{(\cdot)}$ means $\frac{d(\;)}{dt}$

By (2), a low (falling) capital-intensity and a high (rising) productivity of labour can keep capital-output ratio low (falling). By (4), capital-intensity may be low (falling) if rate of capital formation is low (falling) and rate of labour employment is high (rising). The objective of low rate of capital formation may be ruled out in an LDC like India. If capital formation (actual and potential) is high, then low (falling) capital-output ratio depends on (i) high (rising) labour employment, (ii) high (rising) productivity of labour. In a given state of technology, it is paradoxical to attain both (i) and (ii) in the context of profit maximization unless wage rate is depressed at a rate higher than the rate of additional labour absorption aimed at non-reduction in public sector surplus. Depressing the wage rate in a situation of increasing labour productivity in the organised

2. The data are presented from ASI on 23 major industrial groups (at the two-digit level of classification). The industries with low capital-output ratio and high employment generation were found to be cotton and jute textiles, food products, metal products etc. On the contrary, electricity, basic metals and alloys, chemicals and chemical products, were the industries with high capital-output ratios and low employment generation.

(public) sector perhaps is not possible. By implication, either public sector performance has to be judged by criteria other than profit maximization while we identify high capital-output ratio as being responsible to offset growth effect of high public investment, or a high (rising) capital-output ratio on the assumption of profit maximization has to be accepted.

Problem in Perspective

A reduction in capital-output ratio in public enterprises, we think, cannot be taken as a precondition for industrialization which ensures infrastructure and capital-goods output. We do not opine that the ratio should not be reduced where it is possible, e.g., major cost escalation following delayed implementation of public sector projects should be reduced. But then it is a question of decision-making at the political level. The question gets related to existence and exercise of 'State Power', where the 'Power' itself is determined by State-sponsored development of indigenous technology and gets manifestation as a reciprocal of power exercised by the technological leaders (countries and/or corporations) in the rest of the world.

If, for example, in an economy characterised by generally rising prices, only 42 out of 192 major irrigation projects undertaken had been completed during 1951-1980, and then the cost of execution of the rest irrigation projects, if not postponed, increases during post-1980 period, the responsibility of reducing capital-output ratio should not lie in the domain of labour-management interaction in public enterprises, but in the political process of decision-making on projects and technologies (Krishna, 1984, P. 65). "To the extent that the gestation period of new investment is larger than warranted, the capital-output ratio is bound to be higher than it ought to be" (Ghosh, 1988 P. 304). And indeed not only that infrastructural projects by their very nature took long gestation period but also projects like steel etc. took period for completion much more than is optimum (Ghosh, 1988, P. 304)[3]. Again a large number of on-going projects in public enterprises involving huge investment, and often existence of truncated projects, lead to an increase in capital-output ratio.

If a fuel price hike during early seventies (Second Oil Shock, 1973) is supposed to raise capital-ouput ratio (particularly in industries which are oil-cum-energy intensive), what is to be identified as a problem is not the end-symptom but the process which led to that symptom, viz., a process of dependence on import of technology by a State enjoying a position of subordination in global transfer of technology. Thus, an attempt may be made to reduce import-dependence and to find out energy substitutes, and this is related to decision-making on products and technologies.

Following delayed implementation of projects, or otherwise, a rise in price of capital goods will inflate capital-output ratio, and if the government maintains an upward rigidity in price of capital goods produced mainly in public sector, it may work as a damper on wage-salaries and surplus. Unless a reduction in price of capital goods is associated with an increase in output-labour employment-wage share, and reduced price of consumer goods in private sector, the entire objective of keeping capital-output ratio low and reducing in public sector may fail.

An allegation is often put forward, viz., that capital-output ratio in public enterprise rose or remained high because of inefficient utilization and mismanagement of capital. If by existence of inefficient utilization is meant persistence of excess capacity in capital goods sector particularly during post-1966 Indian economy, the problem would lie in selection of inappropriate product-technology continued from the pre-1966 regime, in non-proportional growth of consumer goods and capital goods, in the absence of adequate inter-industry competitive atmosphere and particularly where public enterprises have not generally entered into the production of consumer goods, other than nationalization of sick private enterprises producing consumer goods. If reducing capital-output ratio gets inextricably linked with increasing capacity utilization in industries, it becomes a question of optimal use of men and materials. The necessary condition of increasing capacity utilization is a favourable industrial culture ensured via good management and conscious labour participation. At the same time it should be said that a high (rising) capital-output ratio is not a derivation from labour problems or mismanagement of materials (which may be the immediately preceding symptoms) but is rooted in the planning of products and technologies. If a high capital-output ratio in Indian economy is a derivation from international technological integration then what is needed is an appropriate technology plan accepting the basic premise that our problem at this stage is wholly different from attainment of world best technology and industries (Ghosh, 1988, P. 306)[4]. An international comparison of capital-

3. e.g., a specific project like Visakhapatnam Steel Plant which is now expected to be commissioned by 1990-91, would have taken some thirteen years to complete as compared to, say the Pohang Steel Plant in South Korea which took 30 months to complete. Indeed our own Bhilai Steel Plant (First Phase) was commissioned in about three and a half years from the commencement of construction.

4. e.g., considering steel industry, in India, "Employment of labour per tonne of steel produced is the highest in the World ... Nevertheless, it still remains true that in India, labour cost as a percentage of the total cost of production of steel varies between only some 12 and 15 percent (in the case of the plants under SAIL). Further, next to South Korea, Japan and Brazil, labour costs per tonne of steel are still lower in India than in all other steel producing countries".

output ratio may be misplaced, when the countries, technological leaders and followers, are not in comparable stages of growth. It is beyond the scope of our present study what product-cum-technology mix the Planning Authority should accept to ensure not-too-high capital-output ratio in the not-too-distant future.

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Abbreviations Used : EPW = Economic and Political Weekly.
NPC = National Productivity Council.

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The means by which we live have out distanced the ends for which we live. Our scientific power has out turned our spiritual power. We have guided missiles and misguided men.

—Martin Luther King Jr.

A science is any discipline in which the fool of this generation can go beyond the point reached by the genius of the last generation.

—Max Gluckman

Feature

Technology for Small & Resource-Poor Farmers

S.P. Singh & C. Prasad

The ever-increasing human population is accentuating pressure on land for food and allied items like fuel, fodder, fibre, fruits, etc. This calls for vertical expansion of land productivity. The recent studies have clearly shown that several new technologies are not appropriate for all situations and there is need to tailor technologies suiting different bio-physical and socio-economic environments. This paper deals with the processes and methodologies for generation of appropriate technologies for different ecological situations specially under resource-poor conditions.

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India ushered in the Green Revolution in the sixties. The benefits of this revolution have, however, been restricted to favourable farming situations only. This is clear from the fact that only 44 districts out of 453 in the country, are contributing half of the total foodgrain production of the country. It is apparent that the absorption of new technologies, has been confined to the favourable farming situations only. A critical examination of agricultural development, shows that there are three distinct conditions of agriculture, *viz.* (i) areas where agriculture developed in sixties (developed areas) e.g. Punjab, North-Western Haryana, Western Uttar Pradesh, Coastal areas of Andhra Pradesh and Tamil Nadu, etc.; (ii) areas where agriculture is in the process of development (developing areas) e.g. irrigated areas of most of the states other than the areas mentioned above; and (iii) areas where the pace of agricultural development has either been very slow or has not set in yet. This category consists of mainly rainfed areas and also small and marginal farmers of irrigated areas. The problems of all these areas are distinctly different and require different technologies.

National Food Availability Scenario

The population explosion is causing exponential increase in pressure on already highly strained and resources through the increasing requirements of products of both plant and animal origin. The present production/availability and expected food requirements by 2000 A.D. are summarised in tables 1 & 2.

Keeping the burgeoning food and related agricultural products based requirements in view, the growth rate of 6 per cent has been envisaged in the draft Eighth Plan proposal. This appears to be highly ambitious and difficult to achieve in view of the fact that so far our growth rate, on a long-term basis, has been only 2.6 per cent. It should,

however, not be an impossible task with 143 m ha cultivated land which could be stretched to 155 m ha as per estimates of National Commission on Agriculture (1976) when People's Republic of China with only 100 m ha

Table 1: Present production and requirements for 2000 A.D. for different plant, animal products

Item	1988-89	2000 A.D.	Increase (%)
Plant Products (million tonnes)			
Foodgrains	170.0	225.0	32.4
Edible oilseeds	13.1	19.2	46.6
Non-edible oilseeds	6.0	8.0	33.3
Vegetables	39.0	50.0	27.1
Fruits	27.0	35.0	30.0
Animal Products			
Milk (million tonnes)	48.5	62.4	28.5
Egg (million no.)	18,600	24,000	29.0
Fish (million tonnes)	3.75	5.2	38.6

Table 2 : Present availability and requirements in 2000 A.D. of different food items (g/Caput/day)

Item	1988-89	2000 A.D.	Increase (%)
Cereals	479.0	530.0	10.6
Pulses	45.0	55.0	22.2
Edible Oil	22.0	28.0	27.2
Vegetables	134.0	144.0	7.1
Fruits	92.0	100.0	8.7
Milk	165.0	180.0	9.9
Fish	12.8	15.0	15.3
Egg (no./year)	23.2	30.0	34.3

cultivated land has already crossed the level of 400 m tonnes foodgrain production.

Land Availability Scenario

In the year 1985-86 a total of 76.4 per cent farm holdings were of the category of marginal and small holdings operating only 28.8 per cent of the cultivated land (table 3). It is estimated that at the present rate of decrease in holding size, more than 85 per cent operational holdings will come in this category within the present decade. Further, the per capita availability of cultivated land has already been reduced to 0.19 ha in 1985-86, and shall be only 0.15 ha in 2000 A.D. This shows that Indian agriculture is dominated by small farmers and the farm-size shall keep on reducing. Thus, efforts have to be made to increase productivity of small farmers which has not been possible so far.

Present Agricultural Growth-Rate

The data on compound growth-rate of area, production and productivity (average yield) of principal crops from 1949-50 to 1988-89 and for 1967-68 to 1988-89 are given in table 4. These data show that it is mainly the crop productivity which has contributed 2.64 per cent to the growth-rate in production. Among cereals highest growth-rate was

Table 3 : Distribution of land holdings in India in 1985-86

Category of holdings	No. of operational holdings ('000 ha)	Area operated ('000 ha)	Average size of operational holding (ha)
Marginal (Less than 1 ha)	56748 (58.1)	21606 (13.2)	0.38
Small (1.0 to 2.0 ha)	17881 (18.3)	25533 (15.6)	1.43
Semi-Medium (2.0 to 4.0 ha)	13253 (13.5)	36579 (22.3)	2.76
Medium (4.0 to 10.0 ha)	7920 (8.1)	47008 (28.7)	5.94
Large (10.0 and above)	1929 (2.0)	33187 (20.2)	17.20
All holdings	97731 (100.0)	163913 (100.0)	1.68

Note : Figures in brackets indicate the percentages in respective column totals.

Source : Agricultural Statistics at a Glance 1990; Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Government of India.

in wheat, whereas barley and smaller millets had negative growth rates. The coarse cereals, predominantly rainfed crops, had positive but very low growth-rates. There has not been much improvement in either production or productivity of pulses (about 92% rainfed). Nevertheless, oilseed crops, (having 15 per cent area irrigated) had slightly better rates than pulses. On the whole, it could be inferred from these data that the growth rate of the crops grown in resource - rich conditions were greater compared to the crops grown in poor-resource situations.

Present Day Requirements

The Eighth Plan Approach Paper envisages 5 per cent growth rate in GDP which requires a quantum jump in agricultural productivity. This could be achieved by quick transfer of benefits of scientific farm technologies to small and marginal farmers as well as rainfed areas. This is also essential for poverty alleviation, self-reliance in food and for minimizing regional imbalances in growth pattern. It could be possible only when the national agricultural growth-rate is maintained above 4 per cent per annum during the present decade i.e. 1990's. This may be achieved

Tabel 4 : Compound growth-rates of area (A), Production (P) and average yield (Y) of principal crops in India (% per annum)

Crop	1949-50 to 1988-89			1967-68 to 1988-89		
	A	P	Y	A	P	Y
Cereals						
Rice	0.89	2.54	1.68	0.56	2.60	2.06
Wheat	2.58	5.88	3.21	2.02	5.27	3.17
Sorghum	–0.24	1.19	1.43	–0.64	1.23	1.88
Pearlmillet	0.11	1.63	1.52	0.86	–0.04	0.81
Maize	1.52	2.36	0.83	–0.10	0.89	1.00
Coarse Cereal	–0.15	1.21	1.23	–0.97	0.42	1.34
Cereals	0.70	2.97	1.91	0.20	2.89	2.26
Pulses						
Chickpea	–0.66	–0.08	0.58	–0.68	–0.45	0.22
Pigeonpea	0.82	0.69	–0.13	1.44	1.96	0.51
Other Pulses	0.71	0.71	NEG.	0.60	1.34	0.74
Total Pulses	0.27	0.37	0.26	0.30	0.74	0.51
Foodgrains	0.61	2.65	1.72	0.22	2.68	2.10
Oilseeds						
Groundnut	1.15	1.80	0.65	0.08	1.23	1.14
Rapeseed & Mustard	1.74	3.53	1.76	1.50	4.01	2.48
Total Oilseeds crops	0.85	2.04	0.82	0.17	1.91	1.42
Non-foodgrains	0.99	2.61	1.18	0.42	2.57	1.56
All Crops	0.69	2.63	1.56	0.26	2.64	1.92

Source : Agricultural Statistics at a Glance 1990; Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Government of India.

by accelerating the growth-rate of the areas which have so far lagged behind since the chances of increase in land productivity with efficient use of resources of irrigated and already developed areas, are rather very much limited.

Technology Application Gap on Small-Farms

The present agricultural scenario of the country clearly shows that the productivity of irrigated small-farms, and all rainfed farms has not been influenced much from the green revolution so far and there is wide 'technology application gap'. The experiences of 'Integrated Dryland Development Programme' show that the adoption of improved technologies was fairly high when the farmers were provided with subsidies for adoption of improved technologies. But after the withdrawal of the subsidies, the farmers slowly started reverting back to the traditional practices and after sometime only a few technologies were left with the farmers. Economic constraints were considered the important reasons for the rejection of improved technologies. Critical examination of technology adoption also revealed that even when subsidies were available, there was only selective adoption of some components of the technology, not the full package. Most commonly adopted components were improved seeds and intercultural operations. Though no hard data are available about the adoption of technologies, the estimates indicate very low level of adoption (less than 10% in drylands and about 25-30% in irrigated). The most important points to ponder upon are why the new technologies, claimed to be resource and scale neutral by the researchers, have not gone to the poor-farmers, specially in poor environment conditions? Are the technologies really appropriate for different situations prevailing on the farm of resource poor farmers and in harsh environments?

In the earlier literature, non-adoption of modern technologies by small and resource-poor farmers was attributed to the attitudinal constraint on the part of small-farmers; such as innate conservatism, ignorance, resistance to change, etc. This perception of the problem is largely the product of 'armchair conjecture' (Whyte, 1981) because there was an important basic assumption in these studies that the technology is good and appropriate in all resource conditions. This is not supported by field investigations of small-farm systems. Another reason for this technology application gap put forward is the inadequate support systems for small-farm agriculture, such as extension, credit, input supplies, etc. These unavoidable conditions are well appreciated and recognized but they are only one part of the problem. However, the main area which has not been considered earlier is whether the modern technolgies are appropriate for small-farms, specially resource-poor small-farms? The recent field investigations conducted world over, clearly suggest that many modern technologies are simply inappropriate for the specific conditions of small-farm systems which are highly diverse in nature and are influenced more by socio-economic factors rather than by physical and biological factors.

Characteristics of Small-Farms

Traditional farming systems adopted by small and resource-poor farmers are generally tuned to the physical, economic and social environments of operation. But small-farmers, due to peculiar conditions of their environments, function differently than the resource-rich farmers. The most important feature of small-farm agriculture is that the farming system is embedded within the economy of the houshold and, thus, is organized to meet both the production and consumption goals of the farm family (FAO, 1986).

The small-farmers use an integrated system of production activities - crop and livestock systems of both a subsistence and commercial nature, as well as off-farm

labour and trade enterprise in order to sustain themselves. The specific combination of enterprises managed by a houshold is largely a product of the resources it controls, the means of access available to the factors of production (land, labour and capital), and the balance it has struck among its production and consumption goals related to quality, quantity, flexibility and stability. Production maximization and welfare of the farm family are the major goals governing management decisions with small farmers than profit maximization.

Small-farms are typically constrained by limited resources and access to both land and capital. Scarcity of cash to purchase inputs or hire labour is a common impediment to increasing farm output. Small-farms rely disproportionately on farm labour, as their most available and flexible factor of production. Family labour is usually not considered as a production cost because members have to be sustained whether they work or not, but hired labour is regarded as a drain on scarce money of the household and is eschewed.

Another important point is that most small-farmers operate in rural economies characterized by imperfect markets. As a result, other institutions, such as kin groups or tribal membership, commonly regulate farm family's access to land, labour and capital.

Adoption Behaviour of Small-Farmers

FAO (1986) has identified, the following three important and critical lessons :

(i) The concept that traditional agriculture is static is misleading. On the contrary, small-farm families are also receptive to change and the small-farm systems are dynamic.

(ii) Small-farm families are selective and adaptive in their adoption and use of recommended practices and technologies.

(iii) No single attitude, trait, factor or farming condition explains the pattens of small-farm adoption of all new innovations.

These lessons are valuable conceptual tools to assist agricultural scientists and development planners in better understanding the physical, biological and socio-economic process of technology transfer to small-farmers predominant in India.

A detailed analysis of the patterns of small-farm adoption of technologies makes two things very clear; first, that we must recognise that agricultural development and the transfer of improved technologies to small and resource-poor farmers is a complex process of socio-economic change, and second, that we must allow for this complexity in technology management system.

Agriculture development is influenced mainly by factors : (1) technology and resources, (2) the social, economic and political environment including price policies, input and output systems, development services, communications and infrastructure and (3) the socio-economic organization of the farm. In the present day agricultural research and development, most of the interventions have been focussed on the first two factors and arbitrary assumptions have been made about the last. However, in technology adoption by small resource-poor farmers, it is precisely this factor; the social and economic organization of the farming system; which merits close attention (FAO, 1986).

Another very important point for consideration is that in most of the studies on adoption of new technologies during the sixties, the most common and important reason assigned for non-adoption of new technologies was ignorance of the farmers. However, interestingly in all such studies one basic assumption has been that the technologies are good and appropriate (Chambers and Ghildyal, 1985). It was seldom studied whether the technologies suited the complex and variable farming environments prevailing with the resource-poor farmers and rainfed farming community. The notion that new technologies are scale and resource neutral is not true, is only a recent realization. Therefore, technology transfer cannot be accomplished simply by just replacing one practice with an other as in physical or biological systems. It takes place within a certain social and economic system which bestows upon the technologies numerous dimensions and determines its eventual viability in meeting specified goals. Further, the introduced technology often has multiple repercussions within the system. These can only be predicted with a thorough knowledge of the system into which the technology is being introduced. For example, the dwarf hybrid sorghums were not accepted by the farmers even though they were convinced of its potential. One important reason was the availability of less fodder. There are several such examples.

The determinants of the appropriateness of a technology for small-farms is more complex than simple yield maximization per unit of land, a common target of most agricultural research. The technology must be evaluated in terms of both its technical performance under the environmental conditions prevailing on small-farms and also in terms of its conformity to the goals and socio-economic organization of the small-farm system. This second evaluation criteria is essential because small-farmers operate under a particular set of socio-economic conditions which

are widely different from the conditions of large and resource rich farmers. It is now well understood that the technologies are relevant in the conditions where they are generated and adopted in similar conditions and are mostly not adopted where conditions differ. The physical, biological, social and economic conditions of resource-rich farmers of irrigated areas are much closer to the conditions of the research stations, thus, result in quick adoption of these technologies. Adoption of modern wheat and rice production technologies in Punjab is a very good example to elucidate this point. On the contrary, the conditions prevailing on the farms of poor and small farmers, in general, and in rainfed areas in particular are sharply different from the those of research stations even of those dealing with such situations. It has to be fully appreciated that a technology heavily dependent on purchased inputs from outside and sensitive to environmental variations will not be sustainable on small farms. Therefore, there is wide technological application gap. Chambers and Ghildyal (1985) have concluded that the appropriateness of technology generated on research stations is very high with resource-rich farmers but very low with resource-poor farmers. Therefore, the technology generation process for resource-poor conditions should be different than the present process of developing appropriate technologies.

Research-Extension Gap

Technology development, transfer and utilization are the steps of a mutually reinforcing continuum (Ruttan, 1987). It is a common experience that the extension is often not well linked with knowledge base, research is equally oblivious to the needs of its clientele, i.e. farmers (Russell, 1981). It is, however, well understood that, though both have different needs, their destiny and functions are closely related. Therefore, both these systems cannot operate in isolation. It is unfortunate that there is a gap between research and extension in our country. There is another paradoxical situation that this gap is much wider in understanding the problems and requirements of resource-poor small farmers than those of resource-rich farmers.

The research system depends on the extension services for dissemination of new technologies to farmers as well as to get feed-back about the appropriateness of technologies. There are many factors and conditions which greatly affect the scope and efficiency of technology transfer, such as government policies, infrastructures, availability of appropriate new technolgies, and availability of motivated research and extension personnel. The appropriate technology management system has to cope with the following three established facts in addition to the earlier said factors (Stoop, 1988) :

(i) That there are diverse agricultural environments and there is a need for the technology systems to serve these different environments;

(ii) That there is a need for research and extension to understand existing system; and

(iii) That there is a need for two-way communication among researchers, extensionists and producers (farmers).

These facts must be reconciled with the need for research to search for a relative concentration of its resources, while extension requires a decentralized structure to fulfill its transfer functions. In this context, Roberts (1981) and Chambers (1983) suggest that the technology transfer activity generally faces the following two common traps based on unrealistic assumptions about uniformity :

(i) Agricultural environments; physical, biological and socio-economic factors; are relatively uniform and can be improved by introducing rather specific "packages" of technology requiring, at most, minor adaptive research modifications to become adoptable to major regions; and

(ii) Technology transfer systems can be standardized and a specific model (e.g., Training & Visit approach) and a specific mechanism (e.g. subject-matter specialist) can guarantee success, irrespective of variations in the physical, biological, social and economic environments.

Government policies, at present, are aimed at achieving national food security, generating rural income, saving foreign exchange, and reducing the rural exodus. Consequently, the scientists have to work more closely with farmers and extension agents to improve the effectiveness of research. However, in the absence of clear guidelines about the function of the research technology transfer interphase, such strategies may easily lead to many fragmented and overlapping research activities, which may contribute little to increased production. Thus, to achieve an impact at the farm level, we require something more than just a number of tools and mechanisms for linking research and extension. Stoop (1988) says that prior to implementation, the different options for technology transfer systems should be critically evaluated against certain key factors, such as :

(a) the political and macro-economic development situation;

(b) actual farming technologies, their diversity and evolution;

(c) available research capacity; and

(d) the implications of different transfer systems, with respect to their effectiveness and requirements for trained personnel.

Technology Generation Mechanism

The agricultural technology generation mechanism is a dynamic process which basically has two approaches. The first, a non-formal approach; has been used since the beginning of agriculture and is used by the farm family itself. This approach calls for continuous learning process of understanding the environment for solving the problems faced by them and for making appropriate adjustments from what they learn. The second is the 'formal approach' where technology is developed through scientifically conducted experiments.

Traditional Research-Extension Approach

During the post-independence period there has been considerable extension of formal research efforts in the country to develop technologies for stepping up production and for vanquishing hunger. Due to the technologies developed through this approach the country has been able not only to stop food imports but also to create sufficient food reserves so that we could even face severe droughts like that of 1987. The present model of technology management system i.e. 'Top Down Model', is an one way approach only. In this approach highly trained and specialised scientists generate new technologies on research stations and/or in laboratories or workshops and pass them on to the extension agencies for onward transfer to farmers without considering the needs and capacities of their clients to absorb these technologies. It is true that majority of the researchers are not aware of the practical problems of farmers as well as the farming environments for which the technologies are being recommended. The actual conditions existing at the research stations and on the small and marginal farms have considerable differences. The scientists are neither able to perceive those conditions nor have a chance to test their research findings under actual farm situations. This approach can be compared with a situation where a tailor is asked to stitch a dress without measurements for a person not even seen by him. Another limitation of this model is that the researchers do not get proper feedback about the performance of their technology at farmers' fields. The absence of this feed-back mechanism restricts the chances of fine-tuning of the technologies as per the needs and resource situation of clients. Therefore, most of the technologies developed so far are of a high cost and are not appropriate for the conditions prevailing with the small resource-poor farmers.

Operational Research Approach

In the light of the disappointing experiences of the 'Top-Down Model', many modifications have been introdiced in the recent past. One such significant change was the introduction of Operational Research Project (ORP) concept started in the early 70's. This programme includes on-farm testing of technology, feed-back to researchers and the identification of constraints in the adoption of new technologies by the farmers. It, therefore, addresses to some of the weaknesses of the 'Top-Down' model discussed earlier. This, in fact, is an interphase between technology generation and its transfer to the ultimate users. This approach has proved the economic viability and operational feasibility of technologies, provided valuable feed-back to the researchers about the performance of their technologies and also to reorient their research programmes and has also successfully established the wisdom of many traditional practices.

In the Dryland Operational Research Project, it has been increasingly realized that dryland farmers in India have evolved many useful practices, e.g. methods of avoiding pests and diseases through adjustment of sowing time and selection of crop varieties of proper duration; moisture conservation through suitable land treatments; minimization of risk through mixed inter-cropping, agroforestry and contingent cropping; reduction in cost of weeding through early inter-culture operations. These experiences clearly suggest that we should be ready to learn from farmers who have rich experiences of the local environmental conditions.

The ORP experiences also clearly show that there is no need to make a total change in the system while introducing improved technology. Instead, the mixed approach of bringing in some new practices and retaining some sound traditional practices may be more efficient, economical and pragmatic for accelerating productivity of drylands. These ORP's have also made a very useful and critical evaluation of each component of the modern technology. It is broadly observed that nearly 25 per cent of the research station recommendations have been found to be unsuitable and referred back to the research system for refinement. Out of the remaining recommendations, about 30 per cent have shown high profitability and rapid rate of diffusion among the farmers. The rest of the recommendations did not spread inspite of their successful performance in the verification trials (Sanghi, 1987).

Despite these interesting results, ORP's proved to have a number of limitations. Firstly, the ORP's could not identify site-specific, non-technical constraints. The second limitation was the temptation of the scientists to achieve success while testing the technology by taking control over the trials even though these trials were conducted on farmers'holdings. The third limitation was that there were no solutions for some production problems because either these problems were too difficult and required long-term research or were considered trivial or of limited application by the scientists (Sanghi, 1987).

Therefore, the approach and methodology adopted in ORPs could not provide the farmers with significant control over research priorities, even though it did give clear feedback. At the same time, there was no in-built mechanism to involve farmers in making modifications in the technology at the village level. Another limitation of ORP approach has been that the farmers have remained as passive recipients of the technology and the feed-back function has remained vested with the ORP scientists. Further, the researchers have remained isolated from the farming community. Therefore, the feed-back was nothing but the perception gathered by the ORP staff. In other words, in this approach, active participation of farmers in technology evaluation and tailoring has been missing.

Audience-Oriented On-Farm Research

Consequently, emphasis has been to further modify the approach, by incorporation of socio-economic conditions of farmers in the process, an important factor in technology adoption on small farmers specially of resource-poor farmers. The concept of 'Down-Stream Farming Systems Research' (Gilbert, et al, 1980); 'Farmer-Back-To-Farmer' (Rhoades and Booth, 1982); 'Farmer-First-And-Last' (Chambers and Ghildyal, 1985); 'Farmer-Participatory Research' (Farington and Martin, 1988); 'On-Farm Client-Oriented Research (OFCOR)' approach of International Service for National Agricultural Research (ISNAR) (Merrill-Sands, 1987); 'Audience-Oriented Research and Development' (Prasad, 1987) etc. have been suggested in the last decade to complement conventional research model. In all these models, emphasis has been on technology generation in actual farm situations with active participation of farmers. These approaches broadly termed as 'Audience-Oriented On-Farm Research' (AOOFR); On-Farm Client-Oriented Research (ORCOR) or 'Farming Systems Research/Extension' (FSR/E), start with the assumption that research must begin and end with the farmer. The name is derived from the fact that this approach takes whole farm as a system, not an individual activity. The farmers and extensionists are actively involved in the research process. They contribute their practical knowledge of farming, their perception of problems and evaluation of potential and tested solutions. It also provides an opportunity to understand the farmers' resource availability situation in a locality/area and their requirements before tailoring technologies for them with their full involvement in the process.

The AOOFR has been developed to alleviate many of the limitations of the traditional top-down as well as of ORP approaches. It is a holistic approach and takes the plants, the animals, and the people of each location into consideration. The programmes are jointly controlled by local farming men and women, extension persons and researchers.

This approach uses on-farm trials, formal and informal surveys and meetings with farmers in order to diagnose problems at the farm level, ranks them and designs and tests appropriate technologies for solving the problems. The approach focusses on the needs of Resource-poor farmers and is committed to bring them fully into the research process (Osten, Ewell and Marril Sands, 1988).

Approaches

As stated earlier, the growing awareness of the complexity of the farmers' situation and inability of conventional methods to deal with it eventually led to the development of 'Farming Systems Approach' world over. The first important step in its implementation is to develop an inter-disciplinary research team. This team has to view and understand the complexity of the farmer and his environment as a system. The team has to have coherence and work together efficiently. Several concepts and methods are available to achieve this objective. These mainly include human ecology, agro-ecosystem analysis and rapid rural appraisal.

Human Ecology : It is the study of the relations between people and the surroundings in which they live. It is intended to help both social and natural scientist. Though several approaches are available to study human environment interaction, the 'System model of human ecology' has broadly been recognized more useful in designing the inter-disciplinary research projects on human interactions with environment.

Agro-Ecosystem Analysis : This approach helps in understanding local situations in a manner that can be employed effectively by an inter-disciplinary team. The systems

properties which include productivity, stability, sustainability and equity, describe how an eco-system operates over time. Productivity is the output of a system measured in terms of yield or net income; stability is concerned with variability of yield or output; sustainability is the ability of a system to persist in the face of repeated stress or perturbation; and equity measures the distribution of income or production among the farmers. This approach provides an organizational frame work that encourages scientists from different disciplines to interact with one another to form a homogeneous team. Agro-ecosystem analysis procedure allows agricultural, socio-economic and management issues to be raised simultaneously and for development of multi-disciplinary ideas. It leads to raising of a series of critical questions which should be converted into testable hypotheses and serve as the contextual frame-work for research.

Rapid Rural Appraisal (RRA) : It has several advantages in the agro-ecosystem analysis and in strengthening the operations of the inter-disciplinary teams. RRA can be used to help generate the data for agro-ecosystem analysis as well as to begin testing or better understanding some of the hypotheses that result from such analysis. RRA can also be used to assess the variation in key factors and constraints over wider areas and groups, than a locally focussed FSR approach would normally allow.

Inter-disciplinary Team Approach

The on-farm adaptive research programme involves a range of research activities broader than the limits of any single discipline oriented conventional research programme. Therefore, it requires cooperation between specialists of different disciplines. It is not easy to manage effectively the inter-disciplinary teams of natural scientists, social scientists, technicians and field assistants, as well as extension and other specialists. It, therefore, requires active and creative management skills not only to take work from each individual but also to create a team spirit and a feeling of oneness in the whole team. The ISNAR has drawn the following lessons from the experiences of nine countries for building an inter-disciplinary perspective (Osten, Ewell and Merill-Sands, 1988) :

Maintain Focus on the Clients : Research managers must build special events and meetings into the regular planning and programming process to maintain focus on the clients. If left to the initiative of individual scientists, less emphasis is placed on the specific problems of the complex farming systems of small-farmers. There is a strong tendency for natural scientists to become increasingly specialized as they move up the career ladder. An explicit regional approach to priority-setting and planning in many OFCOR programmes has proved useful in this regard.

Support from Senior Scientists : Methodological innovations are difficult to sustain without the active on-going participation of senior scientists from various disciplines. Consistent support is needed at the policy level (so that scientists derive professional benefits from on-farm research), and on the level of implementation (so that the necessary resources and logistical support are made available).

AOOFR programmes often depend heavily on junior staff members and on generalists for day-to-day field research. Management must support these people so that they are not cast in the role of mere low-status, testers of technology. This is important so that the knowledge they gain from their direct contact with farmers can be used in the programming and evaluation of the broader research programme.

Sustain Social Scientists in Field Research : In general, social scientists are a scarce resource in most NARS. Unless their ongoing participation in on-farm research gets high priority, able senior professionals tend to get drawn off into planning departments, the preparation of proposals to foreign donors and other functions. There is strong evidence that social scientists should participate as regular, on-going members of AOOFR programmes. They help to maintain focus on the dynamic problems of small farmers and to prevent AOOFR from slipping into routine on-farm testing.

Need for Training : Continuous training must have high priority, both to broaden the skills of the field staff to do inter-disciplinary research and to train new scientists and technicians as they join the programme.

AOOFR — Experiment Station research Integration

On-farm research should complement the work done on experiment stations because an AOOFR programme cannot survive as a stable component of a research system if it operates in isolation. In theory, researchers in each programme should provide their colleagues with information and services vital to the achievement of their common goals; the generation and transfer of technology appropriate to the needs of small farmers with limited resources. This may seem self-evident, but many programmes have not been able to maintain productive interaction between scientists working on-farms and those on experiment stations.

Scientists Responsible for both On-station and On-farm Research : When the same scientists are responsible for both on-station and on-farm research, linkage is obviously not an issue. Such cases, face two different kinds of problems. The first has been the organization and subsequent logistical support of many separate research activities. The second problem has been the maintenance of a broad audience-oriented perspective.

The ISNAR experiences show that the following mechanism promote integration between on-farm and on-station research which is another bottleneck. These mechanisms provide opportunities for interaction, mobilize resources to facilitate the process and create incentives for the scientists to participate.

(i) Joint participation in priority setting, planning and review of programme;

(ii) Formal collaboration on-trials and surveys;

(iii) Assignment of responsibilities for coordination; and

(iv) Formal guidelines for allocating time and funds.

Farmers Participation in On-farm Research : One of the principal goals of on-farm programmes is to involve farmers directly in the research process. Four distinct modes of participation were identified in the ISNAR case-studies (Biggs, 1988). The typology is adapted from one developed by researchers at CIAT (Ashby, 1986). Each plays an important role in different types of research.

Contract Participation : The farmers are given contracts to provide land for trials, as well as field preparation and (in some cases) other labour. The researchers are interested primarily in representative soils and agro-climatic conditions and attempt to maintain as much control as possible over experimental and non-experimental variables. This type of arrangement is widely usd for the testing of new varieties and in soil fertility programmes. The trials often conform to standardized experimental designs, with no active participation of the farmers in the progress. Researchers do not systematically take advantage of the knowledge and experience of the local people.

Consultative Participation : The most common mode of participation is consultative. OFCOR programmes seek to tailor technology to the agro-ecological and the socio-economic constraints facing different groups of farmers. Surveys and meetings are used to identify problems and needs. Then the scientists design on-farm experiments to test alternative solutions. This consultative relationship is analogous to the relationship between doctors and their patients. The degree of farmers' participation is always determined by the researcher. Social scientists are commonly charged with representing the farmers' point of view in the planning and review process.

Another common issue, somewhat surprisingly, has been the low priority placed on procedures for selecting representative farmers as co-operators. Many researchers accept the suggestions of extension agents, take volunteers at meetings, or turn the problem over to junior field staff without adequate guidance. Samples are easily biased in favour of relatively more prosperous or politically active farmers, which means that the results may not be appropriate for resource-poor farmers who are the intended clients.

Collaborative Participation : The farmers are regarded as active partners in the research process. They are involved in regular meetings designed to clarify the logic of both their current practices and their demand for new technology. They participate directly in the planning, execution and evaluation of trials. In several cases, individual scientists used innovative methods to involve farmers in research. Because such methods are not easily codified into standardized procedures, they are the first things to be cut in a budgetary squeeze. In general, it requires constant attention to incorporate new kinds of data from the farm level into an established research system.

Collegiate Participation : It refers to the flow of resources and knowledge in the opposite direction from research-minded farmers, who can be found in every farm community, to research institutions. Although, none were documented in the nine case-studies, there are examples from all over the world that have been developed by farmers and then spread laterally. Strengthening farmers' capacity for informal research and development can be an effective strategy to complement formal research programmes, particularly where farming systems are complex and diverse (Biggs, 1986; Biggs and Clay, 1981).

The Indian experiences of on-farm research attempted by different projects/scientists during the past 3 decades or more show that in the present 'Experiments on Cultivator's Fields (ECF)' and earlier Simple Fertilizer Fields (SFF) and several other earlier programmes, scientists take farmer's fields on contract and manage the trials themselves without any involvement of farmers. The consultative type of farmers' participation in on-farm trials is more often seen in several Operational Research Projects (ORPs); the changed approach of on-farm trials started in 70's only. In the Resource Management ORPs on Watershed approach started only a few years back; the

third type of farmers' participation i.e. collaborative has been used, by and large. We should, however, have no hesitation in admitting the fact that 'Collegiate' participation has not been adopted in our on-farm trials. In fact, it is the type of participation which is most desired and has to be inculcated in our on-farm scientists for development of appropriate technologies for resource-poor farmers.

In this approach farmers participate in identification and prioritisation of problems, management of on-farm trials and evaluation of results. Therefore, the relationship of scientists with farmers should be collegiate or partnership type. This participation is the key to success of this approach in development of appropriate technologies.

Stages

As stated earlier, coherence of the multi-disciplinary team and functional linkages among the personnel/agencies involved in the programme are the two cardinal points in the success of this approach. Since there is no set procedure or approach to ensure these, very careful efforts have to be made in the selection of team of research scientists and in developing a mechanism for linkages of the team with extension personnel and with farming community. This requires that the scientific team should not only possess sound knowledge of their own disciplines but should have more altruistic attitude to their work than is required in the conventional research approach. According to Tripp and Wolley (1989) the process can be divided in the following five stages which overlap each other considerably :

Diagnosis : It involves collection and analysis of information to design on-farm trials. The purpose of this initial activity is to collect enough information to describe the basic features of the area, to identify the problems that limit the farmers' productivity and to consider possible improvements in farmers' practices. The diagnostic activities include review of secondary data, interview with local extension personnel, informal farm surveys consisting farmers' interviews and field observations, and formal surveys with questionnaire.

Planning : The planning stage has six steps to identify the factors to be studied in on-farm trials, as well as to suggest other research activities. The information generated during the diagnostic stage is used to design the on-farm experiments for the first year, whereas in subsequent years results of on-farm experiments may also help in planning future work :

1. Identification of the bio-physical and socio-economic resources of the area. It is to be achieved by the use of secondary data and by different surveys.
2. Identification of problems the limit the productivity of each farming system.
3. Ranking or prioritization of the problems.
4. Analysis of causes of the problems.
5. Analysis of inter-relationships among the problems and causes.
6. Identification of potential solutions to the problems for testing on farmers' fields.

Experimentation : The on-farm trials are to be conducted in the fields of the representative farmers and should include only a small number of experimental variables. These trials are described differently, but progress from exploring production problems, to testing possible solutions verifying recommendations and demonstrating them with farmers. The experimental variables in such trials may represent exploratory factors to serve a diagnostic function and also to contribute to the planning of next cycle of experiments; possible solutions to the problems or some combination of the two. Non-experimental variables are usually set at the level of representative farmers management.

Recommendation and Diffusion : When the research team gets convinced and becomes confident of their research information, in terms of both quantity and quality, they should formulate recommendations. These recommendations should be disseminated to the farmers by the associated extension personnel with skill and confidence as he has been actively associated with the whole technology generation process. The actively participating farmers help more in effective diffusion of new technologies. Proper monitoring of farmers' opinions and use of new technologies also help researchers in improving their understanding of farmers' needs and preferences.

Advantages

The overwhelming advantage of this system's approach is the relevance and 'fit' of the messages generated and all the recommendations to be made to the farmers. Another strength of this approach is the strong linkage between the extension and research agencies and persons among themselves and with their clients i.e. farmers and farm women. Since the technologies so developed are a product of the partnership between farmers, extension agencies and research personnel in this

approach, there is full commitment of farmers to the adoption of the technologies. The pioneer agricultural extensionist of the United States of America, Seaman A. Knapp has rightly said that "What a man sees, he may doubt; what a man hears, he may doubt; but what a man does himself, with his own hands, he cannot doubt" (Bailey, 1945).

Limitations

This approach, though very useful in development of appropriate technologies for unfavourable environments and for resource-poor farmers, has some limitations as well. When teams of agricultural researchers representing a range of discipline are brought together for this approach, the cost becomes high. Further, this approach brings results slowly. It takes time and patience to actually study the farm as a system with all its components in their natural eco-systems. Another weakness in the approach is from the heavy specialisation within the scientific agricultural disciplines. Therefore, the specialists and their specialised societies generally do not support this approach. In the administrative set-up, such approach provides difficulty in reporting and control. Thus, this approach requires innovative administrative support.

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Feature

Food Legume Processing Techniques in India

S.D. Kulkarni

Availability of food legumes (pulses) is decreasing every year owing to stagnant production and continuously increasing population. The possible contribution of processing techniques in improving the availability was judged by analysing the existing pulse milling techniques. Details of various pre-milling treatments, use of edible oil and water during processing, their variation with state, etc. are reported for almost all pulse crops and major pulse growing states. This paper also discusses various approaches for improving the availability of pulses through processing techniques, and prioritises these efforts in order to enhance production.

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Food legume (pulse) production of India has almost stagnated since 1969 varying from 11.5. to 12.5 million tons (Kulkarni, 1988a). The entire production is however not available for human consumption owing to seed requirement, losses, etc. The annual seed requirement of pulses has been estimated to be over 5 per cent of total production (table 1). Handling and transportation losses for foodgrains are found to be in the range of 0.5 to 1.25 per cent for various modes of transport (Srivastava and Ojha, 1988). The transportation loss of about 0.5 per cent is considered reasonable for pulses/dal; storage loss of 7.5% to 10% is reported for food-grains (Kulkarni, 1986; Pingle, 1978), and 9 per cent for pulses; over 10 per cent is lost during milling (Kurien, 1977 and 1979, Kulkarni, 1986). The losses and the seed requirement accounts for nearly 25 per cent of the total production thus bringing down drastically the availability of pulses for human consumption. The estimated per capita is 23.84 g/day (fig. 1) as against the revised daily recommended intake of 45 g (Anon, 1984). Considering the increasing demand due to continuous increase in population and near stagnation in pulse production, efforts were initiated at different levels to increase the availability of pulses through increase in production by developing and using high yielding varieties, proper irrigation and fertiliser use, increased area under pulses and proper post harvest operations. However, the desired results are yet to be achieved. Pulse milling losses of over 10 per cent lower the availability by about 3 g/person/day (fig. 1), which is quite significant a quantity and leaves enough scope for improvement.

Milling

Pulse milling is an age old technology and has reached the present stage as an outcome of trial and error approach from time to time. This appears to be the probable reason for nonuniformity in methods (Kulkarni, 1988a) and machinery adopted (Kulkarni, 1989a) by dal millers of

Table 1 : Area, Production (1987-88) and the Seed Requirement for Pulse Crops

Pulse crop	State	Area ('000 ha)	Percent increase(+) decrease(-) over 1986-87	Production ('000 T)	Percent increase(+) decrease(-) over 1986-87	Seed rate* kg/hr Range	Average	Estimated quantity of seed ('000T) (Col. 3x8)	Percent of Production as seed (At col. 5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tur (Arhar)	All India	3291.7	(+) 4.6	2234.1	(—)1.6	13.6—22.7	18.00	59.25	2.65
	Maharashtra	778.9		372.4					
	Madhya Pradesh	424.5		413.5					
	Uttar Pradesh	508.4		684.3					
Gram	All India	5806.2	(—) 16.9	3621.8	(—) 20.1	27.2—90.7*	50.00	290.31	8.02
	Madhya Pradesh	2240.3		1470.7					
	Rajasthan	684.2		411.2					
	Uttar Pradesh	1417.6		1068.9					
Kharif Pulses other than Tur (Mung, Urd, Moth, Kulthi)		6976.7	(—) 7.8	2123.8	(+) 10.3	11.4—28.4 9.1—13.6 11.4—17.0 —	15.00	104.65	4.93
Rabi Pulses other than Gram (Mung, Masoor, Khesari, Urd, Pea)		5484.6	(+) 0.5	3060.6	(+) 2.7	11.4—28.4 28.4—56.7 11.4—39.7 9.1—13.6	25.00	137.12	4.48
All Pulse	All India	21559.2	(—)7.42	11040.3	(—) 5.7	—	—	591.33	5.36

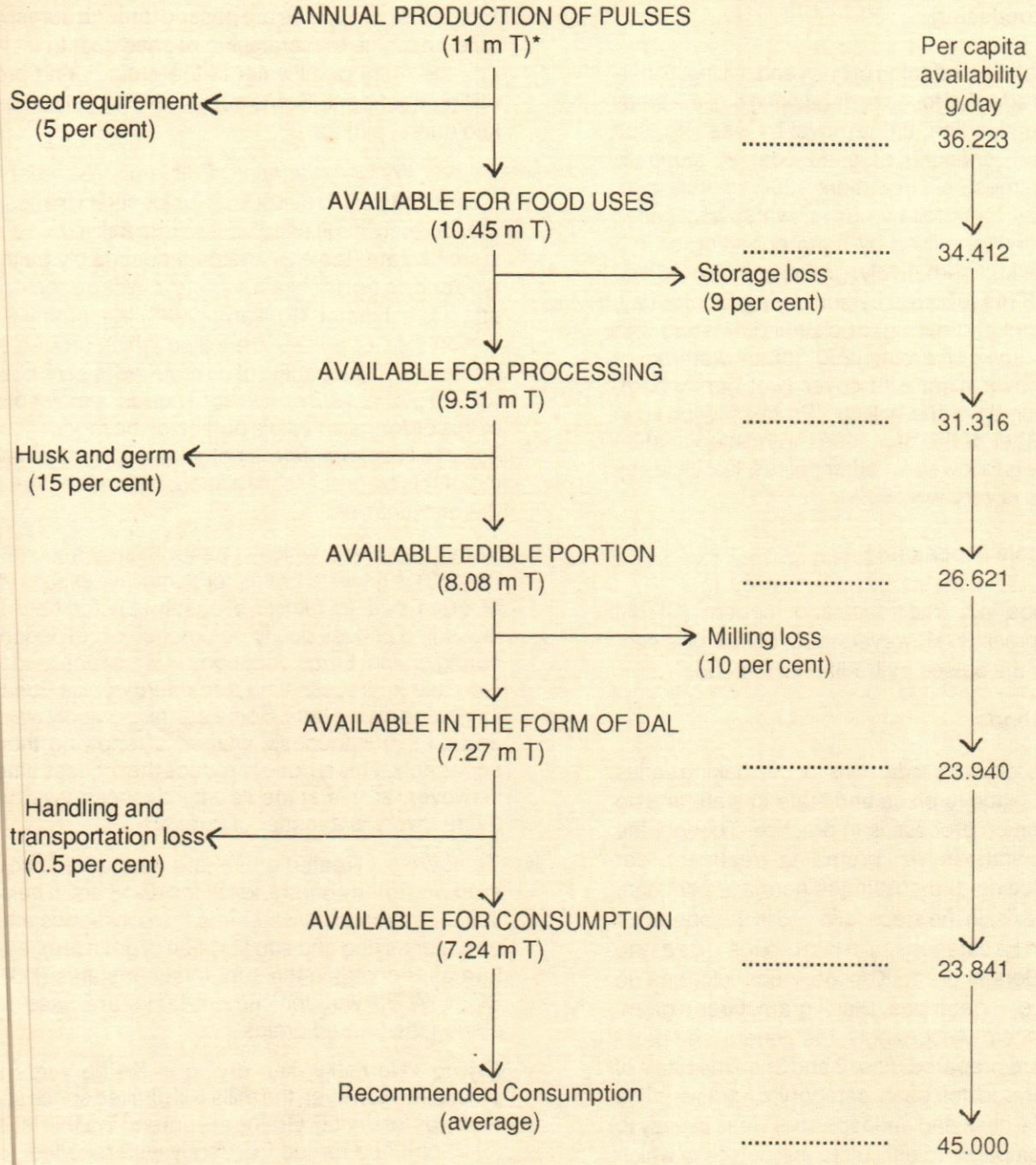
Sources : i. Agricultural Situation in India Vol. XLVI No. 10 p. 919-926, 1990 for area and production (for cols. 3, 4, 5 & 6).
ii. Hand book of Agriculture, ICAR, New Delhi, 1969, for seed rate for pulse crops (col. 7).
Note : i. Seed rate figures converted from lb/acre to kg/ha.
*Seed rate is different for different regions, only upper and lower limits are given and appropriate average value have selected.

different places and regions. In India over 10,000 dal mills of 1 to 50 t/day capacity are in operation at cottage and commercial level. The process and machinery is time consuming, weather dependent and gives considerable losses. To overcome this the CFTRI, (Mysore) developed a set of process and machinery (Kulkarni, 1977) which has not been widely accepted by the millers for various reasons (Kulkarni, 1986). In view of this the detailed information on pulse processing techniques from major pulse growing states was collected and analysed for getting the state of art on this aspect and for deciding possible approaches for improving the availability through proper processing techniques.

Methodology

The pulse processing units (dal mills) from major pulse growing states were contacted for information on pulse processing methods and aspects. A detailed questionnaire dealing with various aspects of pulse processing was prepared and only willing units were actually visited. The information on process followed for each pulse crop was obtained through discussions with the technical personnel working in the mill, and owner of the mill. This included visits to 66 dal mills (63 traditional and 3 modern) spread over different states viz. Uttar Pradesh, Bihar, West Bengal, Orissa, Madhya Pradesh, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Gujarat and Rajasthan. A separate questionnaire was prepared for getting information on home scale processing methods and the help of local persons was taken in states where language was a problem. The information thus collected was analysed to identify the points which could be useful in getting additional dal yield.

Different organisations have carried out a survey at regional/national level at different times and with different objectives (Kurien and Parpia, 1968; Anon, 1977, and 1981; Siripurapu and Jain, 1981, Kulkarni, 1986). It has been reported that the wet method of pulse processing for dal has almost been given up by most of the millers and dry method is commonly followed with state to state variations. Pulses are milled normally for production of dal, roasted products and besan (flour) (Kulkarni, 1987). However, the pulses are mainly consumed in the form of splits (dal) and processed on home scale for production of dal and other products, though the quantity processed is very small, as the major part of the produce is processed on a commercial scale.



*** PRODUCTION FOR 1987-88 IN MILLION TONS.**

FIG. 1 : MATERIAL BALANCE FLOW SHEET FOR AVAILABILITY OF PULSES FOR HUMAN CONSUMPTION IN INDIA (POPULATION : 83.2 CRORES)

Home Scale Processing

It mainly involves loosening of husk and milling. Different methods are adopted for easy dehusking e.g. the steps for arhar include cleaning, dirt removal by washing, sun drying (one day), cracking of seed coat in manually operated stone mills, oil treatment (200 to 400 g/q), keeping in gunny bags for two days, water application (10-20%), sun drying, milling by hand pounding or in a stone mill or chakki. Alternatively, grains are washed and soaked for 2 to 8 hrs followed by sun drying for one day, heaping over night and milling, or cleaning, treating with red earth @ 0.5 kg/kg of grains (250-300 ml water/kg of grain), heaping over night with cover (wet gunny bag), shade drying (one day) and milling. (Process followed in Tamil Nadu). Either of the processes with little variation described above is followed for other pulses. Dal yields by these processes is very low (65%).

Commercial Scale Processing

Two methods viz. traditional and modern (CFTRI method) are in practice. However, most of the mills continue to process the pulses by traditional methods.

Traditional Methods

The process followed in dal mills for dal making varies from mill to mill, place to place and state to state and no standard or common process is in practice. Though, the sequence of operations viz. premilling treatment, dehusking, conditioning and splitting is normally common, large variations exist in the steps followed in the operation itself. Pulses can be categorised in two groups : (i) easy to mill e.g. Lentil, Bengal gram, Khesari, Peas, etc. and (ii) difficult to mill e.g. Pigeon pea, Black gram, Green gram, Beans, Cow pea, etc. Accordingly, the generalised process flow charts are prepared (figs. 2 and 3) on the basis of information analysed for each category of pulses. The bond between the husk and endosperm is weak in easy to mill pulses as compared to difficult to mill pulses in which a gummy layer holds them firmly together.

Process Unit Operations

i. *Cleaning and Grading :* Raw material is cleaned by removing dust, dirt, foreign material, off sized, immature and infested grains and graded in two to process separately. The dockage varies from 2 to 5 per cent and depends on pulse crop, season, etc.

ii. *Pitting :* Whole pulses are passed through abrasive roller machine for scratching of seed coat to facilitate the entry of oil/water in the grain during premilling treatment. Some seeds (2-5%) get dehusked during pitting.

iii. *Oil and Water Treatment :* Edible oil treatment is given to difficult to mill pulses for loosening of husk. The quantity of oil used varies from mill to mill and state to state (table 2) and depends mainly on the type and size of the grain, variety, moisture content, etc. It is estimated (Kulkarni, 1986) that nearly 6.4 million tons of pulses are milled which require oil treatment. The quantity of oil required is estimated (@300 g/q) at 19.2 million kg. Though, a major part of this oil forms an edible portion of the product, the actual oil consumption is not affected. Hence, saving of this by process modification/development is the only answer.

Water treatment, which varies with crop and state (table 3) is given to grains for achieving expansion of grain due to moisture absorption for help in loosening of husk due to contraction of cotyledons during drying. Large variations in water use lead to increase in process time and energy costs due to increased drying time. Some dal millers apply water and oil simultaneously instead of applying them separately. This is done to reduce the process time. However, at this stage its effectiveness *vis-a-vis* dal recovery is a matter of guess.

iv. *Tempering :* Treated grains are heaped and covered with gunny bags and left for 12-18 hrs. It helps in penetration of oil/water into the cotyledons after oil/water mixing and equilibration of grain temperature after drying in the sun. In some states (U.P., Bihar, W.B.) wooden/cement tanks are used for storing the treated grains.

v. *Drying :* Normally, sun drying in drying yards is practised. However, the mills with limited space use roof tops for drying. Grains are spread in a thin layer (3-10 cm) and turned frequently with rake/feet for even drying. Dal millers in Gujarat prefer thick layers (upto 15 cm) of grains in the drying yard for reasons of quality improvement. The drying period for grains varies from 1 to 5 days depending on weather conditions, thickness of layer and pulse crop. Size of the drying yard depends on the capacity of the mill (Kulkarni, 1989a), availability of land and recommendation of manufacturer. Some millers avoid drying or reduce drying time and mill the pulses only after tempering for 8-12 hrs which

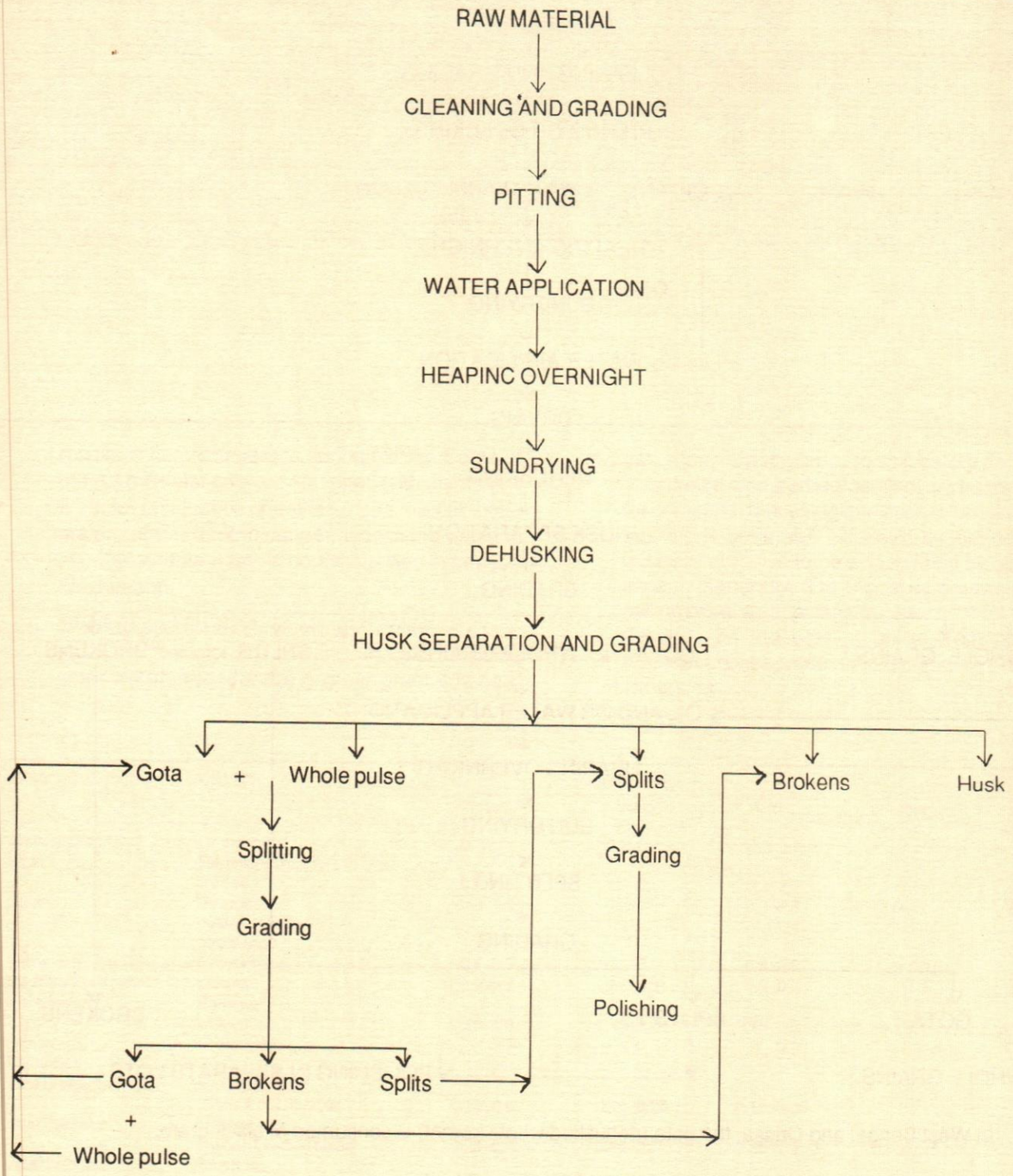
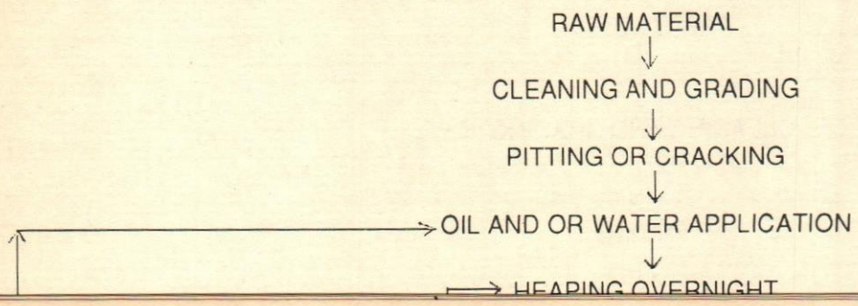


FIG. 2 : PROCESS FLOW CHART FOR MILLING OF EASY TO MILL PULSES (LENTIL, BENGAL GRAM, PEAS, ETC.)
(Source : Kulkarni, 1986)

Madhya Pradesh	2-5	3-3.5	3-3.5	3	1.5-10	2.25-3
Maharashtra	3-30	2-19	2-5.5	3-10	3-22	3.25
	(0.5-1.5)	(0.5-1.5)	(0.5)	(0.5-1)	-	-
Orissa	4	8	4	-	4	-
Rajasthan	-	-	-	-	10-12	-
Tamil Nadu	3-9(1)	3-4	3-4	-	5	-
Uttar Pradesh	2-18(0.5)	6	6	-	2-14(0.2)	2-4(0.2)
West Bengal	-	2	2	-	-	2

Notes: 1. Figures in parentheses indicate per cent water use in polishing.
2. In Uttar Pradesh 1-4 lit water per quintal is used for pea milling.
3. In Bihar and Madhya Pradesh 1-2 and 2.5 per cent water is used respectively during milling of khesari and 0.25 per cent is used for khesari dal polishing in Madhya Pradesh.
(Source : Kulkarni, 1986)



Feature

Milled Pulses : Availability, Constraints and Prospects

K. M. Sahay

For the vegetarian people of India pulses are the main source for proteins, but the availability of pulses has gone down in past decades. To increase the dal production some measures like the need to optimise pretreatment processes and milling equipment may be considered. Also emphasis may be given to milling of pulses just after harvest and storage of dal rather than storage of whole grains. This paper discusses the constraints and prospects of milled pulse availability.

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In India, with a predominantly vegetarian population, pulses play an important role in meeting the protein requirements. India is the largest producer of pulses in the world, the annual yield is 12 million tonnes. Pulses are consumed mostly in the form of dal. Nearly 75% of total legume production is converted into the decorticated and split form of dal.

The availability of milled pulses or dals has been reduced considerably, partly due to population increase and partly to stagnation in production of pulses. In 1961 availability of dal was 69 g per day per person which has come down nearly to 39 g per day per person in 1989. The World Health Organisation after considering Indian food habit has recommended 80 g per day per person. Variety, agronomic conditions of pulses production, the seed size, its maturity and uniformity are few factors which influence the production. Improper conditioning of pulses cause lower yeilds of dal by 10 to 20 per cent. Considerable amount of breakage and powering of the kernel occurs in dehusking and during milling operations. The efficiency of conversion of legumes to dal by traditional wet-dry methods of milling is low.

Milling of edible legumes for the production of dal is an age old process in our country. There are more than 10,000 pulse mills with average processing capacity of 10-20 tonnes/day. Milling procedures vary widely from place to place. The recovery of dal varies from 60 to 75 per cent depending upon the type of pulses and techniques adopted by the millers (Singh, et al, 1982). There is no standard process for milling different pulses.

Problems faced by the pulse milling industries :

(i) Batch process which is presently used involves excessive material handling which can be reduced by introducing continuous processing sytem.

(ii) Sun drying is not reliable and causes mill down time to 3 months. A mechanical drying system which runs on non-conventional fuel is needed.

iii) Improved marketing systems where the millers can purchase cleaned and graded raw materials. It may reduce the cost of processing.

(iv) Standard conditioning process and equipment is required to improve recovery of dal.

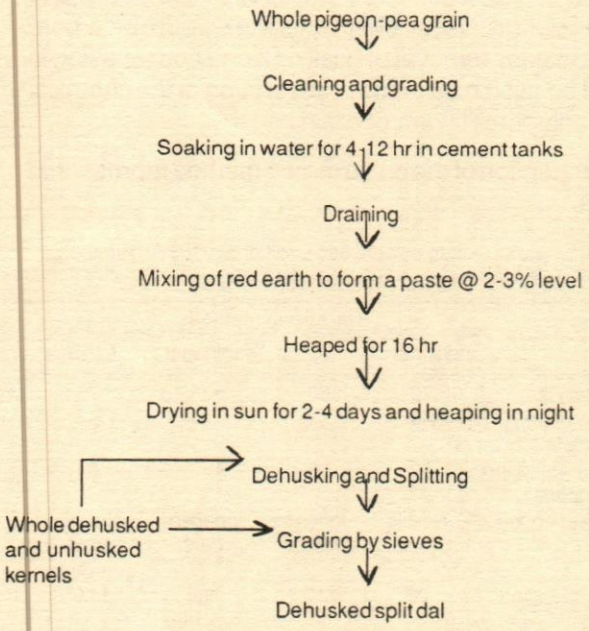
(v) Separation of gota (whole dehusked kernel) from pulse grain after it passes through the abrasive roller. This will lead to reduction in powdering of grains in repeated passes through energy rollers.

(vi) Dust collecting and diffusing devices.

Dal Milling Methods

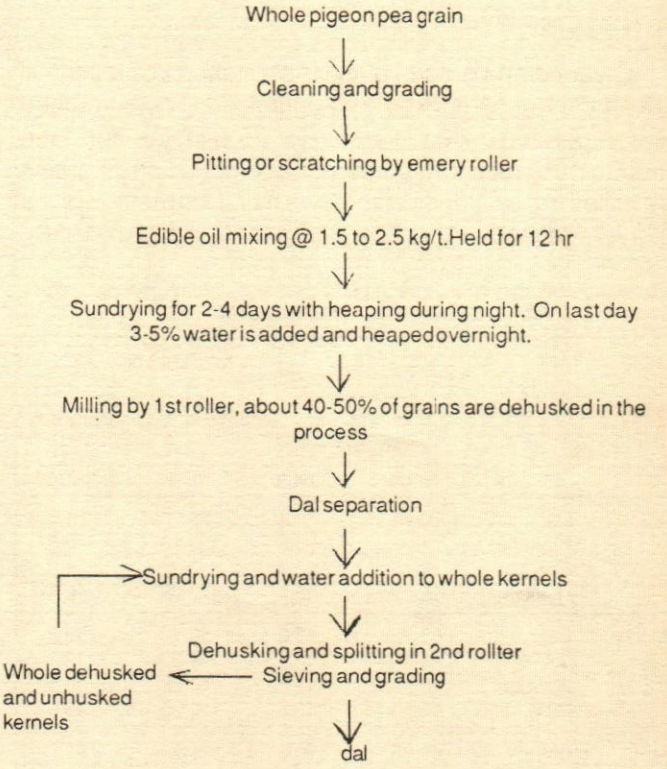
(i) *Wet Milling*

This method of processing being adopted by comparatively smaller units is especially popular in South India. The milling a uality and taste are good, but milled dal requires more cooking time for same degree of dispersion. It depends on the period of steeping which varies between 6-12 hours. Longer steeping period also causes caving in of the cotyledons. This method is dependent on good sunshine and with better facilities may process upto 6-7 tonne grains per batch.



ii) *Dry Milling*

Dry method of milling is practiced in Central and North India. In some mills dehusking and splitting are done simultaneously while in other mills these are performed separately. In roller mills usually 4-5 passes are given for complete removal of husk and splitting. Addition of oil during conditioning varies from 150-500 q./q. It has been reported that the expenditure on oil alone constitutes about 38% of the processing cost (Saini, 1981). This method also requires good sun shine and it is a batch type of operation.



(iii) *CFRT Method*

This method eliminates mixing of oil and water for loosening of husk. It is claimed that it can give average yield of 80% dal in less time and also at a lesser processing cost. Clean and graded grains are conditioned by heat treatment in two passes in LSU drier with 120°C hot air. In between the grains are tempered for 6 hours. The whole dehusked and unhusked grains are mixed with water and tempered. Such conditioned grains are aerated with hot air for few hours. Then the gota are split in an emery roller. The operation is continuous and carried indoors. The dehusking is done by roller mills, and it was reported to be 93-100 per cent in single pass. The process is commercialised (Kurein, 1983).

(iv) *Pantnagar Process*

In this process the pigeon pea grain are cleaned and graded then these pass through an emery roller mill for scratching of grains. After mixing the scratched grain in 10% sodium bicarbonate solution it is then tempered for 4 hours in shade and later under sun in 9.5% moisture content. After milling in a concentric cylinder roller mill (Saxena, et at, 1990) the product is cleaned and graded with the help of blower, cyclone separater and reel

graders. It is reported that this process gives 80% recovery of dal.

v) *CIAE Process*

Cleaned and graded pulse is scratched in a roller mill whose clearance is fixed and optimised. The scratched pigeon pea is soaked in water for 30 minutes and then dried to 10% moisture content. Such conditioned grains are milled in a cylinderical abrasive mill. This method gives an average recovery of 75% dal (Sahay and Bisht 1988).

Table 1 : Milling recoveries of pigeon-pea by traditional milling processes in MP, Maharashtra & UP

State	Milling factors %	Milling techniques: Commercial large scale dal mill		Small scale dal mill (Village Chakki)	
		range	mean	range	mean
M.P.	Dal	60-75	71.4	50-70	61.6
	Brokens	2-8	3.6	5-18	10.5
	Powder	12-15	13.0	7-22	11.0
	Husk	5-22	12.4	10-25	16.5
Maha-rash-tra-	Dal	65-72	68.0	50-70	59.0
	Brokens	4-10	5.8	8-20	12.0
	Powder	10-15	12.6	10-20	13.5
	Husk	10-20	13.4	12-20	15.0
U.P.	Dal	60-85	70.6	50-80	62.0
	Brokens	2-10	4.1	5-20	10.2
	Powder	9-18	12.7	7-20	13.0
	Husk	10-25	12.9	10-25	14.4

Source : Singh and Jambunathan, 1982.

Table 2 : Roller passes required to mill the pulses and recovery of dal and by products in traditional dal mills.

Pulse	Roller passes	Dal recover %	By products %
Pigeon-pea	3-6	68-72	20-24 Chuni 4-5 Husk 3-5 Gajra 1-3 Soil
Bengal gram	1(heavy)	75-70	6 Chuni 10-12 Husk 4-5 Gajra 2-4 Soil
Black gram/ Green gram	4-8	65-70	18-22 Chuni 7-10 Husk 2-4 Gajra 2-4 Soil
Lentil	1-2	78-80	7-8 Chuni 8-12 Husk 2-4 Gajra 3-4 Soil

Source : Singh & Singh, 1981.

Insects, rodents and micro organisms cause nearly 80% of the loss during storage period. Pulses are reported to be more prone to damage by insects as compared to wheat, paddy and maize.

Bag storage of pulse causes more damage than bulk storage, also the utilisation of storage capacity in bag storage is limited to 55-60 per cent while it is 90-95 percent in case of bulk storage. But the bag storage is flexible and requires lower capital cost.

Vegetable oils like coconut, mustard, linseed and groundnut have good protective qualities against pulse beetles. The oil is mixed up at the rate of 500 g per 100 kg of dal and it can be stored for 5 to 6 months without any damage. (Birewar, 1982).

The wet milling method is labour consuming, while the drymilling method requires increased number of dehusking and handling operations resulting in more breakage and powdering of pulses.

Though the CFTRI method is an improved one, it requires high electrical loads and specialised persons to operate the plant. Use of chemicals like sodium bicarbonate helps in easy removal of husk, but one hour soaking in chemical solution may result in absorption of the chemical by husk and outer layers of grain.

A comparison of the pulse milling method is presented in table 3.

Table 3 :Comparative studies between traditional, CFTRI, Pantnagar and CIAE methods of piegon-pea milling

Parameter	Dal milling methods: Traditional	CFTRI	Pantnagar	CIAE
Dal recovery,%	65-72	80	80	75
Processing time for one batch, days	4-8	1	1	2-3
Energy consumption, Kwh/tonne	60	85	45	35
Weather dependence	Needs good	Indepen-dent	Indepen-dent	Needs good sun shine
Cost of processing Rs./q.	20	17.2	Not reported	14.0
Dal quality	Good	Good	Good	Good

Although the dal yield varies from one milling unit to another, depending upon the processing methods used, pigeon pea of uniform seed size and shape are reported to reduce losses. The factors that affects the pigeon pea dal yield is given in table 4.

Whole grain stored over a longer period is also reported to give lower dal yield as compared with fresh grain.

Table 4 : Some factors that influence dal yield and consumer acceptance of pigeon pea (Per cent response)

Factors	Dal yield		Consumer acceptance
	Large scale miller	Small scale miller	
1. Crop			
Variety	n.r.	45	74
Location	40	25	65
Maturation	20	30	70
2. Grain characteristics			
Size	84	55	50
Shape	72	45	n.r
Colour	50	42	60
Texture	65	40	55
3. Storage period (More than 6 months)			
Dal	n.r.	n.r.	76
Whole grain	40	68	70
4. Pretreatment			
Oil	100	30	25
Water	100	85	36
Salt Solution	n.r.	25	30
5. Milling operation			
Roller/Chakki	8 0	20	n.r.
Abrasion type	100	25	n.r.

n.r. = Not relevant

Source : Singh & Jambunathan, 1982.

Dal milled from freshly harvested pigeon pea was observed to taste better than dal obtained from pigeon pea stored for a long period. Considering the above constraints it would be profitable to have dal milling industry installed between a group of villages. It will enable milling of pulses soon after harvest It will necessitate storage of dal rather than whole grains. Dal have better storage life than whole grains although proper protective measures have to be taken.

Conclusion

Availability of dal can be increased by cutting losses at processing level. There is need and scope for modernisation of dal milling to obtain higher yields and optimisation of pretreatment processes. Dal mills should be installed between group of villages to avoid losses occuring due to storage of whole grains.

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Feature

Role of Agro-Forestry in Optimising Tribal Resource Productivity

J. S. Guleria, S. C. Tewari & R. K. Sharma

The introduction of agroforestry coupled with new techniques of production showed spectacular changes in the cropping pattern. With the additional availability of labour and capital there was a shift in the cropping pattern and more area was allocated to willow and potato cultivation. The marginal value productivities of labour and capital were equal to the wage rate and rate of interest' respectively, showing that these resources were required in addition to existing levels. The negative MYPs of barley and peas implied that their cultivation was unprofitable in the area. The farm income too, increased substantially with the introduction of agroforestry. It is, therefore, advocated that to gear up the pace of overall development in the area, agroforestry needs to be taken up.

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In the post-independence period, the stress in Indian economy has been towards growth oriented development therefore, there was a thinking that agriculture should be harnessed first. However, the agricultural development has not been uniform. Many regions particularly the tribal ones remained out of focus for most part of the planning period. It was only after the Fourth Five Year Plan that stress was laid on balanced regional development with special emphasis on tribal belts.

We may take the case of Lahaul-Spiti, a tribal district of Himachal Pradesh, where the type of cultivation is entirely different from rest of the state. Although the soil is fertile, it is very loose, it makes cultivation quite difficult. Sometimes, even irrigation causes soil erosion owing to very poor vegetation growth.

From May to September, River Chanab which flows in this district gets heavily loaded with silt causing flash floods. At times the silt has risen to a high 34.27 gm per litre of water. The situation can be improved by growing trees on slopes, village lands and along the field bunds. Growing multipurpose trees (i.e. fuel, fodder, fibre, etc) on field bunds will be more appropriate as this would ensure the availability of water to the plants, as the fields in the area are connected with irrigation channels. Water which is easily available, would also enhance the chances of success of the plantation without any additional labour. The more viable alternative to the existing practice is to adopt improved package of agroforestry techniques in the cropping pattern. This is not only expected to strengthen farm incomes but would also improve the resource productivities at the farm level. This is particularly important as the extensive cultivation resorted to would result in soil erosion. The present study was undertaken with following objectives :

1. To work out optimum cropping pattern with or without agro-forestry.
2. To examine the changes in the resource productivities with or without agro-forestry.

3. To study the variations in the level of income with or without agro-forestry.
4. To suggest suitable policy measures.

Methodology

Lahaul and Spiti district of Himachal Pradesh was subdivided into two different zones namely Lahaul (zone I) and Spiti (Zone II). Since these areas lie in different climatic and geographical situations, 10 villages in zone I and 3 villages in zone II were randomly selected. The farmers in the selected villages were categorised into small, (less than 1.22 ha), medium (1.22 ha to 2.52 ha) and large farmers (greater than 2.52 ha) on the basis of size of holding using cumulative cube-root frequency method. In all 102 farmers in zone I comprising 49, 31 and 22 farmers in small, medium and large category were selected. The corresponding figures for zone II were 14, 12 and 10.

Linear programming technique was used to work out the optimum cropping pattern and resource productivities. The model used was of the following form :

$$\text{Max. } Z = \sum_{j=1}^{n} C_j X_j$$

s.t.

$$\sum a_{ij} X_j \leq b_i \qquad i = 1, 2, \ldots . m.$$

$$j = 1, 2, \ldots . n.$$

$$X_j \geq 0$$

Where

- Z = Total returns to fixed farm factors
- Xj = Level of Jth acttivity
- Cj = Net returns per hectare over cash expenses for j^{th} activity.
- bi = Availability of ith resource
- aij = Amount of i th resource required by jth activity per hectare.

Following resource restrictions were considered for the present study :

Plan - I —Existing resources with existing level of technology.

Plan - II —Existing resources with modern farm technology along with borrowing-in of capital and hire-in/out of labour.

In addition, agro-forestry was added under each plan for all the groups of farms.

Thus in all following twelve farm categories were studied :

Category	Zone I		Zone II	
	Without agroforestry	With agroforestry	Without agroforestry	With agroforestry
Small	A-1	A-II	D-I	D-II
Medium	B-I	B-II	E-I	E-II
Large	C-I	C-II	F-I	F-II

Salix alba (willow) and Populus ciliata (Poplar) were identified *ex ante* as the suitable tree species for agro-forestry purpose. This was based upon interviews with local forest officials as well as forestry scientists at the University of Horticulture and Forestry, Solan (H.). The tree species selected have been considered to be grown on the bunds of the cultivated fields for purpose of estimating costs and returns. The cost and returns per hectare have been estimated assuming the life cycle of willow plant to be 20 years. The annuity value has been worked out as follows :

$$A = \frac{P}{\sum_{t=1}^{n} \left(\frac{1}{1+r}\right)^t}$$

Where

- A = Annuity valve
- P = Present valve of net annual returns from the project.
- r = Rate of interest
- n = Life of the project in years.

Due to growth of tree(s) on the bunds, the losses to the crops have been estimated to be 10 per cent of the potential yield in the area.

Results

The optimum cropping pattern of small, medium and large farms under Plan I of both the zones has been given in table 1. It can be seen that agro-forestry did not enter the optimum plan on small farms of both the zones mainly because of lack of capital in these farms. On medium farms in zone I, with the introduction of agroforestry the per cent area under potato (HYV) decreased and the left out area was substituted by potato and willow. However, there was no change in the pattern of area in B-II under wheat (HYV); barley and peas as compared to B-I situation. On large farms in zone I, the area devoted for agroforestry was quite low while barley accounted for the largest area under both the situations. Similar trend was observed for zone II

except that the agroforestry was not found to be important in the case of these farms. The preceding analysis, thus, suggests that the farm resources could be better utilized with the introduction of agroforestry. In zone II, the farmers were not in a position to introduce this activity in their cropping system mainly because of capital constraint.

The optimum cropping system under additional availability of labour and capital alongwith modern techniques of production has been summarised in table 2. The results reveal that under all the farm situations under study, the local varieties of all the crops have been replaced by the recommended varieties. Potato (R) has been found to be most profitable, occupying the largest area in all the situations. Both the cereals, i.e. wheat and barley have been given the least importance. Due to additional availability of capital and labour, the agroforestry has been introduced for all the situations covering more than 26 per cent area of large farms. The area under agroforestry increased with the increase in farm size.

The analysis of cropping system reveals that although the existing technology led to better utilization of farm resources, the introduction of new techniques of production showed spectacular changes in cropping pattern. The agroforestry not only utilized the existing resources but also required additional resources. In addition to this, the agroforestry is likely to provide fuel and fodder to the cultivators and reduce the burden on forests of neighbouring districts from where the fuel wood is imported.

Marginal Value Productivities of Resources

The analysis of marginal value productivities of resources in Plan-I shows that the MVP of land increased marginally with the increase in farm size in zone I (table 3). In zone II, it can be observed that the land was not fully utilized on medium and large farms as indicated by zero MVPs. This can be attributed to lack of capital and labour in these farms. The minimum restriction for barley indicated negative MVP which shows that the net returns could be increased if restriction of barley cultivation is removed. The productivity of capital has been estimated to be greater than one under all the situations. The restriction for potato was found to be important on small farms in zone II only. The labour productivity has been found to be zero in general except for medium and large farms in zone II. This implies that the labour was surplus in these farms. The results reveal that with the introduction of modern technology (Plan-II), the marginal value productivities of

Table 1 : Optimum Resource Allocation (Plan-I) for Different Categories of Farms in Lahaul & Spiti Districts of Himachal Pradesh

Crops	Zone I						Zone II					
	Small		Medium		Large		Small		Medium		Large	
	A-I	A-II	B-I	B-II	C-I	C-II	D-I	D-II	E-I	E-II	F-I	F-II
Potato(HYV)	41.03	41.03	44.93	27.54	34.46	34.46	58.06	58.06	36.15	52.53	13.42	13.42
Whear(HYV)	43.59	43.59	26.08	25.08	25.21	16.81	16.13	16.13	18.07	18.07	22.15	22.15
Barley	15.38	15.38	23.19	23.19	35.29	35.29	25.81	25.81	45.78	45.78	46.98	46.98
Peas	-	-	5.80	5.80	5.04	5.04	-	-	-	-	17.45	17.45
Willow+ Potato	-	-	-	17.39	-	8.40	-	-	-	3.62	-	-
Total [Cropred area (ha)]	0.39	0.39	0.69	0.69	1.19	1.19	0.31	0.31	0.83	0.83	1.49	1.49

Table 2 : Optimum Resource Allocation (Plan-II) for Different Categories of Farms in Lahaul and Spiti Districts of Himachal Pradesh

Crops	Zone I						Zone II					
	Small		Medium		Large		Small		Medium		Large	
	A-I	A-II	B-I	B-II	C-I	C-II	D-I	D-II	E-I	E-II	F-I	F-II
Potato (R)	46.15	46.15	42.03	42.03	36.14	36.14	54.84	48.39	40.91	40.91	23.48	23.48
Wheat (R)	10.26	10.26	10.14	10.14	8.40	8.40	9.68	9.68	18.10	13.63	17.39	14.35
Barley(R)	15.38	15.38	23.19	23.19	27.73	27.73	12.90	12.90	20.00	20.00	30.43	30.43
Peas(R)	28.21	12.82	10.14	5.80	27.73	1.68	22.58	12.90	20.91	3.64	28.70	4.78
Willow+Potato	-	15.39	-	18.84	-	26.05	-	16.13	-	21.82	-	26.96
Total Cropped area (ha)	0.39	0.39	0.69	0.69	1.19	1.19	0.31	0.31	1.10	1.10	2.30	2.30

(R) - Stands for recommended improved varieties.

Table 3 : Marginal Value Productivities (Plan-I) of Various Resources for Different Categories of Farms in Lahual and Spiti Districts.

Resources	Zone I						Zone II					
	Small		Medium		Large		Small		Medium		Large	
	A-I	A-II	B-I	B-II	C-I	C-II	D-I	D-II	E-I	E-II	F-I	F-II
Land	403	403	581	597	594	594	463	463	-	-	-	-
Labour I	-	-	-	-	-	-	-	-	13	13	22	22
II	-	-	-	-	-	-	-	-	-	-	-	-
III	-	-	-	-	-	-	-	-	-	-	-	-
Capital	1.21	1.21	1.98	2.12	1.69	1.98	1.66	1.66	-	-	-	-
Potato(Max).	-	-	-	-	-	-	1,143	1,143	-	-	-	-
Barley(Min)	–2,000	–2,000	–710	–515	–718	–718	–608	–608	-	-	–1,285	–1,285
Peas(Min.)	-	-	-	-	-	-	-	-	-		-	

Table 4 : Marginal Value Productivies (Plan-II) of Various Resources for Different Categories of Farms in Lahual and Spiti Districts.

Resources	Zone I						Zone II					
	Small		Medium		Large		Small		Medium		Large	
	A-I	A-II	B-I	B-II	C-I	C-II	D-I	D-II	E-I	E-II	F-I	F-II
Land	6,279	9,482	6,279	9,482	6,279	9,404	6,439	9,824	6,239	9,404	6,239	9,404
Labour Period												
I	10	10	10	10	10	12	-	-	12	12	12	12
II	-	-	-	-	-	-	10	10	-	-	-	-
III	-	-	-	-	-	-	-	-	-	-	-	-
Capital	0.26	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Potato (Max.)	-	-	-	-	-	190	-	-	5,354	190	5,354	190
Barley (Min.)	–772	–5,975	–772	–5,975	–772	-5,937	-766	-6,157	-772	-5,937	-772	-5,937
Peas (Min.)	-	-5,203	-	-5,203	-	-5,164	-	-5,380	-	-5,165	-	-5,164

all the resources showed a marked change (table 4). The MVP of land increased further when the agroforestry was introduced. The MVP of labour and capital was estimated to be equal to wage rate and interest rate, respectively. The minimum restrictions for barley and peas indicate that there was substantial scope for enhancing farm income if these restrictions were lifted particularly under agroforestry conditions.

Farm Income

The farm income under both the plans and zones for all the categories of farms is shown in table 5. An examination of table reveals that the per hectare farm income on A-I situation increased from Rs. 4,673 in Plan I to Rs. 7,407 in Plan II, showing an increase of about 59 per cent. Introduction of willow in the cropping system of small farms increased the farm income by more than 11 per cent under plan II. Similar trend could be observed for zone II situation. On medium farms (Zone-I), it can be seen that agroforestry led to about 10 per cent increase in farm income under plan I while the corresponding value for zone II was about 7 per cent. Agroforestry led to substantial increase in farm income when new techniques of production were adopted (Plan II). The analysis of table 5 further shows that in zone II, agroforestry was not introduced under plan I on large farms. Thus the farm income remained the same whereas under plan II, the agroforestry caused an increase in farm income upto 28 per cent. The corresponding figure for zone I was estimated to be about 22 per cent.

Table 5 : Farm Income per Hectare of Various Categories of Farms in Lahual and Spiti district of Himachal Pradesh.

Category	Zone	Plan I		Plan II	
		Without agrofor-estry	With agrofor-estry	Without agrofor-estry	With agrofor-estry
Small farm	I	4,673	4,673	7,407	8,231
	II	5,337	5,337	8,023	8,565
Medium farm	I	4,883	5,367	6,940	7,982
	II	4,435	4,725	7,693	7,899
Large farm	I	3,852	4,536	6,545	7,962
	II	3,400	3,400	5,682	7,251

Thus the results indicate that the introduction of agroforestry in both the valleys led to significant rise in farm income which is likely to be spent on the farm and thus a regular flow of capital formation can be expected.

Conclusion

The introduction of agro-forestry led to significant change in the cropping pattern. The modern technology was found to be more profitable than existing crop practices. Barley, which was the most important crop under existing technology, was the least important under adequate supply of labour and capital. This caused substantial changes in marginal value productivities of both the resources. The MVPs for labour and capital were equal to their wage rate and rate of interest, respectively showing that these resources were required in addition to existing levels. The cultivation of barley and peas was found to be unprofitable as indicated by negative MVPs. The farm income, too, increased with the introduction of agro-foresty. It is, therefore, suggested that to enhance the pace of overall development in the area, agro-forestry needs to be taken up on a large scale. For this additional supply of capital and labour should also be ensured so that maximum benefits can be reaped by the cultivators of the area.

□

TEN PILLARS OF ECONOMIC WISDOM

1. Nothing in our material world can come from nowhere or go nowhere, nor can it be free: everything in our economic life has a source, a destination, and a cost that must be paid.
2. Government is never a source of goods. Everytthing produced is produced by the people, and everything that government gives to the people, it must first take from the people.
3. The only valuable money that government has to spend is that money taxed or borrowed out of the people's earnings. When government decides to spend more than it has thus received, that extra unearned money is created out of thin air, through the banks, and, when spent, takes on value only by reducing of all money, savings and insurance.
4. In our modern exchange economy, all payroll and employment come from customers, and the only worthwhile job security is customer security: if there are no customers, there can be no payroll and no jobs.
5. Customer security can be achieved by the worker only when he cooperates with management in doing the things that win and hold customers. Job security therefore is a partnership problem that can be solved only in a spirit of understanding and cooperation.
6. Because wages are the principal cost of everything widespread wage increases, witthout corresponding increases in producttion, simply increase the cost of everybody's living.
7. The greatest good for the greatest number means, in its material sense, the greatest goods for the greatest number, which in turn, means the greatest productivity per worker.
8. All productivity is based on theree factors: (1) natural resources, whose form, place and condition are changed by the expenditure of (2) human energy (both muscular and mental), with the aid of (3) tools of some sort.
9. Tools are the only one of these three factors that man can increase without limit, and tools come into being in a free society only when there is a reward for the temporary self-denial that people must practice in order to channel part of their earnings away from purchases that produce immediate comfort and pleasure, and into new tools of production. Proper payment for the use of tools is essential to their creation.
10. The productivity of the tools, that is, the efficiency of the human energy applied in connection with their use, has always been highest in a competitive society in which the ecomomic decisions are made by millions of progress-seeking individuals rather than a state-planned society in which those decisions are made by a handful of all powerful people, regard less of how well-meaning, unselfish, sincere, and intellingent those people may be.

—Thomas.P. Fuller

Feature

A Sugarcane Supply Model - An Econometric Study

D. K. Grover

The sugar industry in the country was plagued by instability arising out of variations in sugarance production on the one hand and the presence of a more competitive gur and khandsari industry on the other. In most of the earlier studies, effort has been to identify the various factors responsible for the fluctuations in area under sugarcane but little effort appeared to have been made to examine the factors causing fluctuations in sugarcane supplies to the sugar factories and the related changes in other sweetening agents. In this paper, a simultaneous equation system has been developed, which enables the planners to enhance the efficiency of suger industry even at the existing level of area under the crop.

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The sugarcane industry in the country is plagued by instability in sugarcane supplies to the factories. There were periods when the sugar factories failed to get adequate quantities of sugarcane and had to virtually run after the sugarcane growers for getting cane supplies. On the other hand, there were many instances when the sugarcane growers had to beg for cane indents for the disposal of their cane.

In most of the studies, effort has been made to identify the various factors responsible for the fluctutations in area under sugarcane but little effort appeared to have been made to examine the factors responsible for the fluctuations in sugarcane supplies to the sugar factories and the related changes in other sweetening agents. It is worth mentioning that only about one third of the sugarcane production was supplied to the sugar factories whereas remaining two-thirds of cane output was used for gur and khandsari units. This implied that the efficiency of sugar industry could be sufficiently enhanced even at the existing level of area under the crop, provided a judicious use of existing sugarcane production is ensured.

It is, therefore, important to examine the factors responsible for fluctuations in sugarcane supplies to the factories. The present study is an attempt in this direction. The study is confined to Punjab State only, where sugar industry is becoming important. The specific objectives of the present study are :

1. To identify the various price and non-price variables responsible for the instability in sugarcane supplies to the sugar factories.
2. To suggest measures that would help stabilise the sugar economy in the country.

Material and Methods

To accomplish these objectives, the secondary data on important variables such as sugarcane production, supplies to the sugar factories, installed crushing capacity

of the factories, production and stocks of sugar, prices of sugarcane, sugar, gur and government policy of control/ decontrol were collected from various sources, such as Indian Sugar, Statistical Abstracts, Bulletin on Food Statistics and the office of the Cane Commissioner, Punjab. The study covered the period 1960-61 through 1984-85, which was considered to be fairly long for the purpose of reliable results.

Since the factors responsible for fluctuating cane supplies to the sugar factories were determined simultaneously because of inter-dependent relationships among themselves, a simultaneous equation model (using three stage least squares method) has been arrived at.

The Model

The sugarcane supply model consists of four behavioural equations and four jointly dependent variables. The following regression equations were developed in the model :

$$S_t = A_0 + A_1 Ps_t + A_2 Pgt + A_3 Y_t + A_4 Ict + U_1 \quad .....(1.1)$$

$$Pst = B_0 + B_1 Pg_t + B_2 Psut + B_3 Ssut + U_2 \quad .....(1.2)$$

$$Pgt = C_0 + C_1 S_t + C_2 P_{st} + C_3 Y_t + C_4 D_1 + U_3 \quad .....(1.3)$$

$$Psut = E_0 + E_1 Pst + E_2 ssut + E_3 D_2 + U_4 \quad .....(1.4)$$

where :

S_t = Supply of sugarcane to the sugar factories (Thousand tonnes)

Pst = Price of sugarcane (Rs./tonne)

Pgt = Price of gur (Rs./Quintal)

Psut = Price of sugar (Rs./Quintal)

Y_t = Production of sugarcane (ten thousand tonnes)

Ict = Installed daily crushing capacity (hundred tonnes)

Ssut = Total supply (opening stock +current production) of sugar (lakh tonnes)

D_1 = Dummy variable representing the disposal problems

D_1 = 1 for disposal problems faced by growers

D_1 = 0 otherwise

D_2 = Dummy variable representing the government policy.

D_2 = 1 for partial decontrol

D_2 = O otherwise

U_i's = Error terms (i=1.....4)

A_0, B_0, C_0 and E_0 are the respective intercepts in 1.1, 1.2, 1.3 and 1.4 regression equations of the model.

A_is (i=1.....4), B_i's= (i=1.....3), C_i's= (i=1.....4) and E_i's (i=1 .....3) are the regression coefficients in 1.1, 1.2, 1.3 and 1.4 regression equations of the model respectively. Subscript 't' implies current year.

The system (1.1 through 1.4) was a complete one in four jointly dependent variables (S_t, Pst, Pgt, Psut) and five predetermined variables (Y_t, Ict, Ssut, D_1 and D_2). Further, all the four behavioural equations (1.1 through 1.4) were found to be over identified. Hence for the estimation of coefficients As, Bs, Cs and Es, the author proceeded along the lines of Three Stage Least Squares Method.

Economic Bases

Regression Equation 1.1

Price of Sugarcane (Pst) : Sugarcane has mainly two uses i.e., either it can be supplied to the sugar factories for sugar making or can be used for gur and khandsari manufacturing. The cane growers will be looking for the most profitable use of their produce. It is expected that if the price of sugarcane actually paid by the sugar factories is more, more quantities of sugarcane is supplied to the sugar factories and less is used for competing agents, *viz.*, gur and khandsari and *vice-versa*.

Price of Gur (Pgt) : It is expected that the relatively high level of gur price during the crushing season has an adverse effect on cane supplies to the factories *i.e.*, if the price of gur (Main competing agent) is higher, more quantities of sugarcane are used for gur manufacturing leaving less supplies for the sugar factories.

Production of Sugarcane (Yt) : During the years of relatively higher production of sugarcane, more of it is available for its different uses. It is, therefore, expected that in the events of higher level of sugarcane production, more sugarcane is supplied to the sugar factories and *vice-versa*.

Installed Crushing Capacity (Ict) : If the crushing capacity of the sugar factories is enhanced, cane growers face relatively less problems in supplying their crop to the factories. It is expected that if the installed crushing capacity of the sugar factories is increased, quantities of sugarcane supplied to the sugar factories is also increased.

Regression Equation 1.2

Price of Gur (Pgt) : The price of gur influences the price of sugarcane. High level of gur price during crushing season of the factories diverts the cane supplies towards gur manufacturing. When the sugar factories do not get the adequate quantities of sugarcane for crushing, then the State Government and sugar factories increase the price of sugarcane to attract the adequate supplies of sugarcane. It is expected that if the price of gur is more, then the price of sugarcane will increase and *vice-versa.*

Price of Sugar (Psut) : Price of sugar also influences the price of sugarcane. If the sugar prices rule high during the crushing season, the State Government and sugar factories will be ready to pay higher price to attract more sugarcane supplies. Thus, if the price of sugar is more, then the price of sugarcane will also be more and *vice-versa.*

Total Available Supply of Sugar (Ssu) : During years of abundant supplies of sugar, the State Government and the sugar factories are not eager to crush more sugarcane and hence offer low price of sugarcane to the growers. It is expected that if more sugar is available during crushing season, then price of sugarcane will be low and *vice-versa.*

Regression Equation 1.3

Sugarcane Supplies to Sugar Factories (S_t) : Out of the fixed sugarcane production during a particular year, if more cane is supplied to sugar factories, the production of gur will be less during that year resulting in a hike in gur price. It is, therefore, expected that if more sugarcane is supplied to the sugar factories, the price of gur will increase and vice-versa.

Price of Sugarcane (Ps_t) : Since sugarcane is the only major raw material used for gur manufacturing, in the event of increase in price of sugarcane, the price of gur is also increased and *vice-versa.*

Production of Sugarcane (Y_{t}): During years of relatively more production of sugarcane, the production of gur increases and the price of gur decreases. The reverse would happen during year of low production of sugarcane.

Problems Faced in Disposal of Cane (D_1) : This variable was included to study the impact of disposal problems faced by the growers on the price of gur. When the farmers face problems in disposal of sugarcane to the sugar factories, they start manufacturing gur. As a result, production of gur increases and its price decreases. It is assumed that during years when the farmers face problems in disposal of sugarcane to the sugar factories, the price of gur decreases.

Regression Equation 1.4

Price of Sugarcane (Pst) : As sugarcane is the major raw-material used for sugar manufacturing, it is expected that with the increase in sugarcane price, the price of sugar is also increased and *vice-versa.*

Total Available Supply of Sugar (Ssu_t) : It is assumed that if more sugar is available in the country in a given year, its price will be low and *vice-versa.*

Government Policy on Controls/Decontrols (D_2) : The Government through its policy of controls/decontrols on sale of sugarcane alter the availability of sugar and its price. It is expected that the shift in the policy from full controls or full decontrols to partial decontrol results in an increase in the price of sugar. It is so because under the situation of full decontrols, the price of sugar is low as it is fully controlled by government and under the situations of full decontrols, again, the price is low due to competition among themselves.

Unaccounted Variables (U_i s) : Although the factors included in the model (1.1 through 1.4) were believed to be most important determinants of cane supplies to the sugar factories there could be some other factors and their interactions which could influence cane supplies to the sugar factories. The net effect of unaccounted factors may be to increase the cane supplies to the sugar factories or to reduce it. This was taken care of by the error terms in the model.

Results

The value of the coefficient of determination (R^2) in each equation of the model showed that a sizeable proportion of the total variation independent variable was explained by the independent variables taken together. Further, the zero-order collection matrix (Appendix-I) and the value of Durbin Watson "d" statistics showed that all the equations of the model under study were free from the problems of multicollinearity and auto correlation.

Factors Influencing Cane Supply

Equation 1.1 in table 1 indicates that supply of sugarcane to the factories is positively influenced by price of sugarcane. The regression coefficient of sugarcane price was 7.01 which was found to be statistically significant at 20 per cent probability level. This indicates that with rupee one per tonne increase in the price of sugarcane, the supply of sugarcane to the factories increased by 7.01 thousand tonnes. This is in conformity with the law of supply, i.e., more the price, more will be the quantity supplied.

The regression coefficient of gur price (-4.36) was found to be statistically significant at five per cent level. This meant that with rupee one per quintal increase in gur price, the supply of sugarcane to the factories decreased by 4.36 thousand tonnes. This was because of the diversion of sugarcane towards the more remunerative alternative of gur manufacturing.

The regression coefficient of sugarcane production was 1.38 and was found to be statistically significant at five per cent level. Thus, with one thousand tonnes increase in the sugarcane production, the supply of sugarcane to the factories increased by 138 tonnes.

The regression coefficient of daily installed crushing capacity (2.31) was found to be statistically not significant.

Factors Influencing the Price of Sugarcane

Equation 1.2 in table 1 indicates that the price of sugarcane was positively influenced by the price of sugar. The regression coefficient of sugar price was 0.20 which was found to be statistically significant at 20 per cent level. The positive sign of coefficient showed that price of sugar and price of sugarcane moved in sympathy because sugarcane was the sole raw material used for sugar production. With rupee one per quintal increase in price of sugar, the cane price increased by rupee 0.02 per quintal.

The regression coefficient of supply of sugar was 0.91 which was found to be statistically significant at one per cent level. The positive sign of regression coefficient was due to increase in sugarcane price on trend basis coupled with increase in sugar supplies.

Further, it was found that price of sugarcane was positively influenced by the price of gur. The regression coefficient of gur price (0.31) was found to be statistically significant but at a higher probability level of 25 per cent. The positive value of coefficient meant that price of gur and price of sugarcane moved in sympathy.

Equation 1.3 in table 1 indicates that gur price was negatively and significantly influenced by the supply of sugarcane to the factories. In years of excessive production of sugarcane when despite increase in cane supplies to the factories, the cane availability for gur production is rather high leading to slump in gur prices, and the reverse is true in years of short supplies. The regression coefficient of cane supply to the factories (-0.18) was statistically significant at one per cent level.

The regression coefficient of sugarcane price (1.56) was statistically significant at one per cent level. With rupee one per tonne increase in cane price, the gur price increased by rupee 1.56 per quintal. The positive sign of the regression coefficient showed that sugarcane price and gur price moved in sympathy. The regression coefficient of production of sugarcane was 0.21 and statistically significant at 20 per cent level. The positive value of coefficient meant that with an increase in sugarcane production, the gur price also increased. This positive relationship between cane production and gur price could be true over a period of time due to the increase in its demand.

The regression coefficient of dummy variable representing the disposal problems of sugarcane was 12.92 and statistically significant at 25 per cent level. The negative value of the coefficient indicated that during the years when the farmers faced severe disposal problems, the gur price also declines. It could be so because of more sugarcane production, the farmers faced disposal problem and as a consequence, the price of gur declined.

Factors Influencing Price of Sugar

Equation 1.4 in table 1 indicates that free market price of sugar was positively and significantly influenced by sugarcane price. The regression coefficient of sugarcane price (2.55) was found to be significant at one per cent level. With rupee one per tonne increase in price of

Factors Influencing Price of Gur

Table 1 : Three Stage Least Squares Estimated Functions for the Sugarcane Supply Model

1.1	S_t	=	−387.94 (506.08)	$+7.01^{*}P_{st}$ (4.88)	$-4.36^{**}P_{g_t}$ (2.03)	$+1.38^{**}Y_t$ (0.58)	$+2.31NSI_{IC_t}$ (11.70)	R^2 = 0.88 D-W = 1.59
1.2	P_{s_t}	=	−44.57 (7.94)	$+0.31+P_{gt}$ (0.24)	$+0.20^{*}P_{su_t}$ (0.12)	$+0.91^{***}$ $(0.26)s_{su_t}$		R^2 = 0.97 D-W = 1.31
1.3	P_{g_t}	=	−29.26 (53.79)	-0.18^{***} $(0.05)s_t$	1.56^{***} $(0.21)P_{s_t}$	$+0.21^{*}Y_t$ (0.13)	$-12.92+D_1$ (10.41)	R^2 = 0.83 D-W = 2.13
1.4	P_{su_t}	=	100.36 (21.73)	$+2.55^{***}P_{st}$ (0.25)	$-1.53^{*}S_{su_t}$ (0.61)	$+23.07^{*}D_2$ (16.33)		R^2 = 0.94 D-W = 1.42

*** Significant at one per cent level.
** Significant at five per cent level.
* Significant at twenty per cent level.
+ Significant at twnenty five per cent level.
NS: Non-significant
Values in the parentheses are standard errors.

sugarcane, the average free market wholesale price of sugar increased by Rs.2.55 per quintal. This high degree of association between the cane price and sugar price is understandable because of the reason that sugarcane is the sole raw material used in sugar production.

The regression coefficient of supply of sugar was 1.53 and significant at five per cent level. The negative sign of the coefficient indicated that free market wholesale price of sugar was negatively influenced by supply of sugar. With one thousand tonnes increase in the supply of sugar, the sugar price decreased by Rs.1.53 per quintal.

The regression coefficient of dummy variable (which was included to quantify the government policy of partial decontrol) was positive and statistically significant at 20 per cent level. The positive value of coefficient indicated that the shift in policy from full control or full decontrol to partial decontrol resulted in an increase in free market price of sugar.

Summing Up

The sugarcane supply to the sugar factories was positively and significantly influenced by price of sugarcane and production of sugarcane, whereas, it was negatively and significantly influenced by the price of gur. The cane price was found to be positively and significantly influenced by price of sugar, price of gur and supply of sugar. The gur price was positively and significantly influenced by the sugarcane price and sugarcane production while it was negatively and significantly influenced by the cane supply to the factories and the disposal problem faced by the growers. The average annual free market wholesale price of sugar was positively and significantly influenced by the sugarcane price and the government policy of partial decontrol, while it was negatively and significantly influenced by the supply of sugar.

Policy Suggestions

The sugar industry in the country was plagued by instability arising out of the variations in sugarcane production on the one hand and the presence of a more competitive gur and khandsari industry on the other. The higher gur price became the cause of diversion of sugarcane from sugar factories. It is suggested that any attempt to stabilise sugarcane supplies should not only seek to stabilise sugarcane production but also try to ensure that each industry whether gur, khandsari or sugar gets its due share.

As in the case with cereal crops the buffer stocks of sugar needs to be created so that the Central Government can have effective control on the marketing during years of fluctuating output of sugar and its prices.

Solution to the problem lies in pursuing a consistent policy on a long term basis for buffer stocks rather than abandoning the adhoc policy of controls during times of excessive accumulation of sugar stocks.

The states have also to play their part in this. Since, factors affecting sugarcane production/acreage in different states, differ at the state level, the State Government, should fix sugarcane price at a level which ensure parity in returns from sugarcane with competing crop rotations in the respective states.

Long term bonds between the sugar factories and cane growers may be another step to control the fluctuations in sugarcane supplies to the sugar factories both at the states as well as at the national level.

Appendix—I

Zero-Order Correlation Metrix of Different Variables (Supply Response)

	S_t	Ps_t	Pg_t	Psu_t	Y_t	IC_t	Ssu_t	DP_t	G_t
S_t	1	.78	.48	.68	.75	.78	.90	-.23	.59
Ps_t		1	.87	.85	.33	.84	.79	-.41	.55
Pg_t			1	.89	.04	.81	.47	-.53	.53
Psu_t				1	.26	.86	.64	-.48	.58
Y_t					1	.33	.58	-.04	.57
IC_t						1	.83	-.45	.51
Ssu_t							1	-.15	.40
DP_t								1	-.24
G_t									1

S_t = Supply of sugarcane available to the factories.
Ps_t = Price of sugarcane, Pg_t = Price of gur, Psu_t = Price of sugar, Y_t = Production of sugarcane.
IC_t = Installed crushing capacity of factories, Ssu_t = Total available supply of sugar, DP_t = Dummy variable. for disposal problems, G_t = Dummy variable for government policy of partial decontrol.

Feature

Spatial Variations in Value Productivity of Paddy Crop

Maan Singh Toor & A. C. Sharma

The present study was taken up in 1985-86 with a view to (i) making a quantitative assessment of the spatial variations in per hectare value productivity and resource use in paddy crop; (ii) examining the factors responsible for these variations; and (iii) identifying the possibilities for the reallocation of available resources on small farms in the paddy-wheat belt of the Punjab State.

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Punjab agriculture has recorded manifold increase in productivity since mid-sixties. But this enhancement in productivity has not been uniform in all the regions of the State partly due to the variations in natural endowments and partly because of the differences in the levels of adoption of modern technology by the farm entrepreneurs. These variations in value productivities have ultimately resulted in a skewed distribution of agricultural incomes even with the homogeneous paddy-wheat belt of the State. Such a situation can, however, be rectified to some extent by reorganising the existing resource use pattern on individual holdings through appropriate farm management decisions. The present study was taken up in 1985-86 with the following objectives :

Objectives

1. Making a quantitative assessment of the spatial variations in per hectare value productivity and resource use of paddy crop on small farms in the paddy-wheat belt of Punjab ;
2. Examining the factors responsible for these variations; and
3. Identifying the possibilities for the reallocation of available resources on these farm situations.

Methodology

The paddy-wheat belt ofPunjab comprised 83 blocks constituting 70.34 per cent of all the blocks in the state. The blocks viz., Jagraon with the highest and Pathankot with the lowest value productivity per hectare were purposively selected for this investigation. The study sample was drawn following a two-stage stratified random sampling technique with the village as the first stage and the operational holdings as the second stage.

The villages with 50 per cent or more area under paddy crop during 1984-85 in the sample blocks were

enlisted and a random sample of 10 per cent of them from each block was taken without replacement for this inquiry. Again, the operational holdings in the study villages were pooled and arranged in the ascending order of size and their distribution transformed to show the size ranges of small (less than 2.31 hectares), medium (2.31 to 5.76 hectares) and large (5.76 hectares and above) farms using the cube-root method. The small holdings in each sample village were then identified and a sample of 15 per cent of them was randomly selected without replacement from each village. Thus, a random sample of 39 small farms from 5 sample villages of Jagraon and 59 small farms from 11 sample villages of Pathankot with a total of 98 small farms was selected for intensive investigation.

Analytical Framework

The differences in the per hectare value productivity and resource use between the highest and the lowest value productivity blocks were studied. The factors responsible for spatial variations in value productivity were identified by fitting the following types of linear and log-linear value productivity functions to the cross sectional data.

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8$$

$$Y = ax_1^{b1}\ x_2^{b2}\ x_3^{b3}\ x_4^{b4}\ x_5^{b5}\ x_6^{b6}\ x_7^{b7}\ x_8^{b8}$$

Where Y stands for value productivity per hectare, X_1 per hectare human labour, X_2 per hectare horse power input, X_3 per hectare water availability in hectare-inches by way of rainfall and artificial irrigation, taken together, X_4 per hectare expenditure on seeds, X_5 per hectare expenditure on manures and fertilizers, X_6 per hectare expenditure on plant protection chemicals, X_7 educational level of the farm operator and X_8 extension contacts of the farm entrepreneur. The equations finally selected, however, included independent variables relating to the employment of human labour hours, horse power hours water availability, the expenditure on seeds and the expenditure on manures, fertilizers and plant protection chemicals. Since the results of the two types of functions brought out that the value of R^2 and the number of significant regression coefficients were higher in the case of log-linear function as compared to the linear, one, further analysis was undertaken on the basis of the log-linear function.

An inter-block comparison of the regression coefficients was made through a 't' test. The inter-block differences in the marginal contribution of each explanatory variable to value productivity per hectare of the crop was studied by examining the sample and modified elasticities of these variables. For this exercise, the elasticity b_{ip} of the resource X_{ip} estimated for the lowest value productivity block (p) was compared with $b_{ip}1$, the elasticity necessary to give the marginal product of the highest value productivity block (j) when X_{ip} and Y_p were those of the lower value productivity block. Thus,

$$\frac{b^1_{ip}\ \bar{y}_p}{\bar{X}_{ip}} = \frac{b_{ij}\ \bar{Y}_j}{\bar{X}_{ij}}$$

$$\text{or } b^1_{ip} = b_{ij}\ \frac{\bar{Y}_j\ \bar{X}_{ip}}{\bar{Y}_p\ \bar{X}_{ij}}$$

The value of 't' was then computed as under :

$$t = \frac{b_{ip} - b^1_{ip}}{\left[S^2b_{ip} + \left(\frac{\bar{Y}_j\ \bar{X}_{ip}}{\bar{Y}_p\ \bar{X}_{ij}}\right)^2 S^2b_{ij}\right]^{1/2}}$$

Where: b_{ip} and b_{ij} indicate the regression coefficient in Pathankot and Jagraon block, respectively.

$b_{ip}1$ represents the regression coefficient of independent variable in Pathankot block which would affect the dependent variable to the same level as in Jagraon block.

S^2b_{ip} and S^2b_{ij} represent variances of regression coefficients in Pathankot and Jagraon blocks, respectively.

$\bar{Y}_p$ and $\bar{Y}_j$ are the average (geometric mean) value productivity per hectare in Pathankot and Jagroan blocks respectively.

$\bar{X}_{ip}$ and $\bar{X}_{ij}$ are the average (geometric mean) use of independent variables in Pathankot and Jagroan blocks, respectively.

The resource reallocation possibilities on sample farm organisation were examined by running the factor-factor analysis. These possibilities were identified by examining the deviations of the existing factor proportions at their geometric mean levels from the optimum factor proportions on sample farm situations.

The existing factor proportions for various explanatory

variables were computed according to the relationship,

$$\text{existing factor proportion} = \frac{\bar{X}_{ji}}{\bar{X}_{j2}}$$

Where, X_{ji} and X_{j2} are the geometric means of the two factor inputs.

The optimum factor proportions for different explanatory variables at the given level of per hectare value productivity were calculated by using the following formula:

$$\frac{\bar{X}_{ji}}{\bar{X}_{j2}} = \frac{b_{j1} X_{j2}}{b_{j2} PX_{j1}}$$ Where P_{xj1} and P_{xj2} are the factor prices.

Variations in Value Productivity and Resource Use

The variations in per hectare value productivity and resource use in paddy crop on sample farms in Jagraon and Pathankot blocks shown in table 1.

Table 1 : Per hectare value productivity and resource use, paddy crop, sample farms, Jagraon and Pathankot blocks, 1985-86

Particulars	Unit	Jagraon Block	Pathankot Block
Value productivity	Rupees	8210.72	4735.53
Human labour	Adult man hours	824.78	772.81
Horse power	Horse power hours	467.05	134.62
Water availability	Hectare-inches	70.93	64.30
Expenditure on seeds	Rupees	68.59	82.37
Expenditure on manures, fertilizers and plant protection chemicals	Rupees	1720.90	805.10

The per hectare value productivity of paddy crop averaged Rs.8210.72 on small farms in Jagraon block and Rs.4735.53 in Pathankot block. The t-statistics showed that these earnings were significantly higher (at one per cent level) in the former. Again, the farms in Jagraon block employed 824.78 adult man hours, 467.05 horse power hours and 70.93 hectare-inches water and spent Rs.68.59 on seeds and Rs.1720.90 on manures, fertilizers and plant protection chemicals per hectare. These figures for Pathankot Block worked out to 772.81, 134.62, 64.30, 82.37 and 805.10, respectively. The 't' test brought out that the use of all these resources was significantly higher in Jagraon block as compared to Pathankot block, exception being the expenditure on seeds which was higher in Pathankot block.

Factors Responsible for Spatial Variations

The factors responsible for spatial variations in value productivity per hectare of paddy crop were identified by examining the log-linear functions fitted to the data collected from the sample farms as shown in table 2.

The per hectare value productivity of paddy crop on small farms in both Jagraon and Pathankot blocks was significantly affected by the employment of human labour

Table 2 : Value productivity functions, paddy crop, sample farms, jagraon and Pathankot Blocks, 1985-86

Particulars	Jagraon Block	Pathankot Block	Inter-Block differences in regression coefficients
No. of observations	39	60	
R^2	0.882***	0.893***	
Intercept (in log)	2.805	2.862	
Regression coefficients			
Human labour hours (X_1)	0.136***	0.177***	-0.041
	(0.047)	(0.067)	(0.082)
Horse power hours (X_2)	0.038	0.106***	-0.068
	(0.028)	(0.033)	(.0.044)
Water availability (X_3)	0.344**	0.311**	0.033
	(0.148)	(0.131)	(0.198)
Expenditure on seeds (X_4)	0.385***	0.205***	0.180
	(0.144)	(0.074)	(0.162)
Expenditure on manures, fertilizers & plant protection chemicals(X_5)	0.253***	0.260***	–0.007
	(0.064)	(0.039)	(0.075)

Figures in the parentheses indicate standard errors.
*** Significant at one per cent level.
** Significant at five per cent level.

hours, expenditure on seeds and expenditure on manures, fertilizers and plant protection chemicals at one per cent level. Besides, the use of horse power hours in Pathankot block influenced the dependent variable at one per cent level of significance. Further, the water availability to the crop had a significant impact on per hectare value productivity at five per cent level in both the blocks. The regression coefficient for horse power hours in Jagraon block was, however, found to be not significant at 10 per cent level.

The selected explanatory variables, taken together, accounted for 88 per cent variations in per hectare value productivity in Jagraon block and 89 per cent in Pathankot Block.

All the independent variables found significant in this analysis were positive and had values less than one. This indicated that they had a diminishing relationship with per hectare value productivity. The 't' test brought out that there were no significant differences (at 10 per cent level) between the regression coefficients of the explanatory variables in the two blocks. This suggested that there was consistency in the roles of all the explanatory variables in explaining the variations in the per hectare value productivity in Jagraon and Pathankot.

Differences in Sample and Modified Elasticities

The inter-block differences in the marginal contribution of explanatory variables to value productivity per

hectare of paddy crop on small farms were studied by examining the sample and modified elasticities of these variables as set out in table-3.

It would be evident from table 3 that the difference between the sample and modified elasticities was positive and significant (at five per cent level) in respect of the variable relating to horse power hours and negative and significant (at 10 per cent level) for expenditure on seeds.

Table 3 : Difference between sample and modified elasticities, selected variables, paddy crop, sample farms, Jagraon and Pathankot blocks, 1985-86

Variable	Sample elasticity (bip)	Modified elasticity ($b1_{ip}$)	Difference ($b_{ip} - b_{ip}1$)
Human labour hours (X_1)	0.177	0.221	-0.044 (0.102)
Horse power hrs (X_2)	0.106	0.019	0.087** (0.036)
Water availability (X_3)	0.311	0.540	-0.229 (0.207)
Expenditure on seeds (X_4)	0.205	0.802	-0.597* (0.309)
Expenditure on manures, fertilizers & plant protection chemicals (X_5)	0.260	0.205	0.055 (0.064)

Figures in the parentheses indicate standard errors.
** Significant at five per cent level.
* Significant at 10 per cent level.

This showed that there was less use of horse power hours and higher expenditure incurred on seeds in Pathankot block as compared with Jagraon block. The differences in the sample and modified elasticities of the variables relative to the employment of human labour hours, water availability and expenditure on manures, fertilizers and plant protection chemicals turned out to be not significant. It indicated that these factors had similar impact on the per hectare value productivity in both the blocks. It was, therefore, concluded that there was a need to increase the use of horse power hours and reduce the expenditure on seeds in Pathankot Block so as to reduce the gap in the per hectare value productivity of this crop in Jagraon and Pathankot blocks.

Reallocation Possibilities

The adjustment possibilities among factor inputs at the existing levels of value productivity per hectare of paddy crop on sample farms in Jagraon and Pathankot blocks were analysed by examining the deviations of the existing factor proportions at their geometric mean levels from the optimum factor proportions as in table 4.

The existing factor proportion of the human labour hours with horse power hours deviated from the optimum proportion to the extent of +0.31 in Jagraon block and -0.25 in Pathankot block. This indicated that while the horse power hours were excessively used under the existing situation in the former block, these were employed below the optimum level in the latter. Consequently, the proportional use of horse power hours in relation to human labour hours should be curtailed on these farms in Jagraon block and expanded in Pathankot block. The deviations of the existing from the optimum factor proportions of human labour hours with water availability, expenditure on seeds, and expenditure on manures, fertilizers and plant protection chemicals indicated sub-optimal use of these factors in both the blocks. The proportion of these resources in relation to human labour hours might be increased by 0.08, 5.58 and 1.63 in Jagraon block and by 0.07, 2.21 and 1.90 in Pathankot block respectively to optimize the resource use levels of these factor inputs.

The deviations of the existing from the optimum factor proportion of horse power hours with human labour hours worked out to -2.10 in Jagraon and +3.37 in Pathankot. This indicated that whereas the use of human labour hours in relation to horse power hours was below the optimum level, in the former, there was an excessive use of this resource in the latter. It would , therefore, be desirable to increase the proportional employment of human labour hours relative to horse power hours in the former and reduce it in the latter case, till the optimum level was attained. Further, the analysis of the deviations of the present from the optimum factor proportions indicated that the proportional use of water input, expenditure on seed, and expenditure on manures, fertilizers and plant protection chemicals with respect to horse power hours was sub-optimal in both the blocks. The existing proportions of these factors in relation to horse power hours might, therefore, be increased by 0.43, 21.73 and 10.70 in Jagraon block and by 0.05, 4.88 and 0.99 in Pathankot block respectively.

The existing factor proportions of water resource with human labour hours, horse power hours and expenditure on manures, fertilizers and plant protection chemicals deviated from the optimum proportions to the extent of +10.53, +8.20 and +10.04 in Jagraon and +17.69, +0.87 and +1.49 in Pathankot. This indicated that there was a need to reduce the proportional use of these resources in relation to water input. Again, the existing factor proportion of water input with respect to the expenditure on seeds deviated from the optimum proportion to the extent of -14.42 in Jagraon and -17.86 in Pathankot. The proportional expenditure on seeds in relation to water use was sub-optimal in both the blocks and that it should be increased upto the optimum level in both the cases.

The deviations from the existing from the optimum factor proportions of expenditure on seeds with human labour hours, horse power hours, water availability, and the expenditure on manures, fertilizers and plant protection chemicals indicated an excessive use of the latter factors in both the blocks. The proportional use of these resources in relation to the expenditure on seeds should

Table 4 : Deviations of the existing from the optimum factor proportions, paddy crop, sample farms, Jagraon and Pathankot Blocks, 1985-86

Variable	Block	Human labour hours X_1			Horse power hours X_2			Water availability X_3		
		Existing factor proportion	Optimum factor proportion	Deviations of the existing from the optium	Existing factor proportion	Optimum factor proportion	Deviations of the existing from the optimum	Existing factor proportion	Optimum factor proportion	Deviations of the existing from the optium
Human labour hours (X_1)	Jagraon	1.00	1.00	0.00	0.57	0.26	+0.31	0.06	0.14	–0.08
	Pathankot	1.00	1.00	0.00	0.17	0.42	–0.25	0.04	0.11	–0.07
Horse power hours (X_2)	Jagraon	1.77	3.87	–2.10	1.00	1.00	0.00	0.10	0.53	–0.43
	Pathankot	5.74	2.37	+3.37	1.00	1.00	0.00	0.22	0.27	–0.05
Water availability (X_3)	Jagraon	17.82	7.29	+10.53	10.09	1.89	+8.20	1.00	1.00	0.00
	Pathankot	26.63	8.94	+17.69	4.64	3.77	+0.87	1.00	1.00	0.00
Expenditure on seeds (X_4)	Jagraon	12.03	0.18	+11.85	6.81	0.05	+6.76	0.68	0.02	+0.66
	Pathankot	9.38	0.43	+8.95	1.63	0.18	+1.45	0.35	0.05	+0.30
Expenditure on manures, fertilizers and plant protecttion chemicals (X_5)	Jagraon	0.48	0.27	+0.21	0.27	0.07	+0.20	0.03	0.04	–0.01
	Pathankot	0.96	0.34	+0.62	0.17	0.14	+0.03	0.03	0.04	–0.01

		Expenditure on seeds X_4			Expenditure on manures, fertilizers and plant protection chemicals (X_5)		
		Existing factor proportion	Optimum factor proportion	Deviations of the existing from the optium	Existing factor proportion	Optimum factor proportion	Deviations of the existing from the optimum
Human labour hours (X_1)	Jagraon	0.08	5.66	–5.58	2.09	3.72	–1.63
	Pathankot	0.11	2.32	–2.21	1.04	2.94	–1.90
Horse power hours (X_2)	Jagraon	0.15	21.88	–21.73	3.68	14.38	–10.70
	Pathankot	0.61	5.49	–4.88	5.98	6.97	–0.99
Water availability (X_3)	Jagraon	1.48	15.90	–14.42	37.18	27.14	+10.04
	Pathankot	2.84	20.70	–17.86	27.74	26.25	+1.49
Expenditure on seeds (X_4)	Jagraon	1.00	1.00	0.00	25.09	0.66	+24.43
	Pathankot	1.00	1.00	0.00	9.77	1.27	+8.50
Expenditure on manures, fertilizers and plant protecttion chemical (X_5)	Jagraon	0.04	1.52	–1.48	1.00	1.00	0.00
	Pathankot	0.10	0.79	–0.69	1.00	1.00	0.00

be reduced by 11.85, 6.76, 0.66, and 24.43 in Jagraon block and by 8.95, 1.45, 0.30 and 8.50 in Pathankot block, respectively.

Likewise, the existing factor proportions of the expenditure on manures, fertilizers and plant protection chemicals with human labour hours and horse power hours deviated from the optimum factor proportions by +0.21 and +0.20 in Jagraon block and by +0.62 and +0.03 in Pathankot block. This indicated that these resources were over-utilized in relation to the expenditure on manures.

Fertilizers and plant protection chemicals and their proportional use could be reduced to the optimum level in both the blocks. The deviations of the existing from the optimum factor proportions showed that the proportional use of water input and expenditure on seeds in relation to the expenditure on manures, fertilizers and plant protection chemicals should be expanded by 0.01 and 1.48 in Jagraon block and by 0.01 and 0.69 in Pathankot block, respectively.

Conclusion

The study brought out that the per hectare value productivity of paddy enterprise in Jagraon block was higher than that in Pathankot Block because of relatively higher use of human labour hours, horse power hours and water input and larger volume of expenditure on manures, fertilizers and plant protection chemicals and smaller expenditure on seeds. Further, these variations could be minimized by employing more horse power hours and curtailing the expenditure on seeds on small farms in Pathankot block.

□

Feature

Employment, Productivity and Farm Size in Punjab

P.S. Khattra & Inder Sain

A study of literature reveals that no systematic relation between farm size and productivity could be regarded as universally valid in Indian agriculture. The knowledge of this relationship is of paramont importance for suggesting measures for improving the contribution of farm sector to the economy of the state. This paper, therefore, attempts to study the relationship between farm size and measures of economic performance and highlights inter-size group disparities in inome, employment and productivity in Punjab.

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The knowledge of precise relationship, if any, of farm size with parameters of economic performance is of paramount importance for suggesting measures for improving the contribution of farm sector in the economy of the state. The significance of these relations has been witnessed by the high degree of interest evinced by many economists in the study of such relations for the past three decades. Rao (1967), Rani (1971) and Bhardwaj (1974) concluded that holding size had no effect on productivity. Ashok Rudra (1968) pointed out that holding size might actually have positive effect on productivity in certain areas of the country. The inverse relationship between farm size and productivity has been confirmed in Indian agriculture in several studies based on regional data. Such generalisation was made by Sen (1962), Khusro (1964), Rao (1965), Saini (1971), Bhardwaj (1974), Singh, et. al. (1978), Bhalla and Chadha (1983) and Shergill (1987).

It may be inferred from the literature cited above that no systematic relation between farm size and productivity could be regarded as universally valid in Indian agriculture. It is, therefore, imperative to re-examine the nature of relationship between farm-size and economic performance in Punjab agriculture. The inter-size group differentials in productivity, income and employment are quite likely to occur in the farm sector of the state. Any strategy to wipe out such differentials can go a long way to accelerate the pace of development of farm sector of the state. This is so because the law of diminishing returns finds its application ultimately necessitating relatively lesser use of inputs to add the same amount of output to the total product in case of lower yield levels as compared to that of higher yield levels.

This study examines the nature of relationship between farm size and measures of economic performance and highlights inter-size group disparities in income, employment and productivity.

Methodology

The data and method of analysis are as follows :

Data : This study is based on two sets of data pertaining to the year 1987-88. The data in set-I compris-

ing distribution of holdings, area, income and labour use across land size categories were obtained from the study entitled, "Income and Expenditure Pattern in the Rural Punjab", carried out in the Department of Economics and Sociology, Punjab Agricultural University, Ludhiana. The data for set-II indicating herd size, milk production per farm and milk production per animal per day against land size categories were obtained through Special Bovine Survey conducted in rural Punjab by the Department of Economics and Sociology, P.A.U. Ludhiana. The number of sample farms was 215 and 300 in the data sets I and II respectively.

Analysis

The sample farms were classified into four land size categories *i.e.* small (upto 2 ha.), medium (2 to 4 ha), large (4 to 6 ha.) and very large size above 6 ha with a view to study the effect of farm size on inome, employment and productivity. The size limits of this classification were used by the National Commission on Agriculture for the country as a whole.

Tabular analysis involving averages and percentages were used to analyse the data.

Income

Among the various concepts of income, the concept of 'farm business income' was used in this study. Farm business income was computed by subtracting paid out costs, interest on working capital and depreciation on farm machinery and buildings from the 'gross farm income'.

Farm business income per farm and per hectare across land size groups was computed and is presented in table 1. The perusal of table 1 revealed that annual farm business income of small farmers was Rs.16,958/- compared with the average figure of Rs.39078 for all farms and it was as high as Rs.81364 for very large farm category. However, farm business income on per hectare basis was the highest in small farms *i.e.* Rs.15216 compared with the average figure of Rs.10211 for all farms. Moreover, there was an inverse relationship between farm business income per hectare and farm size. Farm business income per hectare was at variance among diferent land size categories.

Table 1 : Farm Business Income per Farm and per Hectare in Punjab, 1987-88

Farm Size Category	Farm Business Income in rupees	
	Per Farm	Per Hectare
Small	16958	15216
Medium	29454	10791
Large	48369	10168
Very Large	81364	8989
Overall Average	39078	10211

In order to elucidate further the effect of land size groups on the distribution of holdings, per cent land area operated and the distribution of farm business income were worked out and have been provided in table 2. It may be seen that the share of small farms in income was as high as 15.01 per cent and their share in land was as low as 10.70 per cent. Contrary to it, the share of very large farms, in land was as high as 49.50 per cent and their contribution to income was as low as 45.22 per cent.

It may be inferred that the relative contribution of small farmers in the farm business income was greater than their share in the area operated and this difference was much greater as compared to that of medium farms. In case of large and very large farms, the relative contributions to farm business income were lower than their shares in area operated and this difference of shares increased with the increase in farm size.

Table 2 : Distribution of Holdings, Area and Farm Business Income in Different Sized Farms in Punjab, 1987-88.

Farm Size Categories	Holdings		Area		Farm Business Income	
	No.	Percentage	Ha.	Percentage	Rs.	Percentage
Small	79	36.74	88.04	10.70	1339647	15.01
Medium	52	24.19	141.93	17.25	1599029	17.91
Large	39	18.14	185.53	22.55	1951312	21.86
Very Large	45	20.93	407.30	49.50	4037232	45.22
Overall Total	215	100.00	822.80	100.00	8927200	100.00

Among all the size categories, the small farms accounted for the highest proportion of holdings (36.74%) and their relative contribution to farm business income was the least (15.01%). It revealed the relative poverty of small farmers as compared to their counterparts in other size categories. It is seen in table 2 that farm size has a direct association with the proportion of area as well as with the proportion on farm business income.

Thus farm business inome per hectare witnessed glaring inter-group disparities in the Punjab State. The removal of such disparities by augmenting the use of yield increasing inputs on relatively large sized farms can go a long way to enhance the level of agricultural output. Besides, the adoption of more profitable enterprises in the

product-mix of relatively large sized farms may also help mitigate the inter-class disparities in the farm incomes in the state.

Employment

Table 3, reveals that farm size has a direct association with the proportion of hired labour use on the one hand and with the proportion of total labour use on the other hand in the Punjab State. The relative share of small farms in the total hired labour use was as low as 9.05 per cent and that of very large size category was as high as 50.82 per cent. Family labour occupied predominant position in small and medium farms while the proportions of hired labour on large and very large size categories of farms outstripped the proportions of family labour use in these categories of farms.

The highest total labour use per hectare is in small farms, i.e. 149 man days against the state average of 115 man days. Moreover, farm size showed an inverse relationship with family labour use on the one hand and with total labour use on the other when labour use per hectare was considered.

It may be inferred that intensity of labour use had a positive effect on the farm business income per hectare. It implied that there was ample scope for increasing farm business income through employing more man power on relatively large size farms. However, large farms may not attain as much intensity of labour use as that of small farms. This may be so because the large farms might have been characterised by higher degree of mechanisation.

Role of Dairying

Dairying is next to crops in importance in the farm sector. The perusal of table 4 indicated that the relative share of dairying in total agricultural income was the highest on small farms category which was as high as 32.60 per cent compared with the state average of 18.32 per cent. This implied that dairy activity was one of the important determinants of higher efficiency of relatively small size farms. Besides, the relative share of dairying was found to vary inversely with the size of land holding.

Herd Size and Milk Prodution

The number of dairy animals per farm was found to witness direct association with the land size in the Punjab State (table-4). The smallest number of animals per farm was as low as 3.37 on small farms and the largest number of animals per farm was as large as 9.05 on very large farms as against the state average of 4.76.

Table 3 : Share in Employment Corresponding to the Per Cent Area Operated and the Relationship of Employment with Farms size, 1987-88

Size Groups	Per cent area operated	Relative Share in Human Labour Employment		Total Human Labour	Human Labour Employed on per Hectare Basis (days)		
		Family labour	Hired labour		Family Labour	Hired Labour	Total
Small	10.70	25.95	9.05	19.12	101	48	149
Medium	17.25	24.23	16.30	21.02	73	53	126
Large	22.55	21.33	23.83	22.34	58	61	119
Very large	49.50	28.49	50.82	37.52	37	58	95
Overall	100.00	100.00	100.00	100.00	55	57	115

Table 4 : Position of Dairying and Milk Productivity over Different Size Categories1987-88

Size Categories	Gross farm Income* (Rs.)	Income from Dairying (Rs.)	Per cent share of dairying	Average No. of milch animals	Average milk production (lit)	Milk productivity per animal per day (lit)
Small	25372	8271	32.60	3.37	13.77	4.09
Medium	47916	10202	21.28	4.52	16.96	3.75
Large	78748	13380	17.04	6.16	22.50	3.65
Very large	142451	19026	13.35	9.05	32.55	3.60
Overall	65012	11914	18.32	4.76	18.12	3.81

* Income from Crops and Dairying.

The variation in milk production per farm (table-4) seemed to have been explained by the number of animals per farm across different land size categories. The milk production per farm varied from 13.77 litres to 32.55 litres on small and very large farms, respectively. The largest inter-size group disparity in milk production per farm was as large as 18.78 litres between small and very large farms.

Productivity of Milch Cattle

It may be seen from table 4 that milk production per animal witnessed inverse relationship with the land size on the one hand and with the herd size on the other in the state. The highest milk proddution per animal on small farms was as high as 4.09 litres per day and the lowest milk production per animal was on very large farms which was as low as 3.60 litres per day against the state average of 3.81 litres per day.

Conclusions

That there are glaring disparities in the level of productivity on the farm as well as of the dairying enterprise in the state of Punjab. Even, the employment scenario highlighted the intensive use of family labour on the small farms as compared to large farms providing more employment to hired labour. This reflects the role of managerial cum labour function of family labour. The inverse relationship still prevailing in the Punjab agriculture obviously indicates to the more intensive use of vital resources with rationality by the self involved family members. Thus, there is still potential of increasing the productivity both on the crop farms as well as of milch animals as observed from the performance of smaller size category of farms in the State.

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□

Production is not the application of tools to materials, but logic to work *—Peter F. Drucker*	Strategy alone cannot create excellance. Neither can culture. Like a sound mind in a sound body, only working in harmony can strategy and culture bring excellence to an organisation. Strategy plus culture equals excellence. *—Hickman and Silva*

Feature

Inter-Regional Inequalities in Agricultural Efficiency in Punjab

Inder Pal Singh, G. S. Mander & I. P. Singh

A tendency towards crop specialisation has been observed in Punjab agriculture which has directly affected the agricultural efficiency and has consequently led towards widening of regional inequalities over time. It is suggested that emphasis should be put on research and marketing development activities with respect to competing crops to bring them at par with paddy in terms of profitability with a view to put brakes on the fast growing mono-crop system. This would in turn help successful implementation of the much desired objective of diversification of Punjab agriculture.

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The adoption of seed-water-fertilizer technology by a majority of Punjab farmers has not only helped to achieve the objective of self sufficiency in foodgrains but has also helped to build buffer stocks to meet the unforeseen challenges. Although the results of this process are by and large satisfactory, the major question continues to baffle researchers : who has gained more or which areas have benefited more ?

Despite that Punjab is geographically not very big, the agro-climatic conditions vary from region to region. These conditions are more diverse in the rabi season than in the kharif season resulting, in the process, in a limited adoption of the paddy crop. Of late farmers using irrigation and fertilisers have been growing paddy even on lands not suitable for it in the strict sense. This has led to wide disparities in agricultural efficiency of various regions in Punjab. In this paper an attempt has, therefore, been made to study the shifts in cropping pattern over time vis-a-vis inequalities in agricultural productivity in different regions of Punjab.

Methodology

The requisite district-wise data were collected for the years 1972-73, 1981-82 and 1987-88 from the Statistical Abstracts of Punjab and Deptt. of Economics and Sociology, Punjab Agricultural University. The year 1972-73 represents the period just after the adoption of new technology for wheat by majority of the farmers and secondly, the segregated data for different districts[1] were available from this year onwards only, whereas 1987-88 is the latest year for which the data were available.

Delineation of Regions

The state has been divided into six agro-climatic regions by the expert Committee of Punjab Agricultural

1. The number of districts in the reorganised Punjab increased to 12 with the formation of a new district, i.e., Faridkot during 1971-72 and segregated data for this district is available from 1972-73 onwards.

University, with block as the primary unit. The best thing would have been to study the inequalities in growth of agricultural productivity amongst these regions, but due to non-availability of blockwise segregated data for these regions, the state has been classified on the basis of cropping pattern with district as the primary unit.

Since, during rabi season wheat is the only principal crop in all the districts, regions have been delineated on the basis of proportion of area under principal kharif crops. The districts having more than 50 per cent of the kharif cropped area under any crop were grouped together in that particular crop region, e.g., paddy region includes all the districts having more than 50 per cent of the kharif cropped area under paddy. The districts, where no single crop had more than 50 per cent area under any one crop, were classified on the basis of area under two principal crops, e.g., paddy-maize region comprised the districts having a higher proportion of area under paddy followed by maize and for maize-paddy region it is vice-versa. Using this criteria the Punjab state has been demarcated in to regions in different years (table 1).

Table 1 : Number of Districts Falling in Different Regions in Punjab

Region	year		
	1972-73	1981-82	1987-88
1. Paddy Region	2	6	8
2. Maize Region	3	1	1
3. Cotton Region	2	2	2
4. Paddy-Maize Region	2	1	-
5. Maize-Paddy Region	-	1	1
6. Maize-Cotton Region	2	-	-
7. Cotton-Maize Region	1	-	-
8. Cotton-Paddy Region	-	1	-
Punjab State	12	12	12

Economic Analysis

The relative agricultural efficiency in different regions was compared by working out their efficiency indices and agricultural value productivity per unit (hectare) of net sown area for different years. Following formulae were used to work out efficiency indices :

$$E_j = \frac{\sum_{i=1}^{m} C_{ij} \cdot a_{ij}}{A_j}$$

where :

E_j = Efficiency index for j^{th} district.
A_j = Net sown area in the jth district.
C_{ij} = Yield index of ith crop in j^{th} district.
a_{ij} = Area under i^{th} crop in j^{th} district.

Crop yield indices were calculated as :

$$C_{ij} = \frac{Y_{ij}}{\bar{Y}_i} \times 100$$

where :

Y_{ij} = Yield of the ith crop in the jth district.
$\bar{Y}_i$ = Average yield of the ith crop in the state.

In this paper efficiency index has been referred to as Technical Efficiency.

With a view to capture the effect of the relative price changes for different crops over time, agricultural value productivity per unit (hectare) of net sown area was calculated at current prices.[2]

$$AVP_j = \frac{\sum_{i=1}^{m} Q_{ij} \cdot P_i}{A_j}$$

where :

AVP_j = Agricultural value productivity per hectare (net sown) in j^{th} district.
Q_{ij} = Production of ith in the jth district.
P_{ij} = Post-harvest price of ith crop.
A_j = Net sown area in the jth district.

Temporal Changes in Cropping Pattern

There are various crop rotations followed in different parts of the state. Almost all of these rotations have wheat as a principal crop during rabi season and infact, nature of these rotations is determined mainly by kharif crops. During 1972-73, paddy, maize and cotton covered 24.11, 28.47 and 25.63 per cent of the kharif cropped area of the state, respectively (table 2). Over time, area under paddy is increasing at the cost of maize. After the introduction of high yielding varieties of paddy the majority of the farmers in Punjab shifted towards this crop because of its relatively high profitability and low variability in yields as compared to its main competing crop viz. maize. The area under paddy increased to 49.07 per cent during 1981-82 and then to 61.38 per cent during 1987-88. Some replacement of area from cotton to paddy was also observed during eighties.

During 1972-73, there were only two districts, namely Amritsar and Gurdaspur in the paddy specialising region. Four more districts viz. Kapurthala, Patiala, Ferozepur and Jalandhar entered into this region during the period

2. These values (AVP) for years 1981-82 and 1987-88 were deflated to 1972-73 level by using All India Whole Sale Price Index to make overtime comparison valid.

Table 2 : District-wise per cent Share of Paddy, Maize and Cotton in Kharif Cropped Area in Punjab

District/Region	Paddy	Maize	Cotton
1972-73			
Paddy Region			
Amritsar	53.64	20.70	11.76
Gurdaspur	52.36	22.98	2.17
Maize Region			
Hoshiarpur	29.38	59.49	1.76
Ropar	11.52	54.75	3.17
Jalandhar	19.35	52.71	4.74
Cotton Region			
Faridkot	7.42	14.85	74.68
Bathinda	0.46	9.23	60.31
Paddy-Maize Region			
Patiala	43.73	21.87	10.09
Kapurthala	39.85	22.77	1.71
Maize-Cotton Region			
Ludhiana	5.99	46.96	12.04
Sangrur	7.15	33.05	28.72
Cotton-Maize Region			
Ferozepur	34.43	8.55	46.17
Punjab State	24.11	28.47	25.63
1981-82			
Paddy Region			
Amritsar	81.91	7.03	6.12
Gurdaspur	71.58	10.53	0.84
Kapurthala	76.73	8.76	1.20
Patiala	74.54	7.84	6.60
Ferozepur	61.18	1.73	31.45
Jalandhar	51.55	33.06	3.42
Maize Region			
Hoshiarpur	33.61	54.10	2.21
Cotton Region			
Faridkot	30.36	2.28	60.20
Bathinda	4.13	1.88	85.05
Paddy-Maize Region			
Ludhiana	47.28	22.78	10.92
Maize-Paddy Region			
Ropar	27.47	48.40	2.22
Cotton-Paddy Region			
Sangrur	35.27	9.47	36.97
Punjab State	49.07	22.71	26.62
1987-88			
Paddy Region			
Amritsar	90.90	5.16	0.67
Gurdaspur	77.83	9.54	0.00
Kapurthala	87.89	5.11	0.00
Patiala	87.40	4.23	1.27
Ferozepur	64.89	0.29	28.27
Jalandhar	67.45	20.39	0.52
Ludhiana	73.51	7.11	3.67
Sangrur	67.65	3.25	18.93
Maize Region			
Hoshiarpur	33.54	55.20	0.63
Cotton Region			
Faridkot	41.17	0.57	51.41
Bathinda	12.51	3.25	84.78
Maize-Paddy Region			
Ropar	33.64	42.36	0.75
Punjab State	61.38	8.33	22.16

1972-73 through 1981-82. This shift was mainly from maize. Some shift from maize to paddy was observed in Amritsar and Gurdaspur districts. The same type of shift was also there in Ludhiana, Sangrur and Ropar where the area under paddy increased from 5.99, 7.15 and 11.52 per cent to 47.28, 35.27 and 27.47 per cent of the kharif cropped area, respectively during this period. Even amongst the areas where cotton was clearly a leading crop, some area shifted away from both maize and cotton to paddy, particularly in Faridkot district. The overall pattern showed that during the period 1972-73 through 1981-82, when adoption of high yielding varieties of paddy was on a large scale, farmers who had assured irrigation facilities but were growing maize and to some extent cotton, shifted towards paddy. The reasons for such shifts are probably; relatively more profitability of paddy, its resistance to insects, pests and diseases & low variability in its yield and price and above all assured marketing facilities for its disposal. The trend of shifts in cropping pattern during seventies continued in eighties as well. Two more districts viz. Ludhiana and Sangrur with 73.51 and 67.65 per cent of kharif cropped area under paddy during 1987-88 entered in the paddy region. The proportion of area under paddy in other districts of this region also increased. In Ropar district, there was further shift away from maize to paddy. With the exception of Hoshiarpur, the farmers in all other districts, who were not growing paddy earlier, showed their preference for it after learning from the experiences of paddy growers. This tendency was observed to some extent even in hitherto cotton growing areas and where agro-climatic conditions were not conducive for healthy growth of paddy. These findings clearly indicate a ten-

dency towards crop specialisation in Punjab agriculture over time. The farmers, have shown their preference towards more remunerative crops having low risk in respect of yield and prices.

Variations in Productivity

District-wise technical efficiency indices (TE) and agricultural value productivity (AVP) per unit (hectare) of net sown area are presented in table 3. The AVP in Punjab during 1972-73 was Rs.2295 per hectare. Ludhiana was leading in terms of both TE (135.75 per cent per hectare) and AVP of Rs. 3038 per hectare followed by Jalandhar. However, in the remaining districts, the pattern of ranking on the basis of TE and AVP was different. Ropar with 75.23 per cent per hectare as TE and Bathinda with Rs.1578 per hectare as AVP were at the bottom. The AVP in real terms increased from Rs.2295 during 1972-73 to Rs.2471 and Rs. 4552 during 1981-82 and 1987-88, respectively. Ludhiana was consistently the leading district with Rs.3280 and Rs. 5752 as AVP during 1981-82 & 1987-88, respectively. Whereas Bathinda was at the bottom with Rs.1815 and Rs. 3277 as per hectare AVP during 1981-82 and 1987-88, respectively.

There was no consistency in the pattern of temporal shifts in technical efficiency amongst different agro-climatic regions. However, a consistent pattern was observed in terms of AVP as is clear from the ranking of districts in different crop regions on this basis (table 3). In Amritsar and Gurdaspur, traditionally the paddy growing districts, position regarding relative ranking on the basis of AVP deteriorated during the period from 1972-73 to 1981-82. Whereas, in all other districts, where the cropping pattern has shifted in favour of paddy particularly from maize, the position with respect to relative ranking on the basis of AVP has improved or remained the same. This pattern continued during eighties also. In the areas where paddy crop replaced the other kharif season crops in the crop mix, the relative ranking on the basis of AVP improved during this period e.g., the ranking of Sangrur and Patiala districts improved from IVth and IIIrd during 1981-82 to IIIrd and IInd during 1987-88, respectively. Similarly in Ropar where the area under paddy increased from 11.52 per cent during 1972-73 to 33.64 during 1987-88 (table 2), its relative position improved from XIth to VIIIth (table 3).

It may be concluded from the above discussion that the farmers have shifted towards more remunerative crops, i.e., paddy, which has lower levels of risks both in terms of yield and prices. This crop also has an assured marketing facility. The impact of this shift on technical efficiency indices over time did not manifest in any specific trend. It

Table 3 : District-wise per hectare (Net Sown) Technical Efficiency and Agricultural Value Productivity in Punjab

District/Region	TE	Rank	AVP*	Rank
1972-73				
Paddy Region				
Amritsar	102.95	VI	2600	IV
Gurdaspur	87.11	X	2612	III
Maize Region				
Hoshiarpur	94.93	VII	2210	VIII
Ropar	75.23	XII	1851	XI
Jalandhar	110.40	II	2776	II
Cotton Region				
Faridkot	107.53	V	2324	VII
Bathinda	88.33	IX	1578	XII
Paddy-Maize Region				
Patiala	108.63	III	2394	V
Kapurthala	83.81	XI	2100	IX
Maize-Cotton Region				
Ludhiana	135.75	I	3038	I
Sangrur	107.75	IV	2368	VI
Cotton-Maize Region				
Ferozepur	88.72	VIII	1978	X
Punjab State	100.00		2295	
1981-82				
Paddy Region				
Amritsar	87.87	IX	2324	IX
Gurdaspur	85.23	X	2347	VII
Kapurthala	91.30	VIII	2438	V
Patiala	105.24	IV	2923	III
Ferozepur	100.27	VI	2415	VI
Jalandhar	105.87	III	3001	II
Maize Region				
Hoshiarpur	75.83	XI	1959	XI
Cotton Region				
Faridkot	103.74	V	2326	VIII
Bathinda	100.12	VII	1815	XII
Paddy-Maize Region				
Ludhiana	125.82	I	3280	I
Maize-Paddy Region				
Ropar	73.81	XII	2073	X
Cotton-Paddy Region				
Sangrur	110.03	II	2607	IV
Punjab State	100.00		2471	

Table 3 (Contd.)

	1987-88			
Paddy Region				
Amritsar	95.40	VIII	4300	VII
Gurdaspur	87.49	IX	4157	X
Kapurthala	102.01	V	4949	V
Patiala	111.75	III	5439	II
Ferozepur	101.83	VI	4492	VI
Jalandhar	109.43	IV	5212	IV
Ludhiana	126.31	I	5752	I
Sangrur	119.47	II	5235	III
Maize Region				
Hoshiarpur	67.95	XII	3278	XI
Cotton Region				
Faridkot	97.70	VII	4192	IX
Bathinda	82.44	X	3277	XII
Maize-Paddy Region				
Ropar	75.94	XI	4252	VIII
Punjab State	100.00		4552	

TE = Technical efficiency; AVP = Agriculture Value Productivity.
* = Deflated Values for 1981-82 and 1987-88.

clearly implies that decisions on the farms are governed by relative economy of the crops and not by relative physical products. The overall agricultural value productivity in Punjab increased during seventies and sharper increases were observed during eighties. This increase might be attributed to either increased productivity of principal crops, or more intensive use of area under crops with higher prices of agricultural commodities. The areas, where paddy was adopted during the transitional phase of Punjab agriculture, relatively gained more in terms of agricultural value productivity in comparison with the regions specialising in other crops as well as the traditional paddy growing regions.

Policy Implications

A tendency towards crop specialisation has been observed in Punjab agriculture. This has directly affected the agricultural efficiency and has consequently led to widening of regional inequalities over time. To reduce this gap one way could be to motivate the farmers of other regions also to adopt paddy in kharif season. This would have its own limitations and would lead to mono-culture in the state along with various other long run problems like disturbances in natural eco-system, deterioration of soil health and above all overexploitation of underground water resources. The other way is to improve the relative profitability of competing crops , e.g., maize, pulses, oil seeds, etc. and to bring them at par with paddy. Major emphasis has to be laid on research activities to evolve high yielding varieties of competing crops which have low yields under different agro-climatic conditions and also to provide assured marketing facilities along with remunerative prices. These steps will help not only to bring about equality in agricultural efficiency in different regions but also to break the fast growing mono-crop system causing serious problems and successful implementation of much desired objective of diversification in Punjab agriculture.

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Leadership Makes the Difference

Management at all levels would do well to keep the following in mind: "He was hired for his grasp of technology.He was promoted for his ability to manage.And he was fired for his failure to lead."

—Jack Zenger

If you wish to hire a hard working man, you should hire a man who is hardworking now.

—McQuiag

Survey

System Dynamics In India: A State-Of-The-Art Report

Pratap K. J. Mahapatra and Purnendu Mandal

System dynamics provides a new paradigm for policy modelling, analysis, and design. The paper reports the state-of-the-art of this methodology in India. After a brief introduction to the guiding philosophy and methodology, the paper describes theoretical researches in Indian Universities and applications to various Indian situations.

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System dynamics, earlier known as industrial dynamics, owes its development to Professor Jay W. Forrester of the Sloan School of Management, Massachusetts Institute of Technology, U.S.A. Forrester used concepts of feedback control theory and computer simulation along with the concepts of traditional management to lay the foundation of Industrial Dynamics (Forester, 1961). The underlying principles of the subject proved to be so pervasive that the subject was later appropriately rechristened as System Dynamics (SD).

Traditional management is the world of practising manager. The greatest strength of traditional management is the vast size of the mental database. The mental database is formed with whatever a manager sees, hears, feels and experiences around him. It contains such subtle information as organizational pressure points, conflicting subgoals, and personal biases, etc. A mental model, however, suffers from several shortcomings. Since it does not have a structure, no principles exist to guide its development and to guide the selection of pieces of information for use in the formation of a mental model. Absence of a structure results in changing assumptions over time, difficulty in validation, and poor transferability in space and time. Further, human mind is a poor assessor of dynamic consequences of a set of model assumptions.

System dynamics recognizes the merits of mental databases in traditional management. It, however, supports the development of mathematical model to get over the shortcomings of the mental model. It uses the principles of feedback theory to derive a model structure as well as to select pieces of information from the mental database for use at the decision points. It then carries out a computer simulation to assess the dynamic consequences of a set of model assumptions.

Theoretical Developments in India

A number of theoretical developments have been carried out on the subject in India. Some important ones are reported as follows :

System Dynamics Paradigm

System dynamics proposes a separate paradigm (Mohapatra, 1990). A recent work has highlighted the subtleties of this paradigm as distinct from the popular competing paradigms.

Generalized Results on Exponential Delays

System dynamics models use exponential delays which have a very generalized structure. Higher order delays are like serial queuing systems. Various statistics on exponential delays are developed similar to the ones in the queuing systems (Mohapatra, 1976).

Control System Theory and System Dynamics

Work has been reported showing the equivalence of control systems theory and system dynamics. Such an equivalence helps in making use of many standard techniques of control systems theory in the analysis and design of system dynamics models (Chowdhury, 1988, Mohapatra, 1980).

Linearization and Eigenvalue Analysis of System Dynamics Models

System dynamics models are usually nonlinear. Mohapatra and Sharma (!986) have linearized and have used the eigenvalue analysis to select parameter values in a model to change the unstable behaviour to one of stability.

Synthetic Policy Design

Policy design in system dynamics models is purely an art based on a method of trial-and-error. Synthetic design methods available in modern control theory can be used to help in this stage. Model control theory, optimal control theory and Liapunov stability methods have been used to design policies in system dynamics models (Mohapatra 1985; Sharma & Mohapatra, 1988; Sharma, 1985).

Efficiency of Numerical Integration Schemes

It is known that Euler integration scheme is very simple but is accurate upto the first order. Recently other integration schemes, such as Predictor-Corrector method and Runge-Kutta method, are compared with Euler method. The round-off and integration errors, and how they are accumulated, are measured in each case (Pal and Sethi, 1988).

Physical Systems Theory and System Dynamics

Vij et. al (1988) and Vij (1990) have recently integrated graph theoretical concepts of physical systems theory with system dynamics while modelling various energy related issues of the economy.

Markov Process and System Dynamics

Markov models depict probabilistic situations while system dynamics depicts deterministic situations. Work is in progress which points to an underlying equivalence between the two (Roy, 1989). A lot of extra information, mutually benefiting both the methodologies, can be gained by establishing this equivalence.

Sensitivity Models

Generally system dynamics models are parameter-insensitive, but frequently certain parameters can change the mode of model behaviour. A comprehensive procedure of sensitivity testing has been proposed which discerns 6 types of sensitivity tests : initial value, parameter, table function, structural, exogenous variable, and computation parameter sensitivity tests (Mohapatra and Saha, 1984).

Age Computation in Manpower Planning

Theoretical developments are made to compute average age of man in manpower hierarchical structures in industrial, defence and other systems (Mohapatra, et. al,1990).

Bond Graph and System Dynamics

Bond graphs provide a concise and pictorial representation of physical systems and provide flexibility in modelling. A recent work suggests a method for converting a system dynamics model into a Bond Graph (Sanjal, et.al, 1987).

Testing Delphi Results in SystemsDynamics Framework

A Delphi study can help a system dynamics model in the qualitative stages of defining a problem, fixing model boundary, assessing unforeseen environmental changes and suggesting alternative policies. In a study in Indian tea industry a Delphi study was conducted to build a system dynamics model (Bora, 1981; Mohapatra et al. 1984). However, the policies suggested by the panelists were found to falter in an environment which allowed the unforeseen events suggested by the panelists to occur. This result points to the fact that Delphi results should not just be taken for granted. They should be tested for their validity in a dynamic model before any useful conclusion is drawn.

System Dynamics-Based Games

Both system dynamics and games portray dynamics situations are used as policy analysis and design tools. But system dynamics based games are not very widespread. Principles of developing system dynamics based games are recently outlined (Mohapatra and Saha 1989; Saha, 1990). The learning aspects of such games are also tested in an environment of new product growth.

Testing OR Models in System Dynamics Framework

System dynamics provide an opportunity to test goodness of OR models. Recently, for a highly nonlinear and high order dynamic model of new product growth, an LP model was constructed (Saha, 1990). The original system dynamics model was converted into a game form and the LP result was implemented on it. The dynamic behaviour of the model obtained with repeatedly applying LP was found to be inferior to that obtained with intuitively designed policies.

System Dynamics and Other Dynamic Models

System dynamics is often criticized as a difficult tool to master. KSIM, QSIM2, and MISS-E are other dynamic modelling techniques which are relatively simple and use a cross-impact matrix to model the relationships. Recent works have compared their relative merits and demerits (Ganguli and Sinha, 1987; Mohapatra and Vizayakumar 1988, 1989; Vizayakumar, 1990). They lead to a conclusion that system dynamics is very versatile. The other dynamic modelling techniques need further refinements to match the power of system dynamics.

Decision Support System and System Dynamics

An intelligent optimizer for policy design using system dynamics models is developed recently (Ghosh, 1989). It uses artificial intelligence techniques of heuristic search and knowledge engineering for searching suitable policies. Given a qualitative description of the desired behaviour of the key variables of a model, the optimizer automatically searches for suitable policy structures and reports the user only those attempts which result in not too unacceptable behaviour.

Interpretive Structural Modelling and SD

A recent work has highlighted the use of interpretive structural modelling in the constriction of a casual-loop diagram required for system dynamics modelling (Vizayakumar and Mahapatra 1990).

Applicarion of System Dynamics Models

System Dynamics models have found varying types of applications :

- Explaining the past behaviour
- Forecasting general behavioural pattern
- Generating future scenarios
- Analysing the effect of environmental changes
- Analysing the effect of structural and policy changes
- Designing new policies.
- Testing the adequacy of other methodologies

A few notable Indian applications of system dynamics are highlighted in this paper.

Commodity Industries

Indian tea industry is afflicted with problems of severe price fluctuation and retarded growth. A system dynamics model of the industry consisting of four major sectors: Production, Domestic Marketing, Export, and Research and Development (Mohapatra et. al 1990; Bora, 1981), suggests following :

a. Buffer stocks be created in India and abroad at a fast rate while supplying to the market inventory only gradually to ensure price stability.

b. A favourable financial environment be created with lower tax rate, higher subsidy for replantation, and relatively easier availability of finance.

c. Financial contribution to R & D institutions be increased.

d. Better quality tea be produced.

e. An extension policy based on average operating profit margin and forecast values of demand and yield be followed.

Understanding Stock Price Movements

A system dynamics model divides the capital market into two sectors: speculation sector and investment sector (Srinivasan, 1989, Srinivasan et. al, 1989). Speculators consider buying and selling of stocks depending on price movements; investors, on the other hand, consider dividend yield to fix their level of participation in the stock market. When tested for a particular company, the actual stock price matches closely with the simulated results.

Perspective Plan of Steel Plant

A system dynamics based software package for an integrated steel plant has been developed to carryout what-if type of experiments (Kumar, 1983;1984). The package includes a set of models to estimate general Indian economic conditions, all India demand of flat and tubular steel products, availability of coking coal and power, and the performance of steel plant both in tonnes of output and financial indicators.

In another study demand behaviour of steel products is estimated with a modular approach following system dynamics methodology (Narchal, 1987).

Corporate Planning

System dynamics models are very appropriate for corporate planning (Kumar and Vrat, 1989). It is used as a tool for long range planning for a cement company (Saha, 1984), an aluminium industry (Roy, 1987), explora-

tion and exploitation of oil and natural gas (Chowdhury and Sahu, 1988; Choudhury 1990), an engineering company and the Indian paper industry (Narchal, 1984, Nair, 1986).

Conceptual Framework of Group Behaviour

A system dynamics framework is suggested in modelling and testing the dynamics involved in group interaction process (John and Sushil). It consists of six modules : roles, goal clarity, specific work norms, task control, size and formal leadership. The study is intended to show how the interrelations and interdependence influence the group behaviour.

Urban System Dynamics

A system dynamics framework has been developed for a city (Reddy, et.al, 1987). The various subsystems are population housing, industrial infrastructure, and land. The model is nearing completion and will be published shortly.

Transportation Planning

A system dynamics model for Delhi Urban transportation model has been developed at IIT Delhi (Khanna, 1986; khanna et al, 1989).The model experiments with a wide range of policy structures ranging from increase in petrol price and bus fares, improvement in level of bus service to public transport fare structure, fuel consumption and environment quality.

Technology Management

A system dynamics model has been developed to study the growth characteristics of a new technology product when it coexits with an old technology product (Sahay, 1990). The case of colour and Black and White TVs was kept in view while building the model and choosing the parameter values.

The model has been converted into a game form. The game form allows simulation of intuitively made, rationality bounded decisions, and of optimal decisions of a rational decision maker. The manpower policy, which is based on higher skill development, reducing hiring and training delays, and retaining workers for a longer period, has the highest leverage for an equitable growth of the industry.

Environmental Impact Analysis

A model for environmental impact analysis considers such qualitative factors as social awareness against hazards of pollution, social pressure on the government to take appropriate measures, and counter pressure on the government by pollution generating industries (Vizayakumar 1989,1990). A combined policy of tax exemption on pollution control investment and pollution taxes is found to maintain both the growth of the industry and the pollution within limits.

The dynamic interaction among several activities and impacts of coal mining are analysed in another study (Vizayakumar and Mohapatra 1988). Various alternative pollution control methods are incorporated in the model and tested, over a period of 25 years, for their effectiveness.

Energy Demand Forecasting

A model for railway energy demand is calibrated with data for the period 1961-1971 (Dutta and Mohapatra, 1988), validated from 1971 to 1985, and is further simulated upto the year 2011. The best policy option for Indian Railways seems to be to upgrade technology through higher electrification and augmentation of motive power with high capacity electric locomotives.

A similar model has been built for the road sector which while developing alternative future scenarios has recommended a set of suitable policy options to minimize energy demand without affecting the transport requirement of the economy (Dutta and Mohapatra, 1988).

A model, being developed at IIT, Delhi, applies system dynamics to various energy related issues of the economy (Vij et. al. 1988; Vij, 1990). The model critically analyses the role of waste generation and recycling and concludes that waste generation and recycling is very beneficial to energy economy.

A study at NPC estimates the energy requirement of the Indian domestic sector (Raghavendran, 1985). In another study a system dynamics framework has been suggested for energy planning in India (Dutta and Mohapatra, 1987).

Manpower Planning

Koul and Vrat (1988) have developed a manpower planning model for an engineering company in the public sector. In separate studies at IIT, Kharagpur, manpower planning models are developed for Army Cadre management and Scientists at a CSIR laboratory.

Financial Applications

Roy and Sahu (1987) have developed a model for capital investment mechanisms for production capacity acquisition while Koul and Vrat (1988) report a model which purports the financial working of a public sector engineering company in India.

National Development

Sociol economic factors of development have been brought under a holistic framework in a system dynamics model for analysing national development policies in India. (Wolsten holms and Mandal, 1988; Mandal, 1986). The model consists of an agricultural sector, a non-agricultural sector, and a finance sector. The findings are summarised as follows :

a. With the present structure of the economy, the growth can largely be influenced by changing target growth rate, higher external borrowing, emphasising on agricultural export. However, the long term growth rate is not expected to exceed 4.5% per annum.

b. The income inequality is expected to increase. However, the incidence of income disparity can effectively be reduced by higher rate of economic development, altering agricultural production composition, and by pursuing policies like imposition of land ceiling, minimum wage rate, and providing fertiliser subsidy. But improvement in income distribution may not bring about a higher growth.

Conclusions

An objective analysis of the status of system dynamics in India indicates the following :

(i) SD has not developed strong roots either in educational institutions or in industries.

(ii) The work on SD is very polarised, mostly in two IITs, Kharagpur and Delhi.

(iii) No practical application has ever been implemented.

(iv) There is a steady growth of number of papers appearing in journals and conference proceedings. But most of the papers are either in conference proceedings or foreign journals which are not very well-known or do not have wide circulation.

(v) There is no book on SD which documents Indian experiences.

(vi) Number of theoretical papers matches the number of practical applications.

(vii) Reported application areas have a wide span ranging from commodities to environmental impact analysis.

To effectively disseminate SD into the realms of academics and industry, the following activities are needed :

(i) Short-term courses have to be organized.

(ii) Text books and books depicting Indian applications should be published.

(iii) Papers should be published in popular journals rather than only in journals meant exclusively for SD.

(iv) The relationship of SD with other standard methodologies be established.

(v) SD should be introduced as a compulsory subject in every engineering/management curriculum.

(vi) SD be applied to real-life problems and the works be given wide publicity.

(vii) Sponsorship be sought from government and industries for carrying out more involved studies.

(viii) Softwares be developed and should be available at reasonable price.

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□

Our cultural attitude towards opportunities is more than tinged with envy. There are always more people who wished they had spotted the opportunity than those who have done so. *—Edward de' Bono*	An opportunity is as real an igredient in business as raw materials, labour or finance but it only exists when you can see it. *—Edward de' Bone*

Becoming a Leader: Five Moments of Truth

Becoming a leader is not something that one can do overnight. It's a gradual developmental process similar to the growth of a tree. Leaders grow and develop by the choices they make. There are Five Moments of Truth in Becoming a Leader.

There are three things about these Moments of Truth :

1. **They are sequential. That is, each one depends on the one before it. Unless you have passed Moment One, you don't have the opportunity to move to Moment Two, and so forth.**
2. **They are progressively more difficult. Not only is each dependent upon the previous one, each is progressively more challenging than the one before.**
3. **All of the 5 Moments are within an individual's Circle of Influence. No one else does or can determine the choice.**

Picture for a moment a person inside a camera. It's completely dark inside. Then the shutter clicks. When this happens, the person sees, for a brief moment, the light from the outside. Then the shutter closes and it becomes dark again. The light from the outside represents the true possibilities of people in becoming the type of leaders to which they aspire. The challenge is to keep the shutter open; to be able to see clearly and continuously the vision of their full potential.

Moment One : Discovering One's Core Principles and Values

Around the sixth century B.C., the Chinese philosopher Lao Tzu talked about leadership. He said,

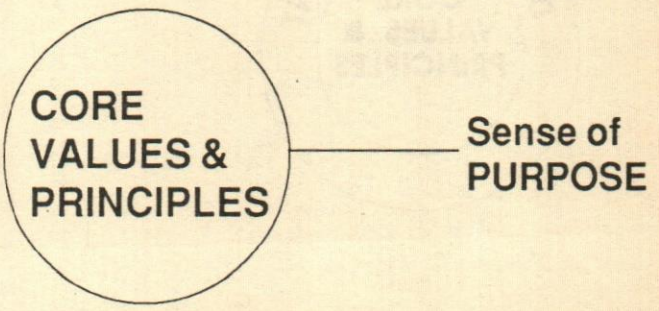
> **"The leader shows that style is no substitute for substance.....that creating an impression is not more potent than acting from one center."**

Almost 2000 years ago, a Roman historian by the name of Plutarch researched the lives of great leaders in the Greek and Roman civilizations. In his book, Plutarch's Lives, he refers to Alexander the Great, Pericles, Solon clif Lawgiver, and so forth. Plutarch talks about a common quality in all great men. He described it as a sense of destiny. Shortly after the turn of this century, a man by the name of Napoleon Hill looked at great leaders of his day. Among the ones he talked with and surveyed were Andrew Carnegie, Henry Ford and Charles Schwab. In trying to uncover the common traits of these leaders, Hill concluded that the common thread was that each had a sense of mission. In 1989, two professors of the Stanford Business School, Dr. James Collins and Dr. Jerry Porras, analysed over 100 successful executives with whom they had observed and worked. Their conclusion reflected that the ingredients common to each were a sense of purpose, mission, and vision.

Deciding and writing down one's core principles and values is the first Moment of Truth. As such, it is the easiest to do. And yet, my observation in working with people throughout the world is that perhaps not one in a hundred have done it really comes to grips with what they really believe and what principles they choose to govern their lives. For a leader, deciding core principles and values is an essential step. As James Callaghan, former Prime Minister of Britain put it,

> **"In my judgement, a leader should have a core philosophy and belief against which he can judge the important issues as they arise. Unless he has that bedrock to fall back on, the unexpected storms that blow up will toss him about like a cork. Without such a foundation, a leader may be able to survive, but he won't be a leader in the sense that I use the term."**

How does one develop a core set of values and principles? The key is to do deep introspection, and write



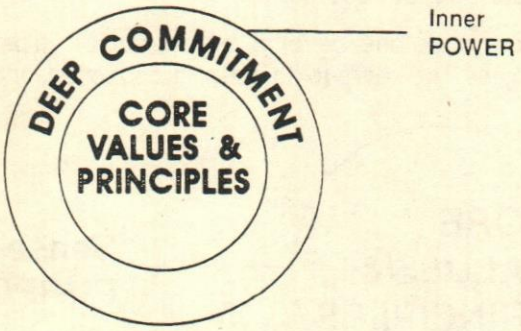
out a personal mission statement. For a mission statement to be effective in one's life it must be read regularly.

The primary result of developing a core set of values and principles is that it gives one a sense of purpose and meaning.

Moment Two: Making a Deep Commitment to One's Core Principles and Values

A deep commitment to one's core Principles and Values is the second Moment of Truth. If reactivity is defined as responding based on the feelings at the moment, then I would like to redefine the concept in this way : If we build our emotions into our core values, then we can and will respond based on our feelings because they will be the same as our core values. When the heroin, Joan of Arc, was confronted with a difficult military challenge, none of her men in arms believed that it was possible to achieve the objective. She told her general in chief that she personally would lead the attack. The general responded, "Not a man will follow you." Her response was, "I will not look back to see if anyone is following me." This is an example of the type of commitment that I am talking about here.

How does one develop commitment? I believe the key is to commit before the event. Don't wait until you are in a situation to make a decision on how you are going to act. Decide before hand, based on your values. Make a decision by picturing yourself in the situation. You're much more likely to respond based on values in the real situation when you have done it first in your mind. The result of a deep commitment is an inner power. This power comes not from the core principles and values alone but from the strength of the commitment to them.



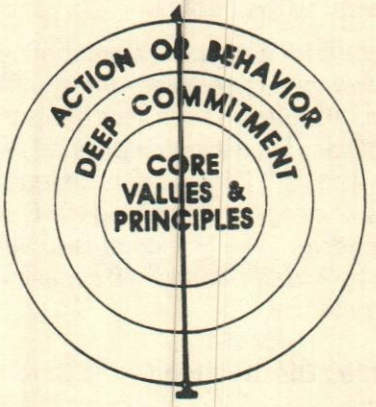
Moment Three : Aligning Behaviour and Actions to One's Deep Commitment to Core Values

Once when Mohandas Gandhi was speaking in England, he held a group of people spellbound for several hours, speaking without explicit preparation, without notes, and in a relatively uncomfortable environment. The crowd was enthralled with what he had to say. Reporters afterwards tried to talk with Gandhi to understand how he was able to speak so convincingly without notes or preparation. Unable to get to Gandhi because of the crowd, the reporters spoke to Gandhi's secretary, Mahadev Desai, about this remarkable man. Desai replied to their questions,

> **"What Gandhi thinks, what he feels, what he says, and what he does are all the same. He does not need notes."**

He was all lined up, and at one with himself.

When our deep commitment to our core values and principles are lined up with our behaviour and our actions, we have integrity. It is interesting to note that the root word for integrity is the same as the root word for integer-both meaning oneness. And note our use of language here : A person who is at one with himself "has it all together", is "straight", "in line", and so forth.



In Shakespeare's play, Hamlet, Polonius gives the following advice to his son Laertes :

> **"This above all : to thine own self be true, and it must follow, as the night the day, thou canst not then be false to any man."**

The great German philosopher, Friedrich Nietzsche, described it this way :

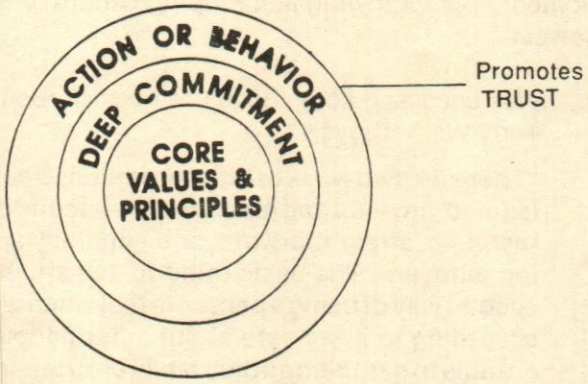
> **"We may lie with our lips but we tell the truth with the face we make when we lie."**

In the movie, Chariots of Fire, the Scottish runner, Eric Liddell demonstrates this integrity when he finds that his race (the hundred metre dash) is on Sunday. Being true to his values, he refuses to run on the Sabbath. Even when the Prince of Wales, the future King of England, tries to persuade him otherwise, he refuses saying that even though he loves his country, he cannot sacrifice his personal integrity. Finally another runner steps in and allows Liddell to take his place, but in a much longer race. One of the Olympic committee members describes the situation saying that it was a good thing Liddell had stuck to his convictions because as a true man of principle and a true athlete, his speed was a mere extension of his life force, of who he is.

That's the way it is with everyone. We all act from our core. For each of us our behaviour is a mere reflection of who we really are at our core.

How do you consistently line your actions up with your core values? I believe it is only by constant effort; by getting up whenever we fall; by constantly reviewing and committing to one's values, and deciding first in our minds how we are going to behave.

The result of this consistency, this inner integrity, is trust. The first two Moments are private. Nobody sees them. They are within a person. But they are reflected in the third Moment through behaviour. People sense when a person is acting out of deeper values. Because of the trust that this alignment promotes, people are willing to follow that type of a person. Without it they feel manipulated and only follow grudgingly, if at all.

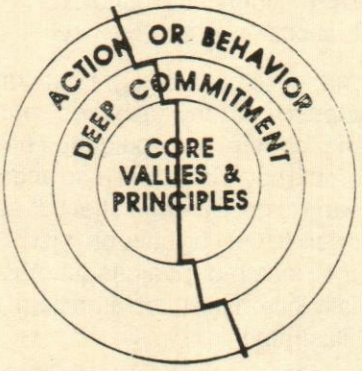


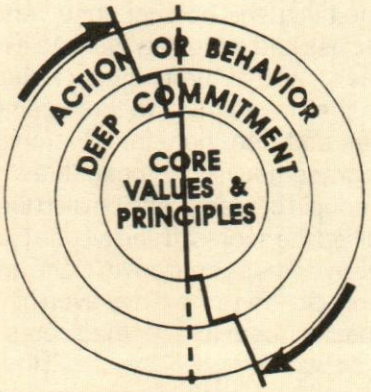
People don't follow a leader only because of what he does or says at the moment. They follow him because of what he has done and said in the past and because of what they believe he will do and say in the future. His power to lead is much deeper than his actions. It's in his being—what he is. By acting consistently upon values and principles to which he is deeply committed, a leader generates trust in his followers. The foundation of great leadership is in the being—the inner self.

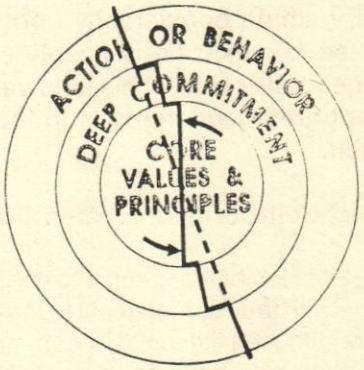
Moment Four : Self-Correcting When Out of Line

It's almost impossible for people to consistently align their behaviour with their commitment to their core values. Often they are off just a little in their commitment. When this happens they may become even further off in their behaviour. They experience a feeling of being misaligned. The language we use reflects this. When a person's bahaviour and commitment are not lined up with his values, we say that he is "crooked", "twisted", "out of line", needs to "straighten up".

This fourth Moment of Truth is the moment of becoming. What people choose to do when their behaviour is not consistent with their core values determine what they will become. At this point almost everyone feels pressure to "straighten up", to "get back in line".







This is the moment of becoming because if we do not respond quickly and straighten our behaviour to line up with our core values then our core values may gradually change to line up with our behaviour. And we become someone different.

And what's wrong with that? Is that not integrity? No. Not at all. There are two problems. First, if we change our values because of our behaviour, then we essentially have no values. We may behave in any way we feel at the moment, and then change the values to correspond. It's like having no anchor, like being driven by the winds and the waves and the influences around us. We have what are known as "situational ethics".

Second, if we have thought out our original principles and values so that they are based on timeless truths, and then changed them, we would then have a dysfunctional core. It would be an incorrect map and would not lead us where we want to go. But what effect does admitting we are wrong and self-correcting have on trust? If we straighten our behaviour to match our values (in other words, self-correct) it usually increases trust rather than diminish it. An example will illustrate this.

My daughter, Tanya, had always been a good student. One day she came home from college with tears in her eyes because she had received a "C" - in bowling, no less! She explained that she had not done very well and that none of the class had done very well. As a result, towards the end of the semester, the instructor asked each of them to go out on their own and bowl three games, keep track of the scores and turn them in. He promised he would weigh their grade heavily by these three games. Tanya went with a couple of friends and bowled the three games. But she falsified the scores. If she hit one pin she recorded five. If she hit five pins she put down eight, and so forth. The other students did the same. They even hinted that the instructor expected them to alter the scores and, because everyone else was doing it, if they didn't they would be unjustly punished. Then, as they were leaving the bowling alley, Tanya said that she felt that it just wasn't right. Even if the teacher expected it, even if all the other students did it, it was not consistent with her values. So, she returned to the bowling alley, paid the money again, and bowled three more games. As she related the story to me, she said, "I did worse than I did the first time!" But she reported the true scores and, as a result she received a "C". I told her that in my opinion that was the highest grade she had ever got—the "C" above high "A", a "C" for courage—courage to stick up for her personal values. And what happened to my trust in her? It soared.

The runner, Eric Liddell referred to earlier, ran in the quarter mile race—a race four times as long as the one for which he had trained. At one point he was pushed and fell down, but he got up and still won the race. He self-corrected. One of the coaches there described it as, "... not the prettiest race, but certainly the bravest." It takes courage to be loyal to what you believe and to self-correct when you are wrong. Because it is difficult. It offers an opportunity for greatness.

When someone is willing to self-correct it offers hope. Everyone is struggling with their own actions, trying to line them up with what they really believe. It's the examples of those who self-correct that offer hope to everyone.

And how does one self-correct? I don't know exactly how, but I believe the key is to do it fast; do it immediately after you realize you are in the wrong and inconsistent with your core values. If you wait you may begin to rationalize and to bend your commitment and your values to line up with your actions.

Moment Five : Allowing and Helping Others to Self-Correct

In his upcoming book, Bonds of Anguish, Bonds of love, Terry Warner says,

> **"There are two ways of being a person. One is alienated, anxious and resentful; the second open, resonate, straightforward, and generally speaking, buoyant. The basic thing to say about this second way of being a person is that when we live according to it, we care about other people, we are able to see them as they really are, rather than as helps or hindrances to the advancement of our interests. They, which is to say their feelings and hopes and needs, are real to us. ... Each of us chooses one or the other of these two very different ways of being and we make the choice from moment to moment by how we look upon and treat other people."**

Caring about others releases their potential. This is partly because people don't care about how much you know until they know how much you care. Tom Watson of IBM put it this way,

"I believe that the difference between success and failure in an organization can very often be traced to the question of how well the organization brings out the great energies and talents of its people."

It's this fifth Moment of Truth that brings out the energies and talents of people.

And how do you do it? How do you allow and help others to self-correct? I believe the key is in our attitudes. It is embodied in the following rule : Don't take offence and don't give offence. As Ken Keys says.

"We make ourselves and other suffer as much when we take offence as when we give offence."

I have a friend who does my tax work. One day when I was at his home going over the numbers, the door bell rang. He went to the door. A young boy scout was standing there. "Hey, mister, do you want to buy a ticket to the Scout-a-rama?" he asked. "How much are they?" my friend asked. "It's one dollar, and that's good for the whole family." My friend bought one and we went back to work. Ten minutes later the door bell rang again and other boy scout stood at the door and asked, "Do you want to buy a ticket to the Scout-a-rama?" I was waiting to hear my friend say "Oh, I'm sorry. You came too late. I've already bought one." But instead, what I heard was, "Sure . How many do you need me to buy?" That's an example of caring rather than taking offence.

When we care about others and allow and help them to self-correct and grow, we give them value. It may be this very feeling of being valued that creates the environment that promotes growth in people.

ALLOW/HELP OTHERS _____ Gives VALUE

Now we come to perhaps the most important question: : Why would anyone do these things? Why would anyone want to pursue these Five Moments? If we do them because they work, the paradox is that then they probably won't work. I believe that the only valid reason to do them is because they re part of our nature, because we believe them, because it's us.

As D.H. Lawrence put it :

"Man should never do the thing that he believes to be wrong. Because if he does he will lose his singleness, wholeness, natural honor. If you want to do a thing, you've either got to believe, sincerely, that it is your nature to do the thing or else you've got to let it alone."

Victor Frankl described it this way,

"Don't aim at success. The more you aim at it and make it a target, the more you are going to miss it. For success, like happiness, cannot be pursued. It must ensure. And it only does so as the unintended side effect of one's personal dedication to a cause greater than oneself. You have to let it happen by not caring about it."

If you do it because it's your true nature, then the paradox is that it does work. Not always immediately, but over time. Immediately it often fails. And that's the final test. For example, my daughter got a "C" in bowling. Eric Liddell was not able to run in the race at first. And when he did run it was in a race four times longer than the one he trained for. Joan of Arc was burned at the stake. It was twenty four years later that she was canonized as a Saint. If one's motivation to do these things is not because they work, can one really do them? Is it just an image? Is it realistic to think of conforming one's life to set of core, principles and values? This is something each person must decided for himself.

Let's move back into the camera, again. We experience short flashes of insight and belief, but then it becomes dark again. When the light is not shining through, doubt creeps in. But, as Shakespeare said,

"Our doubts are traitors and make us lose the good we oft might gain by fearing to attempt."

By doubting, we betray ourselves. In doing anything that we feel we shouldn't do, we betray ourselves. And when we don't do something that we know we should do, we betray ourselves. We even betray ourselves with our feelings. This can be illustrated by the minister who saw a man sleeping in his congregation : He was very upset and sorely tempted to comment on the evils of sleeping in church. He almost said, "Why even come if you're just going to sleep." After the sermon the man's wife came up to the minister, commended him on the wonderful sermon, and said how much she and her husband loved him. She said that even though her husband was dying of cancer and could hardly stay awake because of the medication and treatment he was receiving, there was no place he would rather be than in church with this minister. The minister's feelings immediately changed. But his original feelings were false. The sleeping man had not made him

angry and upset as he had thought. It was the minister who chose that emotional response.

Another story will help further illustrate the betraying nature of feelings. A woman at Heathrow Airport in London was waiting for a plane to fly back to America. She purchased a box of cookies and a book while waiting for her flight. With cookies sitting on the table next to her, she began reading her book. Suddenly a British gentleman sitting on the other side of the table reached over, opened up the cookies, took one out, and ate it. He smiled at her as he did it. The woman was horrified but didn't say anything. She just reached over, grabbed a cookie and ate it herself. The man smiled, reached over and took another cookie, and ate it. The woman, becoming very upset and angry (but not speaking), took another cookie and ate it. And back and forth they went until all but one of the cookies were eaten. And then, as though to add insult to injury, the British gentleman took the last cookie, smiled, broke it in two and slid half of it over to her. After eating his half, the British gentleman got up, smiled again, bowed politely and walked off. By this time the woman was livid. But before she could confront the man or do anything else, her flight was called. She opened her carry-on-bag to put the book away and there in her bag she noticed her box of cookies. She had been eating his cookies! And, more importantly, she had been generating false feelings of anger, resentment, and accusation towards this man who himself had actually been experiencing what she thought she was experiencing. Yet, his reaction was not resentment, not anger, but pleasant sharing.

We create our own feelings and we often betray ourselves by creating counterfeit feelings. When we doubt that we can live according to our values - when something happens and we feel like reacting counter to what we believe inside - what do we do? Or more seriously, when we begin to convince ourselves and rationalize that we believe other than what we have said we believe, how do we straighten ourselves back up? There are two things we can do that will help to bring us back to reality.

First : Drop any resentment that we have towards anyone.

Second : Perform some unselfish act of kind ness.

Another example from Joan of Arc puts all of this in perspective. When Joan was accused of witch craft and asked to recant stories of the voices she had heard, she refused saying that even if she were under the Judgement and saw the fire before her, and even if she were in the flames she would not change what she had said. She was put to the stake and when the fire was brought to her she was given one last chance to recant. Looking down the centuries, she gave these immortal words :

> **"I know this now. Every man gives his life for what he believes. Every woman gives her life for what she believes. Sometimes people believe in little or nothing yet they give their lives to that little or nothing. One life is all we have and we live it as we believe in living it. And then it is gone. But to sacrifice what you are and live without belief, that's more terrible than dying. Even more terrible than dying young."**

And at nineteen, this young peasant French girl gave her life rather than sacrifice her character. Even though few people are asked to sacrifice their lives for their character, character should have that much value to us.

Summary

So, leadership is primarily an inner quality. It's the continuous surmounting of five moments of truth. Not just once, but again, and again and again in an upward cycle.

We are all in this world together. It's as though we're all in the same race with Harold Abrahams and Eric Liddell. We are all both participants and spectators. We make mistakes and we fall along the way. And we hope others will allow us to get up, even help us to get up. At the same time, we need to allow and help others to get up, too.

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Training Challenges to Meet Technological Advances

The technological advances in industry are never questions of just buying the right equipment. Technical change in organisation is multi-dimensional and very rarely involves only change in equipment. It is also a continuing process, not an event and needs to be regarded and planned as such. Return on investment is unlikely to be realised unless technical innovation is accompanied with organisational changes when new technology is introduced. Ways of working and management structures also have to be reviewed and redesigned.

Technological advances raise many organisational and managerial questions about changes in employment levels, supervision, management structure, information systems, skills and training, systems and controls, payment systems, flexibility and productivity. As we want to modernise our plants to compete more effectively in international markets, the need for training and education in new skill areas grows. A recent survey found that upto three quarters of the labour force would need some form of retraining to match skills and knowledge with the demands of emerging technologies (Gramnenos, 1985). There would be increased demands for multi-skilling as new technologies cut across traditional, occupational and task boundaries. The relationship between technology and skill is complex and the simple, 'machines are taking over' claim is grossly exaggerated.

NPC Survey on Training

A survey on Training Policies and Strategies in the Context of Changing Technology and Productivity Improvement was conducted by NPC in 1989. A questionnaire was circulated among 200 public sector organisations in India. Only 25 companies responded. Even the limited response has shown clearly the terrible apathy among our top management towards training. The total revenue budget planned for training and development varies around 0.1 to 0.7% of the annual turnover.* The manpower responsible for training and development is about 5 per 1000 employees. In any particular organisation, about 40% of total managers and supervisors are trained in one area or the other but only 15% of technical workers are trained in a year. Management Development is given top priority in 80% of the companies but these do not coincide with introduction of new technologies. Only 3 units are in favour of involving the trade unions and workers' representatives. The Indian management still do not regard training and development as a strategic issue in technological advancement. This is surprising and disturbing in view of the fact that technological advances are having far-reaching repercussions on all aspects of industrial operations including skills, qualifications and attitude required from the workforce.

Changing Structure of Workplace Skills

In the past, control and coordination have been prime organisational roles. A vast number of production line operatives was a common feature in industry. Functional specialisation and hierarchical authority was a common characteristic. With new technologies, the production process tends to be controlled automatically. The process worker in such a system will typically fulfil a monitoring role and will intervene only if the system breaks down.

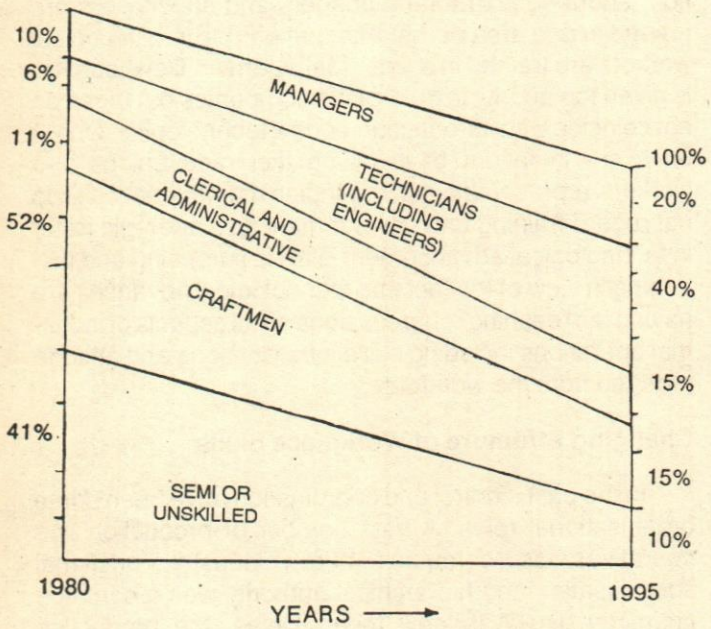
Operations like adjustment are no longer dependent on workers' capacities. They depend on the technical capabilities of the machine. The worker can take no initiative. He serves the machine. Control of the machine is ensured by its programme. The worker can only verify if the process is normal. The share of the worker and task in the process is decreasing. The worker has lost any direct contact with the final product of his work. Earlier, problems stemmed from the high segmentation and specialisation of tasks. It now emanates from the lack of understanding of the production process. The work shifts from the manipulation of the mass to the manipulation of electronic signals.

With changing technology, manual skills are increasingly being replaced by cognitive (intellectual) skills. In 1980, the Battelle Institute had conducted a study on the

* In France and other industrialised countries, 3-4% of the wage bill in the case of firms with over 2000 employees and as much as 10% in the case of certain high-tech companies are being spent for training activities (See Oechslin, 1987).

impact of microprocessors and microcomputers on employment. It had suggested that future jobs would require fewer manual skills and more innovative thinking, improved planning skills and greater capacity for team work. All these changes are altering the occupational structure in manufacturing in the developed countries (Torkel, 1985). Figure 1 projects the changes in the volume and occupational structure of manufacturing employment in the United Kingdom between 1980 and 1995.

FIG. 1 PROJECTED CHANGES IN THE VOLUME AND OCCUPATIONAL STRUCTURE OF EMPLOYMENT IN THE UNITED KINGDOM MANUFACTURING INDUSTRY, 1980 AND 1995.



Source: Commission of the European Communities (in association with the journal Futures): Eurofutures: The Challenge of innovation The Fast Report (London, butterworths, 1984, P. 100)

The proportion of managers, engineers and technicians is expected to increase and that of unskilled workers and craftsmen to decrease, amidst a general absolute decline in manufacturing employment. These trends are not limited to industrially mature economies. In Hong Kong firms manufacturing electronics equipment are now expanding their managerial and, in particular, technical and engineering staff and reducing operative personnel as they increasingly automate production and design their own products and manufacturing systems. In the Republic of Korea so-called technologists able to manage automated production systems will, by the beginning of the 1990, constitute the strategic new workforce at the expense of craftsmen, the traditional core of manpower in labour-intensive industries (Lee, 1983).

Skill Training

New technology, participative management, sophisticated quality controls, customer service, just-in-time production— the reality of tomorrow's hi-tech workplace will induce management to concentrate on skill training. Workers must be prepared to acquire new skills quickly. As technology becomes more instantaneously available worldwide, the presence of highly skilled workforce to use that technology will give management a competitive edge.

Workers are being challenged as never before by an expanding range of skill requirements. To be successful today, workers must be able to work with less supervision but be able to identify sophisticated problems and make crucial decisions. Today's job demands not only skills in reading, writing and computation but much more. Employers want a new kind of worker with much broader set of skills - or atleast a strong foundation of basics that will enable them to learn on the job. The management seek employees skilled in problem-solving, listening, negotiating and knowing how to learn. Without these essential skills, the workforce will have difficulty adapting to technological and economic changes. Also beyond the reach of an ill-prepared workforce are successful job transitions and career growth.

Technological change, innovation and heightened competition drive the upskilling of work in every industry. Competitive challenges will motivate companies to use array of strategies that call for innovative, adaptable workers with strong interpersonal skills. Business strategies such as collaboration, exemplary customer service, and emphasis on quality - require workers capable of teamwork, listening, creativity, goal setting, and problem solving.

With movement toward more participative management, employers are aggressively pushing decision making down through organisational levels to workers at the point of either production or service delivery. As their jobs become more complex and less repetitive, these employees gain greater autonomy and authority. To perform well, they must have the broad set of skills once required only of supervisors or managers.

Beyond good basic reading, writing and computation skills, employers expect competence in creative thinking, personal management and interpersonal relations. Also critical are abilities to organise and verbatise thoughts, conceptualise, resolve conflicts, work in teams.

Today's technology requires employees to have not only the standard academic skills, say employers, but also

other key basics as a foundation for building broader, more sophisticated job-oriented skills. These additional basics are :

Learning to learn : This is the ability to acquire the knowledge and skills needed to learn effectively no matter what the learning situation is Employees who know how to learn can help their companies meet strategic goals by efficiently applying new knowledge to their work. Their learning capability can affect productivity, innovation and competitiveness. By knowing how to learn, individuals can achieve competancy in workplace skills from reading to leadership. Without this basic skill, their learning is not as fast, efficient or comprehensive.

Listening : The ability to heed the key points of customers', suppliers' and co-workers' concerns.

Oral Communications : The ability to convey an adequate response to those concerns.

Problem-solving : This is the ability to think on one's feet.

Creative Thinking : The ability to come up with innovative solutions.

Selfesteem : The ability to have pride in one's self and believe in one's potential to be successful.

Goal-setting/Motivation : The ability to know how to get know how to get thing done.

Personal and career development skills : The awareness of skills needed to perform well in the workplace.

Interpersonal Skills : The ability to get along with customers, suppliers and co-workers.

Teamwork : The ability to work with others to achieve a goal.

Negotiation : The ability to build consensus through give and take.

Organisational Effectiveness : The understanding of where the organisation is headed, and how one can make a contribution.

Leadership : The ability to assume responsibility and motivate co-workers when necessary.

Role of Trade Unions

The management should have a progressive attitude towards the role that the workforce plays in meeting company objectives. The workers and trade unions have to be involved in technological and organisational innovation. Only a well trained workforce would be able to adjust readily to changing technology. An automobile plant in Italy was under the pressure of increased competition. Its management decided to reorganise the car assembly line in order to increase productivity and involved the trade union. The management had two alternatives : either simply replace human beings by robots while retaining the traditional pattern of work organisation or completely transform the production and qualification systems. It opted for the latter. "The decision was largely prompted by the firm stand taken by the workers who had come to expect a better quality of work and were no longer willing to raise and lower steel plates for the rest of their lives nor to breathe in cancer causing PVC (polyvinyl chloride) contained in the varnish" (Pescarollo, 1981).

These joint efforts resulted in a reorganisation of the production process in which individual handling, rigid work stations and simple, repetitive jobs have been replaced by group work, alternating workplace and more varied, complex jobs. "New occupations have been introduced, such as thermal processing specialists and automated varnishing specialists, which are indicative of a gradual vertical integration of work and a shift towards occupations geared to processes rather than to specific skills : regulation of parameters, quality control, minor maintenance, financial management, etc" (Pescarollo, 1981).

The introduction of new technology will generally tend to enhance managerial functions in industrial plants. The managers must put their heads together, use innovative staff management techniques, organise and motivate people in a variety of positions and roles to work effectively together. The managers should be able to use computers or management tools. They should be good in communication and should take clear-cut and total responsibility for the team's work, from design to marketing and beyond.

Technicians will become the largest industrial manpower group in the near future. As a result of the mechanisation and automation of industrial production over the last few decades in the developed countries, manual tasks and jobs have increasingly given way to supervisory and control functions. The trend will continue in future in production design, quality control, repair functions and so on as process and equipment are increasingly automated. This will mean a steady shift away from manual technician function to functions where software skills will be required.

Technician training will, therefore, increasingly need to include training in computer-aided design (CAD), computer-aided manufacturing (CAM), data communication techniques, and production control based on electronic data processing techniques. Training should be of a broad nature and mathematics should be given importance.

In the case of skilled workers, considerable retraining will be necessary. Opportunities for workers have to be upgraded when new technologies are introduced. Educational and training institutions have to change their objectives away from imparting the traditionally established sets of skills and knowledge towards promoting "learning to learn" so that the individual is enabled to keep up with the new developments throughout the whole of his working life. Technology agreements between employers and trade unions would provide for such retraining, revision and upgrading of skills. The negotiation of such agreements has become a regular feature of collective bargaining between industry and organised labour in many advanced countries.

Linking Educational and Research Institutions with Industry

One thing is certain : Only well educated and trained workers have the necessary adaptability or flexibility in continuously changing internal and external labour markets. Hence, the need for high quality, broad-based basic education for everybody. The comparative advantage of education and training institutions lies in transmitting general, theoretical and civil knowledge and skills in order to build up the necessary base for specialisation, upgrading and if necessary, skill retraining. By contrast specialised, directly job-related training should be undertaken where the technical change takes place, i.e., in the firm either on - or off-the-job. A comparative advantage in meeting new technology skills is accruing to institutions that manage to forge close training and research partnerships with innovating firms, thus reducing the distance that inevitably separates their training programmes from changes in technology and training needs. Training institutions must enhance their institutional and managerial flexibility so that they can react quickly - or even better - to anticipate changing occupational, skill and training needs.

It need not be assumed that technology is the causal variable and education and training the dependent variable and so manpower development programmes must adapt themselves by changes in skill and knowledge requirements caused by technological innovation. This is to overlook the fact that causation may also operate in the opposite direction, and that manpower development policies and programmes can significantly influence the direction and pace of technological innovation and change. Lack of proper manpower policies and programmes has caused lot of problems and complications in technology adaptation and assimilation in many industries in India. Instead of adjusting reactively and defensively to technical change as it generally does, educational and training policy should play an active and anticipatory role, and one of its primary objectives should be to promote innovation and technical progress in the economy. But if education and training are to contribute actively to technological development, ways must first be found of improving the links between educational and training institutions on the one hand and industry on the other.

Conclusion

Technological advances are inevitably becoming an integral part of economic and social life everywhere in the world. Developed countries are increasingly using new technologies such as robots and microprocessors in an attempt to compete in the world market. The developing countries like India, are trying their best in introducing advanced technological change.

Thus, more qualified labourforce will be required. The nature of skills would change. Upgradation of educational and training systems will constitute an essential element in the strategy to ensure technological advances. Education and training have to be expanded at all levels in all enterprises. The educational and training institutions have to strengthen their links with industries and research institutions so that they will be better able to anticipate changing skill and knowledge requirements, adjust their activities accordingly and play a more active role in promoting technological advances.

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Communication

Why India Failed to take off Technologically ?

Development and production of new technology, is almost negligible in the Indian industry. The three fields where some indigenous development of technology has taken place are nuclear energy, space research and agriculture. Innovative developments are also known in the railways and defence. Scientific research in the country has, however, largely remained unrelated to industrial applications.

The private sector of industry has sometimes been engaged in a rather low level of R & D work. In some instances, it has successfully accomplished the substitution of relatively scarce raw materials by locally available inputs. The instances refer to the use of bamboos for making rayon grade pulp, seashells in the production of cement, and use of previously unknown oil seeds for edible and industrial purposes. But these instances of factor substitution, can hardly be characterized as technovation. An exception is, however, provided by the development of ultra-pure electronic grade Silicon through the joint efforts of the Indian Institute of Science (Bangalore), Mettur Chemicals, and the Department of Non-conventional Sources of Energy (Prabhu, 1986).

Some Reasons

Some of the major reasons behind the near-absence of innovation in Indian industry, may be specified as :

(i) Indian industrial enterprises have been operating in protected markets dominated by shortages. In the absence of serious internal and external competition, in price and quality, Indian enterprises lacked any incentive for improving their production and productivity through R & D.

(ii) In the absence of large economies of scale, production capacities of industrial units have been fractionalised. The state of industry is characterized by the presence of a large number of units with small production capacities. This situation has been the direct result of the industrial policy regime. It is hardly conducive for the promotion of R & D work owing to the units' inability to generate adequate cash flows required for technology development (Desai, 1988; Alam, 1988).

(iii) When an industrial unit proceeds towardds a new line of production, it meets its requirement of new technology through import. Even though the 'know how' may be available in the national laboratories, it may be inadequate for the requirements of the entrepreneurs. An industrial unit venturing into a new product line, requires not only the 'know how' of production techniques, but also needs help regarding the selection and availability of plant and equipment, marketing & extension support including training of personnel. All these vital requirements of a new industrial unit, cannot often be met through domestic sources. Cooperation between industry, national laboratories, research institutes, and universities, towards specific goals and solution of particular problems, has been missing.

(iv) Research outlays are often inadequate to cover the financial expenditure/investment required, to commercially develop the process(es)/product(s), resulting from the R & D work.

(v) R & D work when successful, does not often focus further on developing the delivery systems needed for the wider use and diffusion of its results. Biogas plants and Solar energy devices, could not be used, and diffused rapidly owing to constraints of their inadequate delivery systems.

(vi) Incentives for in-house R & D cooperation within industrial units do not promote R & D cooperation between them. Such cooperation is vital for setting up better, larger, and more sophisticated, research facilities for their common benefit. Presently R & D expenditure is often incurred mainly for getting tax concessions (Alam, 1988). Pursuit of welldefined goals of productivity and innovation is largely absent. Incentives for technological research and development, need to be meaningfully linked to the

attainment of tangible progress/results, and not merely to the amount of expenditure.

(vii) Even large industrial houses like Tatas or Birlas, have failed to develop technology in areas of their interest despite the availability of opportunities to them, and their years of advantage over their Korean counterparts. Indian business houses do not take R & D seriously, and are as a rule, primarily oriented toward easy and riskless profits (Panandikar, 1990).

(viii) The total innovation chain is weak at several points. For this reason, the results of applied research in the laboratories, cannot often be transferred to the field and production floor in the industry. Production engineering remains a particularly weak point.

(ix) Quality of Science and Technology personnel in the country is highly variable. Many potential leaders in the emerging new fields of science and technology, are being lost to other countries, or to other areas of endeavour within the country. The amenities, incentives, emoluments, promotions, housing facilities, etc, available to them are comparatively unattractive. Loss and diversion of techno-scientific talent, lead to gaps in the ranks of leadership and excellence (Planning Commission Report, 1986).

(x) Acquisition of 'know how' from abroad, is not followed by efforts to understand the 'know why' of imported technology. This results in a one-time copying of the technology abroad. The imported technology becomes obsolete over a few years' time. Efforts to assimilate, adopt, and further develop, the acquired technology in a self-sustained manner, fail to take off. The need to improve learning, and innovative capacities, is greater and more urgent in the case of new information, technologies.

(xi) The overall, and perhaps, the most important single reason for the absence of innovation in Indian industry, is the country's poor culture of productivity (Rastogi, 1988). The basal values of the present national culture, negate and depress the expressions of creativity, work excellence, and work ethics.

Dynamics of Technovation

In terms of the dynamics of technovation process the status of technovation, and R & D in Indian industry, may be seen as the logical outcome of :

(i) weak organizational cultures,

(ii) inadequacy of focussed applied research,

(iii) ill-developed capabilities in design development, and production engineering,

(iv) ineffective delivery systems i.e., modes of diffusion, and finally,

(v) the near-absence of resource generation.

Some Indications

These indicators are applicable to industrial units in both the private and public sectors. Exceptions if any, are rare.

- Firms do not develop their own designs.
- Firms are unable to decrease their costs of production to international level.
- Firms are not able to improve the quality of their products to world standard.
- Firms have, by and large, failed to penetrate world export markets and exploit the areas of their comparative advantage.
- Firms have failed to develop either their inhouse R & D capabilities, or undertake collaborative R & D efforts.

Together, they serve to underscore the continuing failure of the Indian industry to develop its indigenous technology base and capablilities.

R & D Failure in Scientific Establishments

India has built-up over the years, a substantive R & D base. The country has 150 universities, five Institutes of Technology, two advanced institutions of techno-scientific research (e.g., Indian Institute of Science (Bangalore) and Tata Institute of Fundamental Research (Bombay), besides a large number of well-equipped laboratories all over the country managed by the Council for Scientific and Industrial Research. Similar research bodies also exist for various other areas including agriculture and medicine. Approximately one hundred thousand diploma holders, graduates, and post-graduates in various science and engineering discipines are produced every year. The current economically active science and technology people number about three million. Some four thousand persons are awarded doctorates in sciences and related subjects every year. The total number of research institutions engaged in R & D work is about 1,300. These come under the purview of various agencies of Central Government, state governments, public-sector undertakings, and the private sector. Indian investment in R & D is varyingly estimated at one per cent of GDP or about Rs. 4,000 crores

a year (1988-89 figure). India has also the third largest pool of scientific and technological manpower in the world. The Indian scientific and technological manpower fills in gaps in many industrially advanced countries including the USA*.

Impact of R & D activity on different sectors of the Indian economy has been unimpressive. The benefits have, however, been essentially "the products of developmental work where research has played only a minor role. Products, processes, techniques, knowledge had been known, and all that was done was to draw on this resource for doing a particular job in a known fashion" (Sukh Dev, 1989). In several vital areas, indigenous R & D has scarcely made any impact. Some of these are :

- Petrochemicals,
- Polymers and plastics,
- Synthetic fibres,
- Fertilizers,
- Fermentation technology, including antibiotics,
- Industrial enzymes,
- Advanced materials, and
- Electronics.

Why has the Indian performance been so poor? Why has the country failed to develop front line technologies in any field ? The broad answer to these questions lies in the nation's poor culture of productivity which is characterized by the pathological value orientations of individualism, parochialism, and 'soft' rationalism (Rastogi, 1987; 1988). More specifically, some light is thrown on these questions by two reports, one on the CSIR and second on the ICAR. The Abid Hussain Committee reviewed the CSIR system which supports over 12,000 technical personnel. The committee found that the CSIR system had failed to generate any scientific breakthroughs or advances in the frontiers of knowledge. The system had also failed to develop technologies which could meet the most agonising needs of our economy and society. The ICAR Review Committee's reports on the ICAR system which has a scientific manpower strength of over 30,000 are even more critical. The system was seen to be overlaid by bureaucratic restrictions, stifling hierarchy, obstructive procedures, inadequate development of human resources, poor development and assessment of technology, and out-dated information system.

Two basic factors underlying this state of affairs have been identified as (Panandiker, 1990) :

(i) The lack of well defined priorities in R & D in terms of areas where India has a comparative advantage,

(ii) The inability to create the culture of R & D in both public and private sector organisations, where innovation is fostered and the indigenous talent nurtured.

With regard to the first factor, the available data indicates that the resources are thinly spread over too many areas of R & D. All of these areas cannot be properly supported and backed up on account of the constraints of available resources of money and manpower. Careful indentification of a few areas of high priority according to national needs, and comparative advantage in terms of human resource, seems to be missing. With regard to the second factor, the Indian R & D establishments are seen to be stiflingly bureaucratic. They are dominated by either generalist administrators or techno-bureaucrats. These R & D managers neither understand the creative ethos of R & D culture, nor do they have any iidea about how to nourish innovative endeavour (Panandiker, 1990). According to Nigam (1990), 'development of technology is simply not possible in Indian labs, because everybody is obsessed with writing reports and publishing papers'.

In addition to the foregoing negative factors, there are many other missing positive factors at the level of supportive policies, practices, mechanisms, and instruments. They are sought to be elucidated in terms of what needs to be done for technology development at the national level. Culture (i.e., strongly shared values) or the lack of it, however, emerges as a significant causal factor in this context. Both the industrial enterprises, and the R & D organizations, are seen to be singularly lacking in the culture of creativity and excellence, achievement and commitment.

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* Compiled from various official and non-official sources.

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Communication

Managing Pollution from Small Enterprises

There are an estimated 2.5 million small scale units, constituting over 90% of the total number of industries in the country. They produce as much goods and services as the large and medium units. Inherent to their basic development, most of the small scale units adopt inefficient and wasteful technologies, as the emphasis has been on keeping the capital investment to the lowest possible level. Consequently, these units cumulatively pollute as much, if not more, as the large and medium units together, though the unitwise pollution load is small. For example, the specific pollution load of B.O.D./ton of paper produced is in the range of 200—300 kgs. for a small pulp & paper mill (capacity less than 50 tpd), as against 50—100 kgs. for a large integrated paper mill. As a result, small paper units account for nearly 80% of the BOD load from the total paper industry, although their share in total paper production is only about 50%.

Prevention Vs Cure

Due to availability of cheap labour coupled with scarcity of capital and lack of competition the small scale units tend to focus more on quantum of production than on efficiency. Thus, the total resource inputs required per unit of production are much higher in small enterprises as compared to their large counterparts. The chemical recovery for instance,in a large paper mill could be more than 90%, whereas, it is almost zero in small paper plants.

Being very small in size and run by technically not so competent persons, adoption of advanced pollution control systems has been found neither feasible nor desirable. On the other hand, prevention as a means to reduce pollution as well as improve resource efficiency is very attractive. For instance, in electroplating industry, it is possible to reduce the wastage of plating chemicals by as much as 50% through recovery and reuse of dragouts as well as rinse/wash waters. This not only reduces the discharge of pollutants but increases profits too.

Concentrated Clusters

The development and location of industries in India has not been well planned. Highly concentrated clusters of a wide mix of industries came into being in various regions depending upon the availability of facilities like raw materials, market, labour, power and of course fiscal incentives. Thus, we have a mix of sports goods, engineering and woollen textile units in Ludhiana or plaster of paris, textiles and food processing industries in Bikaner. The associated problems of segregation of incompatible wastes, conveyance, etc. therefore, render pollution control at community level for group of industries more difficult.

Poor infrastructure, lack of systematic information dissemination and discouragement of foreign participation has rendered technical awareness levels in these industries very low. Consequently, newer ideas are neither known nor easily accepted.

Approach Towards Pollution Control

The desirable approach to pollution control under these circumstances, should include :

1. In order to combat the industrial pollution problem from small enterprises effectively, a special package should be evolved as these industries neither have their own technical capabilities nor the capacity to engage turnkey suppliers due to limited financial resources. The package should comprise rational policy prescriptions such as techno-economically viable emission/effluent standards, spread-out time-frame for implementation, development of institutions to provide expert services, fiscal incentives for promotion of pollution prevention & low waste technologies and rapid induction of low waste technologies.
2. Increased emphasis should be on pollution prevention and only after exhausting all such avenues should pollution control, in the conventional sense, be resorted to for solving the problem of residual pollution. It has been experienced that this has a much better acceptability among the industry because;
   (a) It offers direct benefits to the industry in terms of increased efficiency of production, reduction in raw materials and energy consumption, better

product quality, resource recovery, etc. Studies carried out by the NPC in a number of small scale units indicate that through simple and inexpensive pollution prevention or waste minimisation measures, it is possible to reduce generation of pollutants at the source, by as much as 50%, leading to increased profitability of a varying degree among different units.

(b) Pollution Prevention, in most cases, has been found to be a complementary and beneficial effort to the conventional 'end-of-the-pipe-control' approach. Modifying and improving the combustion conditions in a down draft kiln for instance, costed Rs.50,000 to bring the particulate emissions down to almost 30% of the original level. To achieve the same result, the cheapest control system would have costed at least Rs. 2,00,000. In addtion, improved combustion conditions reduced the specific fuel consumption by over 20%.

(c) Pollution control, when preceded by pollution prevention becomes cheaper. In an ice- cream manufacturing factory, implementation of pollution prevention measures helped in bringing down the cost of the waste water treatment plant by about 40%.

3. There has to be a gradual shift from purely regulatory measures to that of a helping attitude. The units should be motivated to take up pollution control activities sincerely instead of adopting measures just to fulfil the mandatory requirements. There is an example of a small secondary steel processing unit where the management decided to get a pollution control system installed on the electric furnace to improve the working environment. This decision was taken although there was no compulsion from the regulatory bodies and despite the fact that such a system was to be installed for the first time in this country and no proven experience was available. Such efforts by the units should be recognised and encouraged.

Requisite Actions

In order to effectively implement pollution control in industries several steps need to be taken up immediately :

1. Stringent legal requirements should not be imposed upon the industries at the very first instance. Instead a time bound programme should be drawn up which could be implemented by the units in a phased manner. It should be noted that reducing pollution from 100% to say 10% is cheaper and simpler than bringing it down further to 5%. In other words, the emission standards which the units need to comply with should be made progressively stringent as has been the case world over. This would allow better adaptation of control technologies, spacing out deployment of capital resources and increased inclination of units in meeting the standards instead of circumventing them.

2. The existing institutions & consultancy outfits in the field of pollution prevention and control are beseiged with the following problems :

   (a) The thrust of the private consulting agencies is towards large scale units for commercial reasons. As a result the small and medium scale industries are deprived of expert advice/services. These agencies also often ignore pollution prevention aspects while dealing with pollution problems since pollution prevention or waste minimisation efforts result in less investment on the ultimate pollution control systems and this obviously is in direct conflict with their business interests.

   (b) There is no dearth of the Government institutions/agencies dealing exclusively with the small scale sector. Their primary concern has been to promote small industries with little attention to the environmental repercussions. Be it NSIC, SISIs or DICs they possess virtually no pollution control expertise.

There is, therefore, an imminent need to set up a separate organisation to provide professional technical assistance to these units in the area of pollution prevention & control. Such an organisation could be, at least initially, funded by the government so that it can operate on 'no profit no loss' basis and thus provide services at affordable costs. Assistance can also be sought from international agencies like World Bank, United Nations Environment Programme, etc. for equipping such an organisation with necessary hardware. The basic mandate of this organisation should be to provide technical expertise in evolving simple, cost effective pollution control solutions after exhausting all the possibilities of pollution prevention. Alternatively, existing organisations like, the National Environmental Engineering Research Institute, the National Productivity Council, etc., could be strengthened in order to fulfil this mandate. It may be mentioned

that these organisations' work would be highly specialised and hence emphasis in manning the organisation should be on getting the best of the expertise available in this field.

3. The existing fiscal incentives like rebate on water cess, depreciation allowance, etc. are inadequate and not attractive enough. The government could consider evolving a prudent mix of taxes & incentives and provide funds to the industries to control pollution on concessional terms. Similarly, a package of fiscal incentives should be devised and offered to units to promote pollution prevention and waste minimisation in small scale units.

4. Special emphasis should be given for promoting units which are nonpolluting or low polluting. Substitution of existing technologies by low polluting ones should also get priority attention.

Conclusion

The prevalent approach towards industrial pollution control is biased towards curative or end-of-the-pipe measures. Consequently, pollution control is looked upon by the industries as a costly burden which needs to be circumvented. The existing policies are neither conducive to the type of industries we have in our country nor to our resource scarce economy. More so, the small scale industries presently are treated almost at par with the large scale industries in terms of mandatory pollution control requirements. A shift is essential if SSI units have to be made responsive to the compulsions of maintaining clean environment.

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Just before it comes into existence, every business is an opportunity that someone has seen.

—Edward de'Bono

Money itself is one of the most useful contrivances ever invented; it is not its fault that some people are foolish or miserly enough to be founder of it than of their own souls.

—G.B. Shaw

News is what somebody somewhere wants to suppress; all the rest is advertising.

—Lord Northcliffe

Throughout history money has oppressed people in one of the two ways; either it is very abundent but very unreliable or it has been reliable but very scarce. For many people today, it has a third fault also: it is both unreliable and scarce.

—J.K. Galbraith

Cotton Textile Industry: An Appraisal

N.C. Gupta

Textiles provides employment to about 136 lakhs persons. It is an energy-intensive industry that leaves scope for factor substitution. This paper examines factors determining investment, productivity, factor-substitution possibilities and sickness in cotton textiles industry.

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Textile industry occupies a prominent place in Indian economy primarily because it provided employment to about 136 lakhs persons in 1988-89. Cotton textiles form a major component of the textile industry. Gujarat, Tamil Nadu and Maharashtra contributed to more than 63 per cent of cotton textiles output in 1986-87. This happens to be a high energy-intensive industry as well, leaving scope for input substitution in a labour surplus economy like India.

Yarn

Yarn production is generally divided into three segments : (i) cotton yarn, (ii) blended/mixed yarn, and (iii) 100 per cent man-made spun yarn. Total yarn production which stood at 1.3 thousand million kgs. in 1980-81 increased to 1.45 thousand million kgs. in 1985-86 and 1.56 thousand million kgs. in 1988-89 with an annual average rate of growth of 2.3 per cent during 1980-81/ 1985-86 and 2.5 per cent during 1985-86/1988-89 (table 1). Cotton yarn constitutes the major portion of the total (fig. 1). It showed an annual average rate of growth of 3.3 per cent over the period 1980-81/1985-86 and 1.3 per cent over the period 1985-86/1988-89. One observes a fall in the production of both blended/mixed yarn and 100 per cent man-made spun yarn in 1985-86 as against 1980-81. The annual average rate of decline was greater in the case of 100 per cent man-made yarn. Production both of 'blended/mixed yarn' and 100 per cent man-made spun yarn increased to 170 and 91 million kgs. in 1988-89 as against 128 and 70 million kgs. in 1985-86, respectively, recording an annual average rate of growth of more than 9 per cent over the period. No wonder, this has been achieved with the introduction of new machinery and adoption of different innovative processes and methods.

Domestic consumption of yarn can be divided into the mill sector and the decentralised sector. There has been a continuous rise in the use of yarn in the decentralised sector at the expense of the mill sector. This has been due to the specific policy measures adopted by the Government.

Yarn Production 1980-81 to 1988-89
(By types of fabrics)

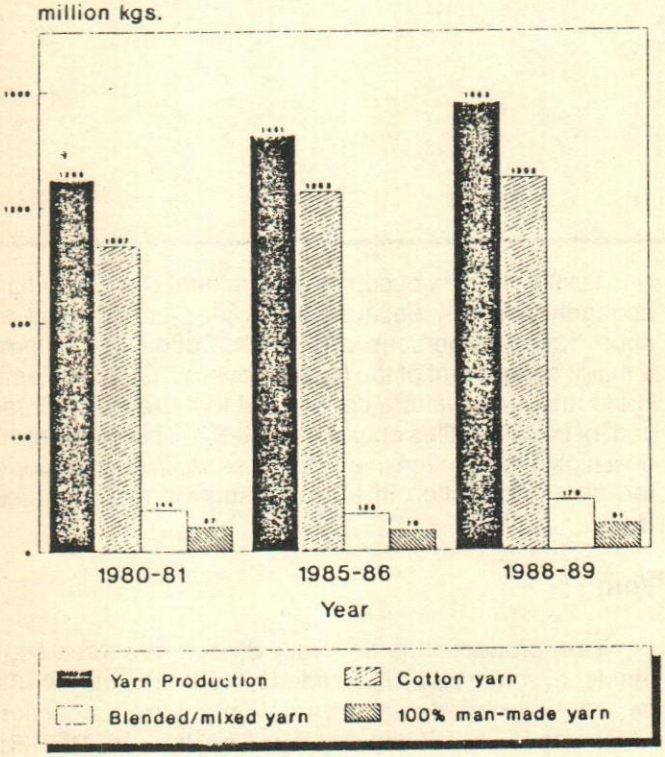

Fig. 1

Table 1 : Production, Consumption, Export and Stock Position of Yarn: 1980-81 to 1988-89

(million kgs.)

Item	1980-81	1985-86	1988-89	Annual average rate of growth 1980-81 to 1985-86	Annual average rate of growth 1985-86 to 1988-89
Production (i+ii+iii)	1,298	1,451	1,563	2.3	2.5
(i) Cotton yarn	1,067	1,253	1,302	3.3	1.3
(ii) Blended/Mixed yarn	144	128	170	-2.4	9.9
(iii) 100 per cent man-made spun yarn	87	70	91	-4.4	9.1
Domestic Consumption (all-yarn) (i+ii)	1,263	1,256	1,379	-0.1	3.2
(i) Mill Sector	538	451	374	-3.5	-6.4
(ii) Decentralised	725	805	1,005	2.1	7.7
Export (Cotton yarn)					
(i) Quantity	7	11	40.4	9.5	54.3
(ii) Value (Rs. crores)	21	45	236.2	16.5	73.8
Year-end Stocks (unsold)	16	31.1	31.2	14.2	-

Note : Consumption relates to wearing cloth only.
Source : Office of the Textile Commissioner and Indian Cotton Mills Federation *cf.* R.B.I. Report on Currency and Finance, 1981-82, Table II-35, p. 80; 1986-87 and 1988-89 Table IV-24, p. 104.

Total yarn consumption increased to 1.4 thousand million kgs. in 1988-89 with an annual average growth rate of 3.2 per cent over the period 1985-86/1988-89. Consumption of yarn in the mill sector declined from 538 million kgs. in 1980-81 to 451 and 374 million kgs. in 1985-86 and 1988-89, respectively, showing a greater decline over the period 1985-86/1988-89. Domestic consumption of yarn in the decentralised sector standing at one thousand million kgs. in 1988-89 showed an annual average growth rate of about 8 per cent over the figure for 1985-86. Export of cotton yarn showed significant increase both in quantity and value terms particularly during the period 1985-86 to 1988-89. The appreciable increase in value terms with a growth rate of around 74 per cent over the period 1985-86/1988-89 had partly been due to price increase in the foreign markets. Year-end stocks position of yarn showed an increase of the order of 14.2 per cent per year over the period 1980-81/1985-86 but the position of stocks remained nearly the same during the next three years.

Cotton and Man-made Textiles

Production of cotton and man-made textiles can be divided into the mill sector and the decentralised sector. It can further be sub-divided into : (i) cotton fabrics, (ii) blended/mixed fabrics, and (iii) 100 per cent man-made fibre fabrics pertaining to the two sectors.

Production of cotton and man-made textiles grew at the rate of 1.8 and 3.4 per cent over the period 1980-81/1985-86 and 1985-86/1988-89, respectively. Production of textiles in 1988-89 was 13.3 thousand million metres (table 2). There has been a gradual decline in production of textiles by the mill sector; from a percentage to total of 38 in 1980-81 to 28 and 21 in 1985-86 and 1988-89, respectively. A comparative increase in percentage terms with respect to the decentralised sector has thus been observed.

Cotton fabrics in the mill sector have been losing ground [fig. 2(a)], the rate of decline being 9 per cent over the period 1985-86/1988-89. Slightly higher percentage of blended/mixed fabrics is observed in the total of the mill sector. There has been no change in respect of 100 per cent man-made fibre fabrics. On the other hand, decentralised sector accounts for a very significant (almost 100 per cent) increase as far as man-made fabrics is concerned [fig. 2(b)]. Growth rate of 18 per cent per annum in respect of man made fibre fabrics during 1985-86/1988-89 has

Textiles Production 1980-81 to 1988-89
(By type of sector/fabric)

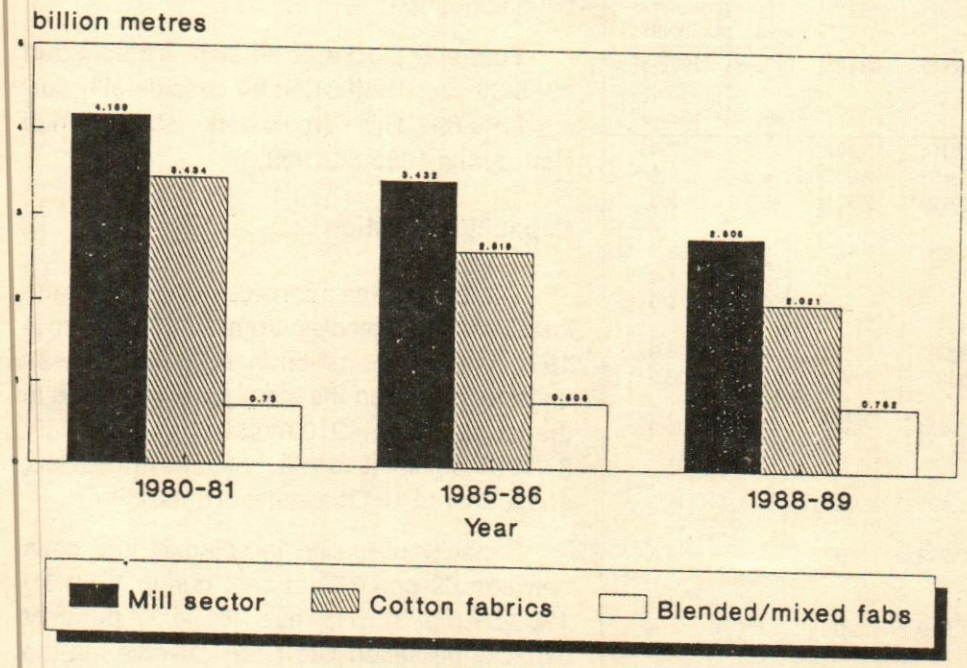

Fig. 2 (a)

Textiles Production 1980-81 to 1988-89
(By types of fabrics)

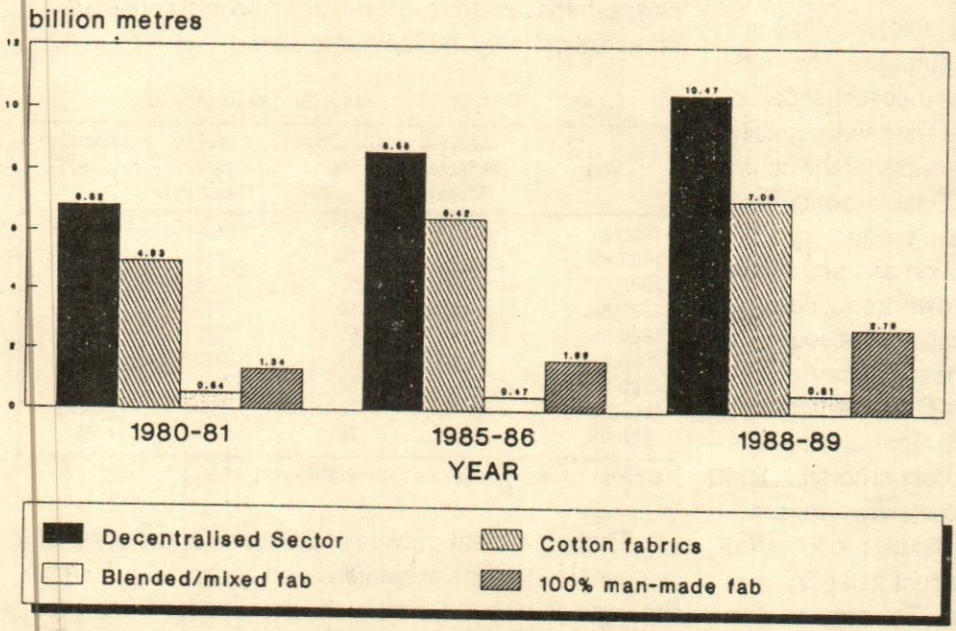

Fig. 2 (b)

been achieved due to the introduction of modern machinery, development of skill, availability of raw material/finance, market research through different media of advertising and publicity, besides various government policies towards encouragement of this sector.

There does not appear to be any change in domestic consumption of all-cloth during 1980-81/1985-86. But, one notices some improvement from 10.2 thousand million metres in 1985-86 to 11.5 thousand million metres in 1988-89, recording an annual growth rate of more than 4 per cent over the period. This has been due to the increase in national income and thereby per capita income and standard of living of the people.

Export of cotton fabrics more than doubled to Rs. 1519 crores in 1985-86 from Rs. 671 crores in 1980-81, showing an annual average growth rate of around 18 per cent over the period. It declined to Rs. 1105 crores in 1988-89, annual average rate of decline being 11 per cent over the period 1985-86/1988-89. This could be attributed to increase in consumption of cloth within the economy as also growing competition abroad. In case one takes into account price rise also, export in quantitative terms would have fallen at a much higher percentage.

Studies for the period 1952-61 and 1962-79 reveal that it is by and large the overseas price competitiveness which has been an important determinant of India's textile exports (Jain, 1988). Measurement of the price competitiveness in conjunction with the domestic prices *i.e.* through the domestic demand

Table 2 : Production, Consumption, Export and Stock Position of Cotton and Man-made Textiles : 1980-81 to 1988-89

(*million metres*)

Item	1980-81	1985-86	1988-89	Annual average rate of growth 1980-81 to 1985-86	Annual average rate of growth 1985-86 to 1988-89
Production (i+ii)	10,989	12,014	13,282	1.8	3.4
i) Mill sector (a+b+c)	4,169	3,432	2,808	-4.0	-6.9
(a) Cotton Fabrics	3,434	2,619	2,021	-5.6	-9.0
(b) Blended/Mixed Fabrics	730	808	782	2.1	-1.1
(c) 100 per cent Man-made Fibre Fabrics	5	5	5	0.0	0.0
ii) Decentralised Sector (a+b+c)	6,820	8,582	10,474	4.7	6.9
(a) Cotton Fabrics	4,934	6,421	7,061	5.4	3.2
(b) Blended/Mixed Fabrics	540	470	615	-2.8	9.4
(c) 100 per cent Man-made Fibre Fabrics	1,346	1,691	2,798	4.7	18.3
Domestic Consumption (all cloth)*	10,071	10,212	11,517	0.3	4.1
Export of Cotton Fabrics Mills (Powerlooms and Handlooms) : (Rs. crores)	671	1,519	1,105	17.8	-11
Year-end Stocks (unsold) (all cloth)**	122	175	140	7.5	-7

*Relates to total availability. ** Relates to mill sector only.

Source : Office of the Textile Commissioner and Indian Cotton Mills Federation *cf.* R.B.I. Report on Currency and Finance 1981-82, Table III-36, p. 82 and 1988-89, Table IV-25, p. 105.

pressure is found to be a determining factor only in 3 out of 9 regression equations run for the purpose. The non-availability of various raw materials and their higher costs, relatively poor raw material productivity and lower capacity utilisation have also been found responsible for the country's poor performance in the past. Obsolescence and sickness in the textile industry; poor product quality, variety and design; inefficient distribution and promotion strategies as well as the government's own production and export policies seemed to be responsible for the country's poor competitiveness resulting in unsatisfactory export performance in the overseas market. The broad conclusions that emerge from Jain's (1988) analysis towards strategies for improving the country's product composition are : (a) reducing dependence on select slow moving products; (b) increasing exports of dynamic textile products; (c) greater diversification within each product category; and (d) larger exports of non-cotton textiles. Towards improving country's non-price competitiveness, he suggests rationalisation and modernisation of the handloom sector, promoting exports of a wider variety and streamlining overseas distribution strategies, besides streamlining government production and distribution policies.

Year-end stocks of all cloth increased in 1985-86 over 1980-81. It fell considerably during 1988-89. This reveals better absorption of cloth during 1985-86/1988-89.

Capacity Utilisation

There had been a consistent increase in the installation of spindles from 23.23 million in 1980-81 to 26.48 million in 1988-89 (table 3). Installed looms on the other hand remained in the range of 208—210 thousand during 1980-81/1986-87. It fell to 199 thousand in 1987-88, and further to 184 thousand in 1988-89.

Capacity utilisation in spindles had been between 69 and 77 per cent during 1980-81/1988-89 (fig. 3). However, 61 to 77 per cent capacity utilisation had been observed in the case of looms over the period 1980-81/1988-89. Lower percentages (64-65) were observed for the years 1982-83/1983-84. 57 to 59 per cent capacity utilisation had been seen in the case of looms. This phenomenon had perhaps been due to lower demand as a consequence of recession in the market for textiles.

Table 3: Capacity Utilization in the Textile Industry

Year	Installed Spindles (Million)	Utilization %	Installed Looms (Thousand)	Utilization %
1980-81	21.23	77	208	77
1981-82	22.22	74	210	74
1982-83	22.91	65	210	59
1983-84	24.28	64	210	57
1984-85	24.42	69	210	63
1985-86	25.02	73	210	62
1986-87	26.10	72	208	61
1987-88	26.25	70	199	65
1988-89	26.48	70	184	65

Source : Ministry of Textiles : Annual Report, 1989-90.

There is a clear decline in utilisation of the order of 7 per cent in the case of spindles and atleast 12 per cent in the case of looms. Some of the reasons for this fall are : inadequacy of finance, labour unrest, shortage of raw material, technical skill and the like.

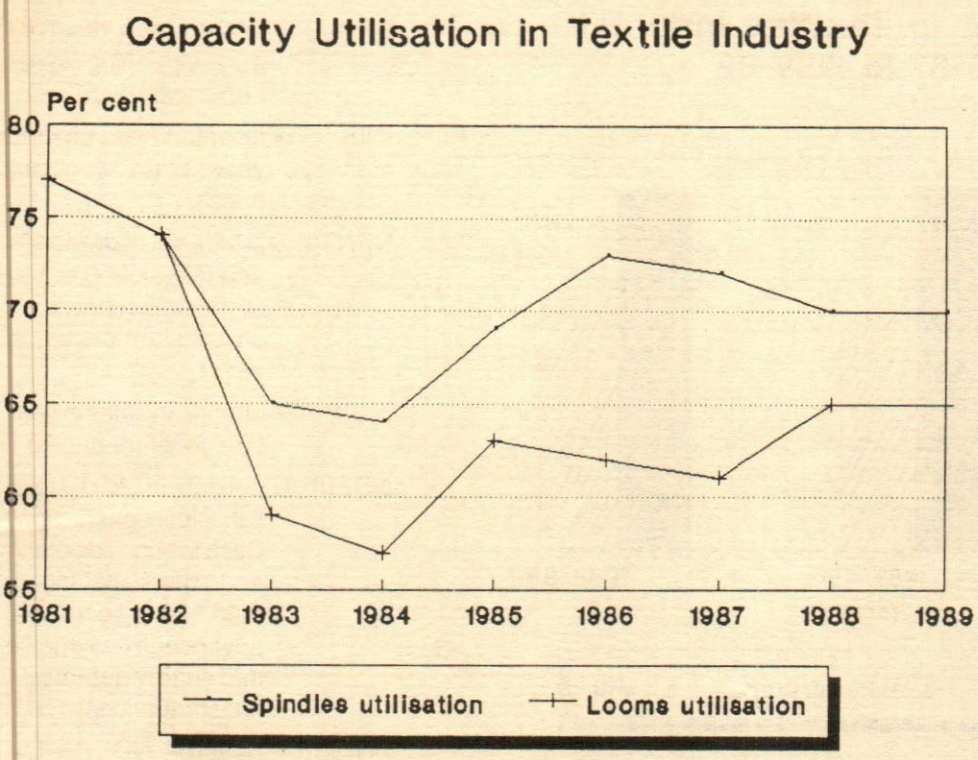

FIG. 3

Employment

An important parameter for evaluating performance of the textile sector is the generation of employment. Levels of employment in the different sectors of Textile Industry during the last three years are given in table 4.

Table 4 : Employment in Textile Industry

(Figures in lakh)

Sectors	1986-87	1987-88	1988-89
Mill	12.05	12.30	11.04
Handloom	73.58	74.84	73.43
Powerloom	35.35	48.00	51.70

Source: Ministry of Textiles: Annual Report 1989-90.

A significant decline was observed in employment in the organised mill sector from 12.3 lakhs in 1987-88 to 11 lakhs in 1988-89. This had been more than compensated by the increase in employment in the powerloom sector (fig. 4). It grew at an annual average rate of 35.8 per cent in 1987-88 over 1986-87 and 7.7 per cent in 1988-89 over 1987-88 in this sector. Part of this growth had been due to incentives provided by the Government to promote growth in the powerloom sector.

Demand Pattern

Prices of cotton textiles in India are low in absolute terms and lower still in comparison with international benchmarks. The international data on per capita fibre consumption shows that India has an abysmal record in clothing its people and, hence, there is enormous scope for improvement. Despite artificially high prices of synthetic and blended cloth, households of all income classes are shifting towards man-made fibres. Besides, there are no supply side constraints. There is adequate spinning, weaving and texturising capacity in the country, and short run domestic supply constraints on polyester staple fibre (PSF), polyester and nylon filament yarn (PFY and NFY) can always be met through imports. If the price differentials between cotton and man-made fibres can be reduced through cuts in excise and customs duties on PSF, PFY and NFY, there is every reason to believe that there will be a growth in aggregate as well as per capita textile purchases (Goswami, 1990).

According to the CPT, the actual per capita consumption of textiles in 1987 was :

Cotton	10.75	metres
Non-cotton	2.40	"
Mixed	3.20	"
Total	16.35	"

Goswami's (1990) study throws some insights that have important policy implications. These are :

(1) Own price elasticities of non-cottons and mixed textiles are significantly greater than unity.

(2) Their expenditure elasticities are also greater than unity.

(3) Even cotton textiles have an own price elasticity that is greater than one.

(4) A look at the expenditure elasticities shows that cottons are "necessities", while non-cottons and blends are "luxuries". Despite the shift at the margin towards man-made fibres, cottons still accounted for almost 68 per cent of total textiles purchased in 1986. For the richest income group, the share of cotton was above 56 per cent, while for the poorest it was almost 83 per cent.

Employment in Textiles Industry
1986-87 to 1988-89

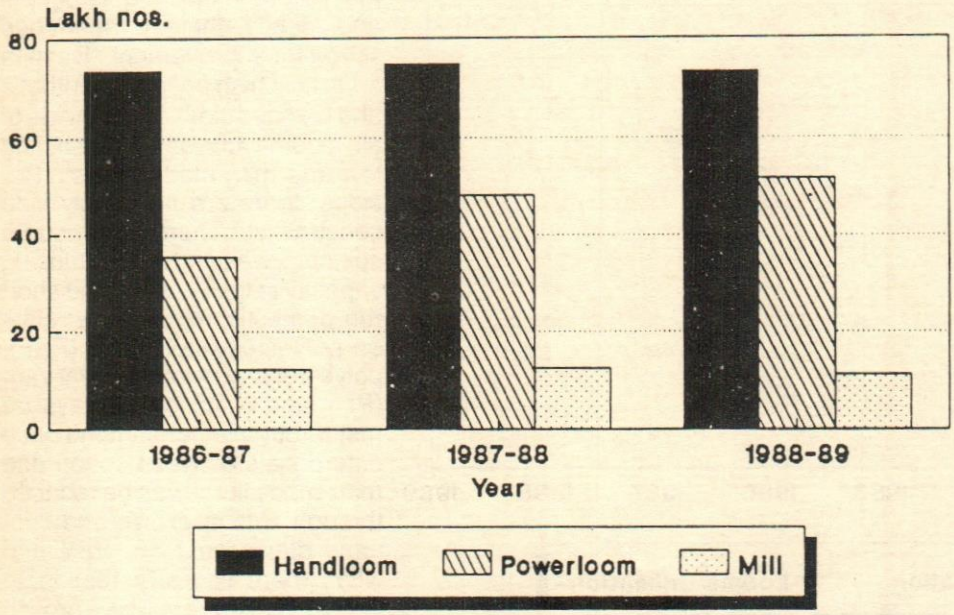

Fig. 4

DR(t-1) = depreciation reserves at the beginning of year t (in constant prices)

IN(t) = inventory investment in year t (in constant prices)

RENT(t) = profits net of dividends and taxes but gross of depreciation provision (in constant prices) in year t.

Δ S(t) = change in sales in year t (in constant prices)

NDE(t) = net debt in year t = total liabilities—cash flow. Cash flow includes cash and bank balances, marketable securities, advance-tax payments and sundry debtors (in constant prices)

FNDT(t) = NDE (t)—NDE (t—1) = flow of net debt in year t (in constant prices)

Fixed and Inventory Investment

Following Krishnamurty and Sastry (1975) and Gupta (1987), the present study uses the accelerator model with financial variables for the purpose of analysing fixed and inventory investment behaviour in Cotton Textile Industry over the period 1980-89. (Also see Garg, 1990).

Fixed Investment and Inventory Investment - Model Specification

The specification of gross fixed investment function is as follows :

$$\frac{I(t)}{K(t-1)} = a + b\frac{\Delta S(t)}{K(t-1)} + c\frac{RENT(t)}{K(t-1)} + d\frac{FNDT(t)}{K(t-1)} + e\frac{IN(t)}{K(t-1)} + f\frac{DR(t)}{K(t-1)} + \sum_{j=2}^{3} g_j S_{jt}$$

where,

I(t) = gross fixed investment in year t (in constant prices)

K(t-1) = gross fixed assets at the beginning of the year t (in constant prices)

S_{jt} =dummy variable representing state.

This equation is fitted to the time-series data for individual firms, using ordinary least squares (OLS) method. Current sales change has been taken to capture the impact of accelerator on fixed and inventory investment. Gross retained earnings, *i.e.* profits net of dividends and taxes but gross of depreciation provision, is used as an explanatory variable. Total liabilities less cash flow represents the net debt. Cash flow includes cash and bank balances, sundry debtors, marketable securities and advance-tax payment. Difference between net debt of the current and the previous year represents external finance or flow of net debt. Inventory investment is included as a regressor to examine the competition for investment funds between fixed capital and inventories. Depreciation reserves represent the age variable to account for replacement demand. Capacity utilization at the firm level could not be included because no satisfactory data on this variable could be taken from the published sources. The deflation of investment and other variables by gross fixed assets (lagged) has been taken to correct for the heteroscedasticity of the error term in the equation. Various price deflators have been used to correct for price change.

The specification of inventory investment function is as follows :

$$\frac{IN(t)}{K(t-1)} = a + b\,\frac{\Delta S(t)}{K(t-1)} + c\,\frac{RENT(t)}{K(t-1)} + d\,\frac{FNDT(t)}{K(t-1)} + e\,\frac{I(t)}{K(t-1)} + \sum_{j=2}^{3} f_j S_{jt}$$

The equation is fitted to time series data for individual firms as has been the case for gross fixed investment. Current sales change and financial variables are the same as those in equation for fixed investment. Fixed investment is included in the equation to capture the competition for investment funds between the two components of investment.

The specification of fixed and inventory investment prescribed is an improvement over both Krishnamurty and Sastry (1975) and Gupta (1987) studies since the former is at current prices and the latter has deflated physical variables like sales change, fixed and inventory investment only to correct for price change. The present exercise introduces state dummies for capturing location effect.

The Data : The study is based on data relating to profit and loss statement and balance sheet of public limited companies taken from the Stock Exchange Official Directory, Bombay. 12 Companies are selected for purpose of analysis. Only those companies are taken for which data are available for 10 years atleast upto 1988-89. The sample of firms covers the mill sector.

The present study attempts to overcome the problem of the impact of price change by using various price deflators for physical variables namely, sales change, inventory investment and fixed investment, and financial variables including retained earnings, external finance and depreciation reserve. Deflators have been taken from the Index Number of Wholesale Prices in India and Reserve Bank of India Bulletin, for the relevant years (with base 1981-82 = 100). Sales change and inventory investment in respect of cotton textile firms have been deflated by the index number of wholesale prices for cotton textiles given in Index Number of Wholesale Prices in India. Fixed investment has been deflated by a composite index. Composite index is calculated by the following formula :

Composite Index = 0.6 × Electrical Equipment Index + 0.4 × Non-Electrical Equipment Index

Electrical equipment is multiplied by 0.6 because the ratio of plant and machinery to gross block in sample firms ranges from 50 to 70 per cent.

All financial variables namely, retained earnings, external finance and depreciation reserve of sample firms have been deflated by the Index Number of Security Prices of cotton textiles given in Reserve Bank of India Bulletin. This again is an improvement over the earlier studies in the Indian context.

Characteristics of Sample Firms

A glance at table 5 reveals the following :

(1) Of the 12 firms chosen for the study 6 pertain to Bombay, 3 to U.P., 2 to Coimbatore and 1 to Calcutta.

(2) Growth in capital has been of the order of 8 to 20 per cent in the case of firms in Bombay, 3 to 12 per cent in the case of U.P., 1 to 11 per cent in the case of Coimbatore and 20 per cent in the case of Calcutta.

(3) Growth in sales ranges between 5 and 15 per cent in the case of Bombay, 3 and 15 per cent in two firms and decline of the order of 13 per cent in the case of U.P. is observed. Sales growth has been positive and negative in one case each in Coimbatore. It is of the order of 10 per cent in the case of Calcutta.

(4) Bombay firms seem to be maintaining good stock in terms of inventory. The growth ranges between 8 and 14 per cent in these firms over the period 1980-89. In the case of U.P one firm carried good growth, another minor improvement and the third one showed a decline in terms of inventory stock. In the case of Coimbatore, one firm showed a decline in inventory stock, whereas another showed a trend rate of growth of the order of 12 per cent. Calcutta firm showed annual average growth in inventory stock of the order of 9 per cent.

(5) There is a mixed picture with regard to retained earnings and external finance. In some of the cases one observes positive change in retained earnings and external finance, whereas in many cases one observes one variable with a positive growth and the other with a decline.

Table 5 : Growth in Sales, Capital and Inventory Stock of Sample Firms in Cotton Textile Industry : 1980-89

Name of Firm	Annual average rate of growth of		
	Sales	Capital	Inventory Stock
Cawnpore Textiles, Kanpur	0.054*	0.072*	0.018
Bombay Dyeing and Manufacturing, Bombay	0.1148*	0.175*	0.106*
Dhanlaxmi Mills Ltd. Coimbatore	0.026	0.009	-0.008
Elgin Mills, Kanpur	0.032*	0.033*	0.153*
Kesoram Industries, Calcutta	0.099*	0.203*	0.085*
Laxmi Mills Co.Ltd. Coimbatore	0.021	0.113*	0.118*
Mafatlal Fine Spg. and Wvg.Co.Ltd., Bombay	0.100*	0.111*	0.080*
Maheshwari Mills Ltd. Ahmedabad	0.049*	0.123*	0.106*
Matulya Mills Ltd. Ahmedabad	0.103*	0.120*	0.135*
Ruby Mills Ltd. Bombay	0.093*	0.078*	0.112*
Standard Mills Co.Ltd. Bombay	0.102*	0.200*	0.105*
Modi Spg.and Wvg.Mills.Co.Ltd. Ghaziabad	-0.134*	0.116*	-0.121*

* Significant at 5 per cent level.

Fixed Investment and Inventory Investment

Regression results on gross fixed investment relating to cotton textile industry, employing the accelerator model with financial variables are presented in table 6. Explanatory power of the regressions is quite satisfactory. Sales change variable appears with a positive sign and is also significant. Retained earnings and external finance both appear with positive signs and are also significant. This shows that financial variables are also important determinants of fixed investment in cotton textile industry. Coefficient of retained earnings having a greater magnitude as against external finance seems to have an edge in financing gross fixed investment. The coefficient of inventory investment being positive and significant shows that both inventory and gross fixed investment grow simultaneously, showing a complementary role. The positive and significant coefficient of depreciation reserves representing age of equipment shows the 'Echo Effect'. Coefficient of dummy variables for states showing state effect is positive in one case and negative in another. Both of these, however, are not-significant.

Results relating to inventory investment in respect of cotton textile industry are given in table 7. The explanatory power of the equation is around 40 per cent. Sales change coefficient is positive but not significant. Both retained earnings and external finance have negative coefficients. Also, these are significant. This being so, the results show perverse sign. implying that factors other

Table 6 : Gross Fixed Investment : Pooled Cross Section Results (with intercept dummies for states) : Cotton Textiles Industry : 1980-89

Dependent variable : I(t)/K(t—1) Sample size : 121*** No. of firms : 12

Independent Variables	Regression Coefficients	
	Equation 1	Equation 2
S(t)/K(t-1)	0.098*	0.099*
	(1.924)	(1.925)
RENT(t)/K(t-1)	0.761*	0.825*
	(3.021)	(3.105)
FNDT(t)/K(t-1)	0.449*	0.463*
	(1.961)	(2.002)
IN(t)/K(t-1)	0.671**	0.642**
	(1.814)	(1.720)
DR(t)/K(t-1)	1.636*	1.664*
	(11.169)	(11.248)
State Dummy 1 (U.P.)		0.034
		(0.291)
State Dummy 2 (Coimbatore and Calcutta)		-0.157
		(1.566)
R^2	0.660	0.669
$\bar{R}^2$	0.645	0.648
F	44.558	32.573
DW	1.46	1.48

(t - values are given in brackets).
* Significant at 5 per cent level.
** Significant at 10 per cent level.
*** Data for one firm is for 11 years.

Table 7 : Inventory Investment : Pooled Cross Section Results (with intercept dummies for States) : Cotton Textile Industry : 1980-89

Dependent variable : IN(t)/K(t—1) Sample size : 121 No. of firms : 12

Independent Variables	Regression Coefficients	
	Equation 1	Equation 2
S(t)/K(t-1)	0.017	0.013
	(1.325)	(1.021)
RENT(t)/K(t-1)	-0.316*	-0.343*
	(6.172)	(6.311)
FNDT(t)/K(t-1)	-0.332*	-0.342*
	(7.107)	(7.287)
IN(t)/K(t-1)	0.025**	-0.027**
	(1.575)	(1.689)
State Dummy 1 (U.P.)		-0.047
		(1.645)
State Dummy 2 (Coimbatore and Calcutta)		-0.027
		(1.101)
R^2	0.41	0.43
$\bar{R}^2$	0.39	0.39
DW	2.33	2.38

(t - values are given in brackets).
* Significant at 5 per cent level.
** Significant at 10 per cent level.

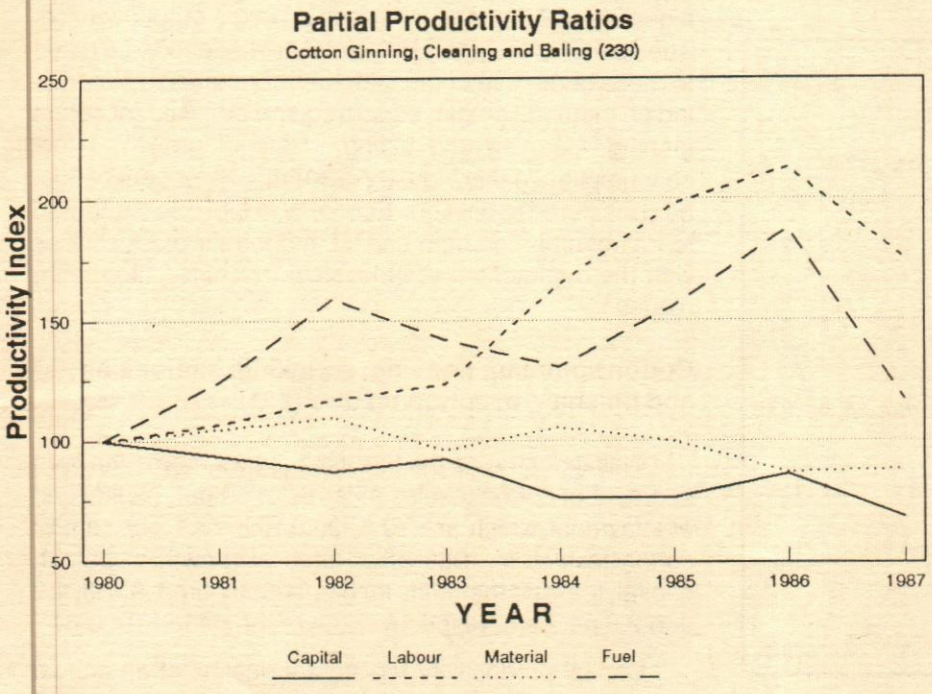

Fig. 5

than financial variables have an impact on inventory investment. The coefficient of fixed investment being positive and significant shows that both inventory and fixed investment grow simultaneously. The coefficients of state dummies are negative and non-significant. It shows absence of any location effect on inventory investment as well.

It would be better if we compare our results with those of Krishnamurty and Sastry (1975) dealing with 165 firms in cotton textiles relating to the period 1961-67, since we have adapted their specification with minor modifications pertaining to deflation of variables by price changes. The comparison reveals that sales contribute significantly to gross fixed investment in both the cases. The contribution of retained earnings and external finance as an explanation of gross fixed investment in both the cases is significant in respect of cotton textiles industry. While our results show complementarity in respect of inventory investment, Krishnamurty and Sastry (1975) results reveal a negative effect. The age of equipment coefficient is positive and significant in both the studies.

Comparison of results pertaining to inventory investment in cotton textiles (table 8) reveals that the coefficient of sales change representing accelerator is negative in the present exercise, whereas it is positive and significant in Krishnamurty and Sastry (1975) study. The coefficients of retained earnings and external finance show a negative and significant sign in the present study, whereas these are positive and significant in the case of Krishnamurty and Sastry (1975) study. One observes a difference in their specification with that of our equation in that they had included inventory stock lagged also as a determining factor in their study. Besides, coverage of firms and time period are also different in the two cases.

Having analysed determinants of fixed and inventory investment in cotton textiles firms, we analyse partial productivity ratios/indices relating to cotton textiles industry at a disaggregated industry level over the period 1980-87, using data from ASI. These have been examined under five major heads : (1) cotton ginning, cleaning and baling (230); (2) cotton spinning, weaving and finishing of cotton textiles (231); (3) printing, dyeing and bleaching of cotton textiles (232); (4) weaving and finishing of cotton textiles in powerlooms (236); and (5) others.

Cotton ginning, cleaning and baling (230)

This segment of cotton textiles accounts for 7.9, 3.7 and 14.5 per cent of output, capital and employment of cotton textile industry in 1986-87, respectively. As a result of annual average rate of growth of 11 per cent in capital and decline of 10 per cent in the annual rate of labour, capital intensity in this industry grows at an annual average rate of 15 per cent over the period 1980-87. Rate of growth in wage rate of about 8 per cent per annum is much higher than that for value added per employee (table 9). Capital productivity based on output version (fig. 5) declines particularly for the years 1984, 1985, and then for 1987. Labour productivity showing an upward trend touches the peak in 1986 and declines in 1987. Capital productivity based on GVA version shows an annual average growth

Table 8 : Trend Rates of Growth in Capital (KP), Labour (LP), Material (MP) and Fuel (FP) Productivities based on Output and Capital (KP_1) and Labour (LP_1) Productivities based on Gross Value Added : Cotton Textiles Industry. : 1980-87

Industry	KP	LP	MP	FP	KP1	LP1
Cotton ginning, cleaning and baling (230)	-4.2	11.0	-2.3	3.6	2.0	17.2
Cotton spinning, weaving and finishing of cotton textiles (231)	-11.6	5.2	-0.1	-2.3	-13.9	2.8
Printing, dyeing, bleaching of cotton textiles (232)	-4.0	8.3	-1.8	4.4	-6.5	5.8
Weaving and finishing of cotton textiles in powerlooms (236)	10.5	5.6	-0.4	-8.7	-7.0	9.1
Cotton spinning other than mills (Charkha) (233)	5.1	29.5	-6.0	6.4	-13.2	11.2
Production of Khadi (234)	-15.0	1.6	4.0	-6.9	-5.3	14.0
Weaving and finishing of cotton textiles in handloom other than Khadi (235)	-10.5	5.6	-0.4	-8.7	7.0	9.1

Source : Based on ASI, Different issues.

rate of 2 per cent over the period, whereas rate of growth in labour productivity in GVA version jumps to 17.2 per cent. Fuel productivity shows an annual average rate of growth of 3.6 per cent and materials productivity records a decline of 2.3 per cent per annum in the output version. The upshot of the analysis points out that efforts be made to make better use of the materials consumed by improving on methods employed and equipment used for cotton ginning, cleaning and baling. Rate of growth of fuel consumption in this industry (230) at 1.5 per cent cannot be considered to be high. Economy in fuel-use could lead to improvement in both capital and labour productivities with the deployment of innovative machinery and techniques.

Cotton spinning, weaving, shrinking, sanforizing and finishing of cotton textiles (231)

This industry, as the title itself shows, forms the core segment of cotton textiles in terms of output, capital and employment which are 79.6, 90.0 and 76.1 per cent of cotton textiles in 1986-87. Rates of growth of output, capital, fuel and materials for this industry are 1.9, 7.3, 4.2 and 2.9 per cent, respectively, over the period 1980-87.

Capital productivity registers a decline at an annual average rate of 11.6 per cent in the output version and 13.9 per cent in the GVA version. Besides, the decline in capital productivity has been continuous. Labour productivity shows an increase at the rate of 5.2 per cent in the output version and 2.6 per cent in GVA version. One observes a sharp fall in the number of employees, showing a decline of the order of 22.2 per cent over the period. This has a bearing on capital intensity. Capital intensity, thus, turns out to be the basic reason for improvement in labour productivity. Changes in fuel and materials productivities are minimal (fig. 6). Wage rate has increased substantially to the extent of achieving an annual average growth rate of 35 per cent, as a consequence of employing labour-saving devices by incorporating innovative technology.

Goldar's (1986) results for this segement of cotton textiles (231) reveal that capital intensity increases

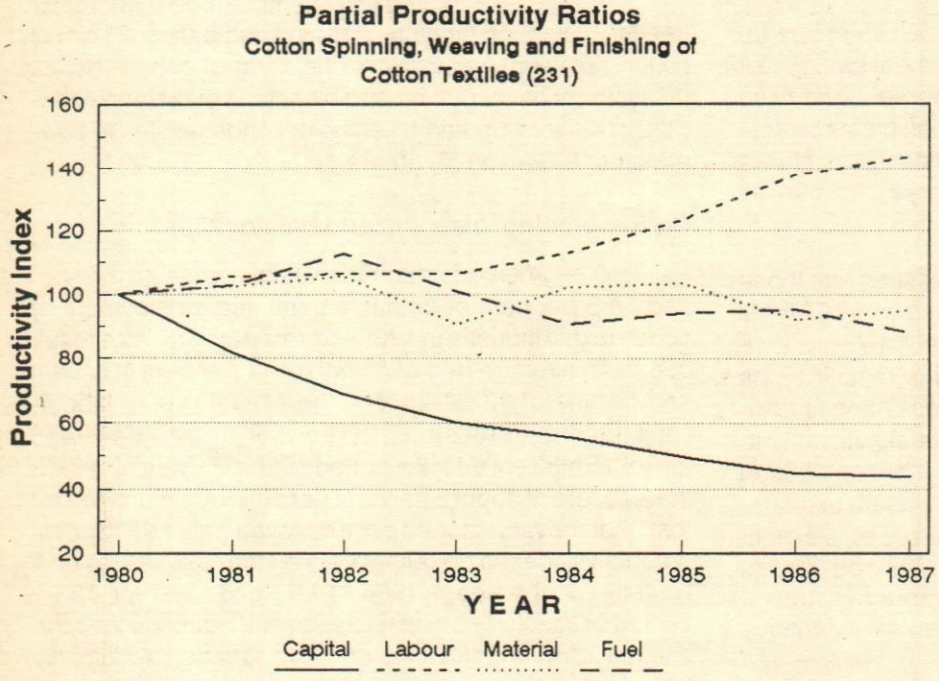

FIG. 6

at an annual average growth rate of 6.19 per cent over the period 1960-70. Labour productivity shows an increase, whereas capital productivity declines at an annual average rate of 3.28 per cent. The pace of progress thus has improved further.

Sastry (1981) attempts an analysis on productivity in Indian cotton mill industry over the period 1949-70. The comprehensive exercise based on inter-state comparison arrives at the following conclusions :

(1) Labour productivity increased both in Maharashtra and Tamil Nadu over 1949-70, with faster growth in the latter.

(2) Capital productivity declined both in Maharashtra and Tamil Nadu, with a faster decline in Maharashtra, perhaps due to its old capital stock.

(3) All three indices of total factor productivity, namely, Kendrick, Solow and Domar, show a general uptrend both for Maharashtra and Tamil Nadu.

(4) As between capital surrogates, Sastry shows his preference for total energy consumption in terms of coal replacement, it being a more inclusive measure and he having obtained coefficients of this variable to be positive and significant.

Kohli (1989) works out partial productivity ratios in respect of different industries to pinpoint inter-regional differences as well. Cotton textiles is an important segment of the industry in Madhya Pradesh, whereas it is jute, hemp and mesta textiles that is important in West Bengal.

Partial Productivity Ratios
Printing, Dyeing and Bleaching of Cotton Textiles (232)

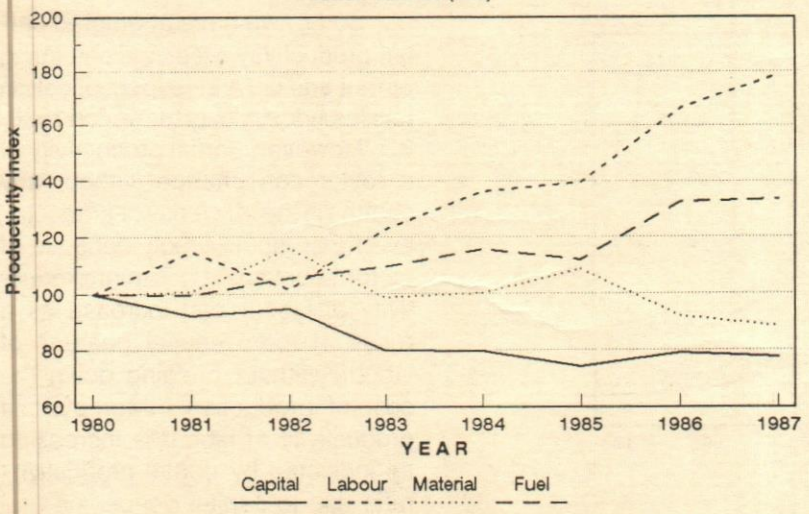

FIG. 7

Cotton textiles in Madhya Pradesh shows a sharp decline in gross value added in 1984-85 as against 1980-81. Capital productivity has been the highest in electrical machinery and cotton textiles, whereas labour productivity has been the lowest in food products and cotton textiles in Madhya Pradesh. Capital intensity in this industry in M.P. has been low in comparison to other industries. This may perhaps be due to the fact that share of decentralised sector requiring lower capital happens to be more dominant in Madhya Pradesh.

Printing, dyeing and bleaching of cotton textiles (232)

This industry accounts for 9.3, 4.7 and 5.3 per cent of output, capital and employment in cotton textiles, for 1986-87, respectively. The activity adds to the stature and finish of the commodity being sold in the market. Output, capital, fuel, materials and labour in printing, dyeing and bleaching of cotton textiles (232) grow at an annual average rate of 9.4, 7.4, 5.0, 11.2 and 7.6 per cent over the period 1980-87, respectively. Capital intensity shows an annual average rate of growth of around 12 per cent, whereas wage rate registers a growth of around 15 per cent. This industry deserves promotion in the use of innovative techniques since it is on the improvement in this endeavour that would enable promote growth in cotton textiles.

A glance at partial productivity indices (fig. 7) reveals fall in capital productivity till 1983 and then it is flattened. One observes rise in labour productivity till 1985 which gains momentum after that year. Fuel productivity shows an upward movement after 1985, whereas materials productivity falls after 1985. Capital intensity in 1986 and 1987 seems to have enabled introduction of innovative machinery.

Weaving and finishing of cotton textiles in powerlooms (236)

Powerlooms have wide range of weaving facilities, from high speed jet looms in some units in Surat to simple non-automatic looms. In general, non-automatic looms predominate. Entrepreneurship is essentially organised along two lines — the master weaver and the owner entrepreneur. Output, capital and

employment in powerlooms accounts for 2.0, 1.0 and 2.4 per cent of cotton textiles in 1986-87, respectively. Output, capital, fuel and material used in this segment of cotton textiles recorded an annual average growth rate of 3.1, 10.2, 14.9 and 8.0 per cent, respectively. One observes a decline of the annual average rate of 13.7 per cent over the period 1980-87. Capital intensity in powerlooms increased at an average growth rate of 10 per cent. The features that deserve mention are the high growth rates, particularly in the fuel consumed, and materials used. Of the segments of cotton textiles analysed, it is only in powerlooms that one observes decline in annual average rates of labour and wage rate. Capital augmentation thus plays a crucial role in this industry.

A glance at (fig. 8) reveals that capital productivity declines but more so after 1985. One observes fluctuations in the case of labour productivity. Peak for material productivity is observed in 1983. It moves in line with fuel productivity during 1984-87.

Variations in wage rate at different mills are due to large variations in product-mix, from plain grey cottons to sophisticated synthetic textiles woven in Surat. Powerlooms produce textiles that are considerably cheaper than corresponding mill varieties. Composite mills have to pay duties on cloth, while powerlooms, being decentralised, cannot be policed in general. Annual average rate of growth in gross value added of the order of 7.3 per cent is an indicator of its achieving better performance. Value added per employee also shows a growth rate of 10 per cent over the period 1980-87.

Partial Productivity Ratios
Weaving and Finishing of Cotton Textiles in Powerlooms (236)

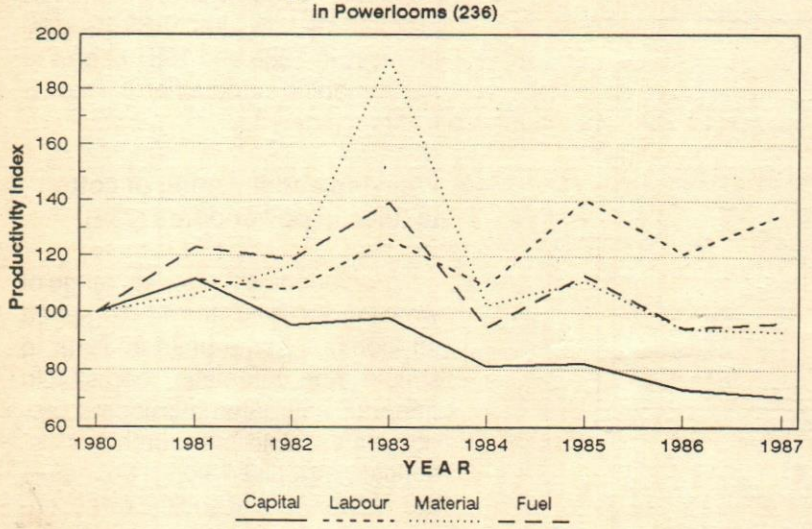

Fig. 8

Output and GVA partial productivity versions reveal that capital, fuel and materials productivities record a decline, whereas it is labour productivity alone that registers an increase.

Others : [Charkha (233), Khadi (234), Handloom (235)]

Under the output version, one observes growth in capital, labour and fuel productivities and a decline in materials productivity in the case of Charkha (233). As per GVA version capital productivity shows a decline and labour productivity an increase. The common indicator in both versions is that there is greater increase in labour productivity. Growth in K/L has been the reason for this result (table 9).

In the case of Khadi (234), capital productivity shows a decline in both the versions. There is substantial difference in growth in labour productivity, though both the versions reveal an increase. It is much higher in the GVA version. Materials productivity shows growth whereas fuel productivity shows decline. There is need for effecting economy in energy use in Khadi (234).

In the case of Handloom (235), capital productivity shows a decline in both Output and GVA versions whereas labour productivity shows an increase. Capital intensity happens to be the reason for growth in labour productivity. Fall in fuel productivity is much greater than materials productivity. Here also economy in the use of energy is needed in the processes being used.

Factor Substitution

So far, we have attempted partial productivity ratios/indices using output and GVA in respect of cotton textiles industry over the period 1980-87. However, partial productivity of a factor can change without any change in the efficiency or productivity of that factor simply because of factor substitution. Partial productivity of labour can increase as a result of more capital per unit of labour, without bringing down the cost of production. Moreover, if productivity of labour is increasing as indicated by partial productivity ratio due to capital deepening and without any increase in the efficiency, then there is a possibility that the

Table 9 : Trend Rates of Growth of Output, Gross Value Added, Capital, Fuel, and Materials (constant prices), and Labour : Cotton Textiles Industry 1980-87

Industry	Output	Gross Value Added	Capital	Fuel	Material	Labour	Value added per employee	Wage rate	Capital Labour ratio
Cotton ginning, cleaning and baling(230)	5.1	11.2	10.7	1.5	7.4	-10.4	1.1	8.2	15.2
Cotton spinning, weaving and finishing of cotton textiles (231)	1.9	-0.5	7.3	4.2	2.9	-22.2	10.4	34.8	16.7
Printing, dyeing and bleaching of cotton textiles (232)	9.4	6.9	7.4	5.0	11.2	7.6	15.0	15.2	12.3
Weaving and finishing of cotton textiles in powerlooms (236)	3.1	7.3	10.2	14.9	8.0	-13.7	10.2	-2.3	10.0
Cotton spinning other than mills (Charkha) (233)	15.6	-2.7	2.9	9.2	21.6	-1.8	0.7	3.7	24.4
Production of Khadi (234)	4.8	10.3	4.5	11.7	0.8	3.4	0.01	15.2	16.6
Weaving and finishing of cotton textiles in handlooms other than Khadi (235)	4.9	8.5	5.7	13.6	5.3	-5.9	5.0	3.8	16.1
	4.9	8.5	5.7	13.6	5.3	-5.9	5.0	3.8	16.1

Source : Based on ASI, Different issues.

productivity of capital as indicated by partial productivity ratio (O/K, V/K) exhibits a downward trend. Hence, partial productivity ratios/indices should be treated with caution, while interpreting the results. Some studies (Sastry, 1981; Goldar, 1986) have attempted total factor productivity (TFP) indices to frame some hypothises regarding the overall efficiency in the use of inputs. Though TFP indices are useful and widely calculated, these, too, are based on some restrictive assumptions.

Production processes are conceived as a means of transforming certain inputs (capital, labour and intermediates) into certain outputs. It is essential to know—how much output could be produced with certain combinations of inputs and what alternatives are there for producing outputs in particular ways. The production function defines these alternatives specifying the range of technical possibilities open to producers. Given, the current state of technological knowledge, these functions include the possible efficient relations between inputs and outputs. Due to their easy applicability to empirical problems, Cobb-Douglas and Constant Elasticity of Substitution production functions have gathered popularity. Cobb and Douglas suggested the following production function on the basis of empirical observation :

$$V = AL^{\alpha} K^{1-\alpha}$$

where V is value added, L is labour input and K is capital stock. Cobb and Douglas constrained exponents of L and K to sum to unity, but it is an unnecessary restriction. A generalisation of the function could be to recognise the possibility of there being many inputs. The equation could be extended to

$$Q = AL^{\alpha 1} K^{\alpha 2} M^{\alpha 3} F^{\alpha 4}$$

where Q represents output, L labour, K capital, M material and F fuel. The sum of the exponents of inputs determines the returns to scale, increasing if sum > 1, constant if sum = 1 and diminishing if sum < 1. For Cobb-Douglas Production Function, the elasticity of substitution is everywhere equal to unity. This is the basic assumption and has to be tested prior to application of Cobb-Douglas production function. Some side relations of Constant Elasticity of Substitution production function are estimated in the literature to derive an idea about the elasticity of substitution and thereby applicability or otherwise of Cobb-Douglas production function (Gupta, 1987).

Having obtained evidence of elasticity of substitution between capital and labour not being statistically different from unity in the results for side relations of CES production function, using ASI data at the disaggregated industry level as also state level observations over the period 1980-87, we worked out estimates of C-D production function, using output as also GVA versions. The values of variables have been multiplied by $\sqrt{N}$ to take care of heteroscedasticity. We also present results by adjusting the value of RHO to take care of serial correlation. Kmenta's approximation procedure has also been tried by introducing the term $(\log K - \log L)^2$ that represents a "correlation" due to the departure of RHO from zero, in the equation

$$\log V = \beta_1 + \beta_2 \log K + \beta_3 \log L + \beta_4 [\log K - \log L]^2 + e$$

which represents an intrinsically linear regression model. If the estimate of β_4 is not significantly different from zero, we would reject the CES model in favour of Cobb-Douglas Model. β_4 represents magnitude of $[\rho \upsilon \delta (1 - \upsilon)/2]$ with a negative sign in the prescribed equation (Kmenta, 1986).

Pooling of Cross-Section of Time Series : State Level Observations

A glance at table 10 reveals that the coefficients of capital and labour are positive and significant in C-D production function estimates. But the total of the coefficients reveals diminishing returns to scale. Introduction of dummy variable disturbs the sign and magnitude of the coefficients, since the coefficients of dummies for Maha--rashtra and Tamil Nadu are negative and significant. The coefficient of labour gets enhanced and that of capital assumes a negative sign. t bears a positive and significant sign. But the total of the coefficients showing returns to scale is implausible in the third regression with the State dummies.

Table 10 : Least Squares Estimates of the Cobb-Douglas Production Function for Cotton Textile Industry : Pooling of State-level Observations : 1980-87

Dependent Variable : log V — No. of observations :24

Regression No.	log K	log L	t	Coefficient of Independent Variables: Dummy Mah.	Dummy T.N.	Returns to scale	$\bar{R}^2$
1	0.187** (1.915)	0.633 (4.792)				0.820	0.50
2	0.178** (1.774)	0.693* (3.868)	0.003 (0.510)			0.871	0.48
3	-0.806 (1.692)	1.138* (3.614)	0.154* (2.130)	-1.209* (2.055)	-2.378* (2.104)	0.332	0.54

t-values are given in brackets.
* Significant at 5 per cent level.
** Significant at 10 per cent level.

A glance at table 11 reveals diminishing returns to scale with positive and significant coefficients for capital and labour (Reg. 1). Explanatory power of the regressions is quite satisfactory. Introduction of materials reduces the coefficient of capital but the total of the three variables is not significantly different from unity (Reg. 2).

Addition of fuel reduces the coefficients of capital as also of labour. The coefficients of capital and fuel become non-significant, though positive. The total of coefficients adds up to .9 which is not significantly different from 1 (Regression 3). Introduction of time and state dummies results in showing negative sign for capital, though it is not significant (Regressions 4 and 5). Overall one observes evidence of diminishing returns to scale though not very much different from unity. The results are confirmed by looking at the estimates of C-D production function in Table 12, wherein we take care of serial correlation by adjusting the variables by RHO = 2.0.

Results of Unrestricted C-D Production Function

Results from the pooled cross section time series at disaggregated industry level in respect of cotton textile industry over the period 1980-87 are given in tables 13, 14 and 15. Table 13 reveals positive and significant coefficients of capital and labour showing increasing returns to scale as also prevalence of technical progress represented by positive and significant coefficient of t. One gets confirmation of the results, looking at the estimates using output in place of gross value added (except for the observation that the coefficient of fuel is negative and significant in Regressions 3 and 5 Table 14). The coefficients of capital, labour and material bear positive sign with

Table 12 : Least Squares Estimates of the Cobb-Douglas Production Function : Pooling of Cross Section of Time Series : Cotton Textiles Industry : 1980-87

Dependent Variable : log V — No. of Observations : 24

Coeff. of Independent Variables: log K	log L	t	Returns to scale	$\bar{R}^2$	DW
0.207 (1.560)	0.713* (3.483)	0.006 (0.840)	0.920	0.40	1.87

* Adjusted for RHO = 2.0.

Table 11 : Least Squares Estimates of the Cobb-Douglas Production Function : Cotton Textiles Industry : 1980-87: Pooling of State Level Observations

Dependent Variable : log Q — No. of Observations: 24

Regression No.	log K	log L	log M	log F	t	Dummy Mah.	Dummy T.N.	Returns to scale	$\bar{R}^2$
1	0.340* (4.507)	0.413* (4.042)						0.753	0.65
2.	0.102* (2.472)	0.277* (5.917)	0.606* (9.505)					0.985	0.92
3.	0.049 (0.936)	0.192* (2.712)	0.540* (7.204)	0.118 (1.549)				0.899	0.93
4.	-0.053 (0.296)	0.347* (2.103)	0.589* (4.918)		0.024 (0.847)	-0.203 (0.892)	-0.394 (0.881)	0.883	0.91
5.	-0.043 (0.248)	0.256 (1.430)	0.532* (4.172)	0.104 (1.213)	0.016 (0.552)	-0.136 (0.537)	-0.257 (0.565)	0.849	0.91

t-values are given in brackets.
* Significant at 5 per cent level.

Table 13 : Least Squares Estimates of the Cobb-Douglas Production Function : Cotton Textiles : Pooling of Cross Section and Time Series : 1980-87

Dependent Variable : log Vt — No. of Observations : 64

Regression No.	Coeff. of independent vars. log K	log L	t	Returns to scale	$\bar{R}^2$
1	0.646* (4.888)	0.469* (3.069)		1.115	0.88
2	0.604* (4.911)	0.643* (4.258)	0.019* (3.316)	1.247	0.90

t-values are given in brackets.
* Significant at 5 per cent level.

Table 14 : Least Squares Estimates of the Cobb-Douglas Production Function for Cotton Textile Industries : Pooling of Cross Section of Time Series : 1980-87

Dependent Variable : Q — No. of Observations : 64

Regression No.	Independent variables log K	log L	log M	log F	t	Returns to scale	$\bar{R}^2$
1	0.630* (6.539)	0.364* (3.262)				0.994	0.92
2	0.196* (2.676)	0.188* (2.659)	0.634* (10.055)			1.019	0.97
3	0.341* (4.349)	0.113* (1.672)	0.848* (10.193)	-0.230* (3.565)		1.074	0.97
4	0.182* (2.583)	0.252* (3.499)	0.634* (10.521)		0.007* (2.599)	1.068	0.97
5	0.325* (4.377)	0.177* (2.597)	0.846* (10.755)	-0.228* (3.740)		1.120	0.98

t-values are given in brackets.
* Significant at 5 per cent level.

significance. One observes existence of technical progress represented by the coefficient of t in this table. Returns to scale obtained in most of the equations is not significantly different from unity. Explanatory power of the regressions is quite satisfactory.

Results in table 15 also reveal positive and significant coefficients for capital and labour. The results reveal increasing returns to scale and the correction factor (log K - log L)^2 introduced by Kmenta does not change the sign and significance of the coefficients of capital and labour. The results had been adjusted by RHO = 2.37 as required to take care of the serial correlation. The estimate of β_4 is positive and also significantly different from zero. Therefore, it would be advisable if one attempts estimation of CES production function parameters and other relevant

Table 15 : Least Squares Estimates of the Cobb-Douglas Production for Cotton Textiles Industry : Pooling of Cross Section and Time Series : 1980-87

Dependent Variable : log V — No. of Observations : 64

Regression No.	Independent variables log K	log L	(log K-log L)^2	Returns to scale	$\bar{R}^2$	DW
1	0.646* (4.838)	0.469* (3.069)		1.115	0.88	1.60
2	0.597 (4.837)	0.645 (4.252)	0.130* (3.288)	1.242	0.90	1.87

Variation adjusted for RHO = 2.37.
t-values are given in brackets.
* Significant at 5 per cent level.

mathematical formulations rather than C-D production function estimates only.

Goldar and Mukhopadhyay (1991) and Jha et al. (1991) have drawn deeper insights in to the growth in cotton textiles. The former study examines substitution between labour, capital and energy applying Conrad's cost price approach (Conrad, 1983). They assume, as Conrad does, that the cost function is of Cobb-Douglas type. The cost function according to them is :

$$\ln C = \ln F(Q) + \ln [G(t)] + a_0 + \Sigma r_j q_j$$

where, C denotes total cost and $\Sigma r_j = 1$. Differentiating the cost function with respect to the own prices of factors yields the cost share equations

$$S_i = p_i \left[\sum_j \alpha_{ij} \left(r_j / q_j \right) \right]$$

$$i = L, K, E$$

where S_i is the cost share of factor i, P_i is the own price of factor i and q_j is the cost price of factor j. α_{ii} is equal to one by definition. Thus, there are nine parameters to be estimated. Once the estimates of α_{ij} and r_j are obtained, the Allen partial elasticities of substitution between factors i and j are obtained by

$$\sigma_{ij} = 1 - \left(P_i P_j / S_i S_j \right) \left[\sum_k r_k d_{ik} \alpha_{jk} / qk^2 \right]$$

$$i, j = L, K, E$$

They have also estimated share equations from conventional translog cost function. The share equations in this case are:

$$S_i = ai + \Sigma b_{ij} \ln P_j$$

$$i,j = K, L, E$$

Given the estimates of the parameters of the share equations the Allen partial elasticities of substitution have been obtained as

$$\sigma_{ij} = \left(b_{ij} + S_i S_j\right)/S_i S_j$$
$$i \neq j \; I, j = K, L, E$$
$$\sigma_{ii} = \left(b_{ii} + S_1^2 - S_i\right)/S_1^2$$
$$I = K, L, E$$

Data have been taken from CMI and ASI for the period 1951 to 1982, with gaps for 1967 and 1972 for which these are not available. They have estimated both the cost-price and the translog model by FIML procedure which is available in the SORITEC package for both linear and non-linear systems of equations. Results for the cost-price model indicate a high degree of boundedness among inputs. A strong K-L, K-E, L-E, E-L, and L-K binding was found in cotton textiles. Allen elasticities of substitution between labour and energy was found to be positive. This is indicative of a substitution relationship between labour and energy. Own price elasticities obtained from the cost price model are low in relation to the estimates from the translog model. This is to be expected since cost-price model takes into account the bindings among factors of production, while the translog model does not do so adequately. This reflects that translog cost function model tends to overstate the price responsiveness of input demand to price changes.

Jha et. al (1991) is concerned with the measurement of biases of technical change, economies of scale and elasticities of substitution between factors of production in cotton textiles and other three industries in India. The study covers the period 1960-61 to 1982-83 taking data from ASI. The study estimates translog cost functions for each industry and, therefore, admits very general production characteristics. The results reveal that technical change in cotton textiles has been capital using and labour and EM saving. The study ascribes this to the growth of trade unions and to the movements in relative factor prices during the sample period. Further, it opines that in the recent past trade unions have become dominant and able to wrest rapid and large wage raises from the management. Price of capital has increased at a lower rate due to availability of cheap institutional credit. Besides, the desire on the part of management to minimize disputes with labour could have led to investment in capital and energy material using and labour saving technologies in cotton textiles. Rate of capital bias in technology is highest in iron and steel followed by cotton textiles. Technical change in this industry has caused factor income ratios to move against workers and in favour of suppliers of capital and, to a lesser extent, suppliers of energy material (EM). Estimates of elasticity of cost with respect to output indicate presence of economies of scale in cotton textiles. Labour and capital, and capital and energy materials are complements, whereas labour and energy materials are substitutes in the production of cotton textiles. Ironically, cotton textiles emerges as a consumer good industry wherein capacity acts as a binding constraint.

Sickness

Pursell (1989) lamenting the phenomenon of industrial sickness in India points out that the subsidising and continued protection of marginal firms that would have normally left the industry causes primary sickness. It further depresses price and leads to losses causing secondary sickness to another set of otherwise relatively profitable firms necessitating further subsidisation. In any realistic economic cost-benefit evaluation, transaction costs, by-product distortions, second best and dynamic consideration weigh heavily against the sickness equilibrium. The transaction costs include both the direct costs of paying and administering the sickness subsidies, and probably more important, there are by-product distortions consequent on the way the subsidies are paid. For example, written-off electricity debts and reduced electricity rates exacerbate the deficit of the state electricity boards and/or lead to increased charges for other users. Similarly, written-off bank loans and low interest rates increase the costs of other bank borrowers, and more seriously, continued lending to sick firms reduces the availability of credit to healthy firms, given the general Indian situation wherein bank credit is rationed. Similarly by-product distortions are associated with tax-financing of the sickness-subsidy including special concession on any funds on the sick firms' current operations. The phenomenon of sickness, therefore, calls for detailed examination in the context of textile industry in India.

A non-SSI sick unit refers to a medium and large industrial company which has at the end of any financial year accumulated losses equal to or exceeding its entire networth and has also suffered cash losses in such financial year and the year preceding the financial year. Industrywise classification indicates that sickness was more pronounced in the case of engineering group, followed by textile with 227 units and outstanding bank credit of Rs. 997 crore as at end June 1988. A weak industrial unit is one which does not come under the purview of Sick Industrial Companies (Special Provisions) Act, 1985, in whose case RBI has advised the banks to take necessary remedial measures at the stage of 50 per cent erosion of its networth. Industrywise, the sickness in the case of non-SSI weak industrial units was more rampant in the case of textiles 171 with an outstanding bank credit of Rs. 539 crore (Report on Currency and Finance, 1989-90).

Padaki and Shanbhag (1988) emphasises the role of modernisation, besides (i) fibre-mix and intersectoral fibre policy; (ii) technology mix for the sectors and choice of production modes, (iii) and machinery manufacture and transfer of technology. These clusters in their own opinion, however, do not in any way preclude parallel research activity in technological R & D and organisational studies. The latter research may be concerned with: (i) the drive for the diffusion of professional management; and (ii) the search for early warning signals of sickness.

Salient features *e.g.* (i) dismantling the sectoral approach to the industry and retaining the special role only for non-power technology; (ii) multi-fibre orientation and fibre flexibility; (iii) adequate raw material at reasonable and stable prices, and (iv) emphasis on modernisation, making possible technology and machinery imports at international prices, seemed to have taken care of the deep structural and environmental problems of the industry.

Anubhai (1988) examines the following set of factors in the case of sickness in textile industry :

(a) Environmental factors

Freeze on capacity, restrictions on automation, artificial compartmentalisation, restrictions on export of yarn, restrictions on utilisation of processing capacities, and sector protection-fiscal and non-fiscal constitute the plethora of restrictions that prohibited the overall growth in Indian textile industry. If excise duty on every input consumed by the industry is taken into account, the non-favourability of tax incidence becomes most conspicuous. According to his assessment, the total indirect incidence on textiles works out to around Rs. 4,000 crores per annum as against Rs. 50 crores in 1955-56 (Anubhai, 1988). The textile industry is still predominantly based on one agricultural raw material-cotton. Cotton prices tend to fluctuate a great deal depending on the size of the crop. With widely fluctuating raw material prices, the fortunes of the industry also swing from year to year. Even after reductions the total of Indian synthetic fabric prices are about 3-5.5 times the international prices. It dampens the demand for such fabrics on the one hand, and encourages smuggling on the other. The relentless increase in the cost of inputs and the deteriorating capacity to pass these on and realise economic prices has been detrimental to the growth of this industry. The state sector units like NTC are being supported by the state by the direct and indirect subsidies. The direct funding includes the provision for losses and interest subsidy. The indirect subsidies take the form of providing them with duty-free polyster fibre and near duty-free polyster filament yarn for schemes like Sulabh and Saubhagya cloth. Despite the fact that private sector mills realise somewhat better price than the state sector units, as the prices of the state sector units are far below average costs, the private sector prices remain uneconomic. The unequal competition coupled with excess capacity succeeds only in speeding the sickness rather than stemming it.

(b) Structural Factors

The powerloom units have certain inherent advantages. These have an intangible edge in terms of their flexibility of production in response to market swings in demand. In the organised sector, there exists high labour complement due to early unionisation with the formation of unions like RMMS in Bombay and TLA in Ahmedabad. Workloads have remained low as a result thereof. Partial or full closure of uneconomic units has not been possible.

(c) Locational Factors

Power, sales tax, octroi and wages have had a bearing on the emergence of the cost structure. Anubhai (1988) points out that these the differences can be as large as Rs. 2 crore per year for a unit located in Punjab compared to the same unit located in Ahmedabad. With the spread of entrepreneurial and technical skills, the advantages of agglomeration that were available to older units to counterbalance the cost have since disappeared.

(d) Managerial Factors

The management of the textile industry has largely suffered from static perceptions. These perceptions related to cotton prices, technology, products as well as markets. Technology was perceived through a mind frame of marginal changes *e.g.* from looms running at 200 RPM against looms running at 180 RPM or from 4 roller drafting system to top arm drafting system. Earlier the industry enjoyed a sellers' market. Foreign exchange constraint and the concern about protecting employment, restricted entry of new technology.

(e) Government Policy

For encouraging exports, Governmental efforts can be classified under : (a) special facilities to make inputs available at reduced cost; (b) subsidies on domestic raw materials; (c) facilities to make machinery and equipment available at reduced cost; (d) profit tax and credit subsi-

dies; (e) assistance with export marketing; and (f) free trade zones and bonded manufacturing. There is no doubt that these initiatives are having a favourable impact, as evidenced in particular by increased exports of garments, gems and jewellery. However, in the highly protective Indian environment, the greater the export-specific support, the greater are the administrative efforts required to prevent the benefits to exporters from being diverted to the protected domestic market. The consequent administrative burdens have been the bane of most interventions.

For encouraging small-scale industries, excise tax concessions are given that taper off as size increases. Finance on concessional terms is available, encouraging higher capital intensity—and there has been freedom from the price and production controls which exist, *e.g.* in the textile, cement and steel industries. These factors, together with greater labour flexibility and freedom from controls, have enabled some SSIs to operate more efficiently than would otherwise be possible. However, the threat of losing these freedoms by graduating from the small-scale sector has in many cases discouraged growth (World Bank, 1989).

Goswami (1990) examines sickness in most of the composite mills. His series covers the period 1971-87. He mentions that the number of working looms has fallen from 1.44 lakh in 1971 to around 1.33 lakh in 1987, showing an annual decline of 0.65 per cent. Production of mill cloth declines from 4.1 billion metres in 1971 to 3.1 billion metres in 1987, again a decline at the rate of 1.55 per cent. He also laments the decline in real price of cotton textiles with fall in the relevant price index. Besides, profitability in the industry has been less than the all-industry average. Giving ample material for examination, Goswami builds up a case for reducing subsidies to the handlooms sector that has enabled it to maintain relatively inefficient units for long.

Examining issues relating to: powerlooms versus mills, powerlooms vs. handlooms, rationalising the workforce in the mill sector, and the myth of modernisation, he opines that there is very little hope for most of the composite mills, especially the nationalised ones, in the face of competition from powerlooms. The options that exist are closely linked to rationalising the labour force which, in turn, requires a definite policy decision by the government backed up by an attractive voluntary retirement package—things that the government has chosen to ignore to the further detriment of the sector. Similarly, without heavy doses of subsidies, the share of the handloom sector is bound to shrink over time. With its striking cost advantages, the only winner seems to be the powerloom sector.

Conclusions

Textile industry assumes importance in the Indian context since it provided employment to about 136 lakh persons during 1988-89. Gujarat, Tamil Nadu and Maharashtra contribute to more than 63 per cent of cotton textiles output. Total yarn production which stood at 1.3 billion kgs. in 1980-81 increased to 1.56 billion kgs. in 1988-89. Cotton yarn production that stood at 1 billion kgs. in 1980-81 increased to 1.3 billion kgs. in 1988-89. Domestic consumption of yarn in the mill sector showed decline in the mill sector and an increase in the decentralised sector. Export of cotton yarn showed sharp increase particularly during 1985-86 to 1988-89.

Production of cotton and man-made textiles grew at a rate of 1.8 and 3.4 per cent over the period 1980-81/1985-86 and 1985-86/1988-89, respectively. The figure for 1988-89 is 13.3 billion metres. One observes a phenomenal increase in the percentage of blended/mixed fabrics in the total output of the mill sector. This has been achieved with the introduction of new machinery and adoption of different innovative processes and methods.

Domestic consumption of all-cloth shows a perceptible increase during 1985-86 to 1988-89. Export of cotton fabrics more than doubled to Rs. 1519 crore in 1985-86 from Rs. 671 crore in 1980-81, showing an annual average growth rate of around 18 per cent over the period. Export of cotton fabrics declined to Rs. 1105 crore in 1988-89, annual average rate of decline being more than 11 per cent. Steps are to be intensified by following different strategies to promote exports. Year-end stocks of all-cloth increased in 1985-86 over 1980-81 but fell considerably during 1988-89. This shows better absorption of cotton textiles in the domestic economy.

Installed spindles increased from 23.23 million in 1980-81 to 26.48 million in 1988-89. Installed looms remained in the range of 208 to 210 thousand during 1980-81 to 1986-87. It fell to 199 thousand in 1987-88 and further to 184 thousand in 1988-89. Capacity utilisation in spindles lay in between 69 and 77 during 1980-81 to 1988-89. However, 61 to 77 per cent capacity utilisation has been observed in the case of looms over the corresponding period. Marginal decline in employment in the organised mill sector from 12.3 lakh in 1987-88 to 11 lakh in 1988-89 was observed. There has been considerable increase in employment in powerloom both in 1987-88 and 1988-89 as against 1986-87.

The study analyses the determinants of fixed investment and inventory investment in cotton textiles over the

period 1980-89, covering 12 firms in different states, *viz.* Bombay, U.P., Coimbatore and Calcutta. The results reveal accelerator and financial variables—retained earnings and external finance– to be important and significant determinants of gross fixed investment. Inventory investment has been of a complementary nature. Age of equipment shows 'Echo Effect'. On the other hand, we get rather perverse results in respect of inventory investment i.e. accelerator coefficient is not significant. Coefficients of retained earnings and external finance show negative sign and are significant. This shows that reasons other than financial variables and accelerator, *e.g.* capacity utilisation and power availability determine inventory investment in cotton textiles industry.

The present exercise measures partial productivity ratios/indices based both on output and gross value added versions in respect of different constituents of cotton textile industry. Cotton spinning, weaving, shrinking, sanforizing and finishing of cotton textiles (231) forms the core sector in terms of output, capital and employment, which are 79.6, 90 and 76.1 per cent of cotton textiles in 1986-87. One observes decline in capital productivity in cotton spinning, weaving and finishing of cotton textiles (231), Khadi (234), Handlooms (235) and Powerlooms (236). Labour productivity shows an increase in Charkha (233), cotton ginning, cleaning and baling (230), printing and dyeing (232) as also in other segments like cotton spinning, weaving and finishing of cotton textiles (231) and handlooms (235). Materials productivity shows a decline in all the constituents except Khadi (234). Fuel productivity shows a decline in constituents bearing Nos. 231, 234, 235 and 236. The fall in materials and fuel productivities in different constituents leave scope for analysing input substitution behaviour in this important industry.

Production function estimates have been obtained at two levels : one by pooling of cross section of time series using state level observations and the other using disaggregated industry level observations over the period 1980-87. Different side relations of the Constant Elasticity of Substitution production function were obtained to look for application of Cobb-Douglas production function. The evidence revealed relevance of estimating Cobb-Douglas production function parameters since the elasticity of substitution between capital and labour did not come out to be significantly different from unity in many models used for the purpose in both the versions using the state level as also disaggregated industry level observations.

The results of unrestricted Cobb-Douglas Production Function show positive and significant coefficients of capital in the case of state level observations, though with diminishing returns to scale, both employing gross value added and output as the dependent variables and the relevant independent variables.

Pooling of cross section of time series at the disaggregated industry level in respect of cotton textiles over the period 1980-87 reveals the coefficients of capital and labour to be positive and significant in all the cases, except where one uses the variables materials and fuel in the output version. The finding of increasing returns to scale gets confirmed in the three series of results presented (tables 13, 14 and 15). The per establishment variables have been multiplied by $\sqrt{N}$ to take care of heteroscedasticity. We have also checked for Kmenta's approximation by introducing $(\log K - \log L)^2$ as the term for "correlation" due to the departure of RHO from zero. Besides, the values have also been adjusted by RHO = 2.37 to check for serial correlation. The results reveal presence of technical progress since we obtain the coefficient of 't' to be positive and significant in the series at disaggregated industry level (tables 13 and 14).

Goldar & Mukhopadhyay (1991) results for the cost-price model indicate a high degree of boundedness among inputs. A strong K-L, K-E, L-E, E-L, and L-K binding was found in cotton textiles. Allen elasticities of substitution between labour and energy were found to be positive. This is indicative of a substitution relationship between labour and energy. Own price elasticities obtained from the cost-price model are low in relation to the estimates from the translog model. This is to be expected since cost-price model takes into account the binding among factors of production, while translog model does not do so adequately.

Jha et. al (1991) results reveal that technical change in cotton textiles has been capital using and labour and energy material saving. They ascribe this phenomenon to the growth of trade unions and to the movements in relative factor prices during the sample period. Further, they are of the view that in recent past, trade unions have become dominant and are able to wrest rapid and large wage raises from management. Price of capital has increased at a lower rate due to availability of cheap institutional credit. Technical change in this industry has thus caused factor income ratios to move against workers and in favour of the suppliers of capital, and to a lower extent, to the suppliers of energy material. Estimates of elasticity of cost with respect to output confirm the finding of presence of economies of scale.

The exercise also takes into account the result of Jain (1990) with regard to determinants of exports of cotton textiles and the various strategies suggested therefor. Following Pursell (1989) and Goswami (1990), the study discusses the reasons for sickness. It examines the suggestions made in World Bank study (1989) with regard

to industrial sickness in this industry. It is in line with the argument that reduction in subsidies to handloom industries would result in checking to an extent maintenance and promotion of sick and inefficient units.

The distinguishing features of this study are :

(i) It examines production, consumption, export, stock position of 'yarn' and 'cotton and man-made textiles', capacity utilisation and employment in cotton textiles industry during 1980-81, 1985-86 and 1988-89.

(ii) It examines the determinants of fixed investment and inventory investment in cotton textiles industry based on data at the firm level.

(iii) It employs output and GVA versions to discuss partial productivity ratios/indices both at the disaggregated industry level and state level, based on data during 1980-87 from ASI.

(iv) It presents results employing C-D production function and Kmenta's measure for efficiency evaluation, both at the disaggregated industry level and state level to find out the elasticities of output/GVA with respect to factors of production over the period 1980-87.

(v) It presents results by Goldar and Mukhopadhyay (1991), and Jha et al (1991) to throw light on cost-price production function and cost function using data in respect of cotton textiles industry. The results confirm the finding of economies of scale obtained in the present study.

(vi) It discusses the reasons and extent of sickness in cotton textiles.

To sum up, the paper examines the structure and growth of cotton textiles industry, and also determinants of fixed and inventory investment at the firm level, discusses partial productivities at the disaggregated industry level, comments on the coefficients of capital, labour, materials and fuel forming part of returns to scale, and 't' representing technical progress. It reports about the application of Kmenta's measure to check for C-D production function. Results reveal a strong binding for different inputs. The study also reveals that technical change in cotton textiles has been capital using and labour and energy material saving. Presence of economies of scale is confirmed.

Despite government efforts, sickness in cotton textiles remains a problem deserving attention for early prediction and removal. Export promotion strategies and measures need intensification. The paper leaves scope for further work on cotton textiles to take into account the impact that the emerging world scenario *e.g.* Europe 1992, unification of Germany, etc. would have on Indian trade and production in respect of this industry. Other aspects needing treatment are technology diffusion, research and development that affect the growth of this industry both at the firm and the plant levels if we wish to catch up with the improvements and innovations that are being introduced and practised at different places of the developed and developing economies.

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Productivity and Economies of Scale in Public Sector Banks

R.N. Agarwal

This study examines the impact on productivity, technical change and economies of scale since nationalisation of banks in 1969. Productivity growth has been evaluated with the help of partial and total factor productivities. Economies of scale and technical change have been analysed using translog cost function. Estimation of translog cost function reveals the existence of economies of scale and technical change. Productivity analysis reveals a rising trend in capital and labour productivities. Expansion of banking activity by increasing the number of bank branches is found to have contributed to productivity growth and increase in cost per unit of output. Finally, the study concludes that nationalisation of banks in 1969 has led to an increase in productivity of public sector banks along with a disproportionate growth of expenditure on manpower.

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Productivity, technical change and scale economies are three major technological characteristics that must be analysed while investigating the growth of industry over time and comparing the technological performance between firms in an industry.

Productivity measures the level of output per unit of input. It explains the efficiency in the use of factors of production because improving productivity means producing more goods and services with the same resources or maintaining the same level of production with less resources. Technical change refers to changes in technology that is, the set of techniques available to produce a given commodity. This is reflected through changes in the level of output or cost of production. Technical change may be embodied or disembodied. It is said to be disembodied if the technical change occurs not in inputs but outside them. The resulting shifts of the production function can be represented by including a time variable; $Q^t = f(L^t, K^t, t)$.

This implies that the same input quantities yield different outputs at different points of time. Technical change is called embodied when such changes are embodied in inputs of different vintages. For instance, new machines may be more productive than old ones and thus capital is no longer homogeneous. A neutral disembodied technical change is one which neither saves nor uses either factor and so leaves the marginal rate of substitution unaltered. Technical change shifts the isoquants inwards and Hicks neutral technical change leaves the slope of the isoquants along a ray through the origin unchanged. Thus there is no incentive to vary factor proportions unless relative factor prices change. Technical change is said to be non-neutral if the production function shifts so that the marginal product of capital rises relative to that of labour for each factor combination. Increasing returns to scale are said to exist when an equiproportional increase in all inputs results in a greater than proportionate increase in output or equivalently when an increase in output at constant

input prices leads to a less than proportionate increase in total costs. Thus average cost declines as output expands.

There are some studies on Indian banking sector which have analysed the cost and productivity behaviour. Major studies include Rangarajan and Mampilly (1972), Varsha & Sampat Singh (1982) and Subrahmanyam (1984). But Rangarajan and Manpilly's study is based on banking data of pre-nationalisation period i.e. (upto 1969) or they estimate a simple cost function to determine average and marginal costs for determining the optimum bank size. The other two Indian studies cited compute partial and total factor productivities only. An important but a neglected area is the impact of technical change on economies of scale in the banking sector as the new vintage of capital may be more expensive but more efficient also. Hence scale of operation might become an important determinant of the rate at which costs decline over time. The interrelationship between technical change and scale economies can have significant effects on optimal bank size. This will help regulatory decisions concerning the organisation of financial markets. Empirical evidence on bank's technological characteristics is also important for decisions at the macro and micro levels. At the micro level the knowledge of banks technological characteristics may help to answer questions concerning optimal size, product mix, and product pricing. At the macro level the evidence can affect policy making in the banking industry.

The literature analysing scale economies in commercial banking elsewhere is voluminous. The early studies include Benston (1965), Greenbaum (1967), and Murphy (1972).[1] More recent studies include those by Benston, Hanweck and Humphray (1982), Clark (1984, 1988) and Noulas, Ray and Miller (1990).[2] Most of the studies use samples of smaller banks. They find that economies of scale are quickly exhausted and that further increases in bank size occur at constant or possibly increasing cost.

The present paper attempts to provide empirical evidence on bank's technological characteristics in India and the influence of factors such as organisational form and branching structure etc. have on these characteristics as well as on scale economies. Thus, the objective of the study is to analyse partial and total factor productivities to explain the productivity growth over time and also to analyse economies of scale after the nationalisation of banks in 1969.

1. These studies estimated banking cost functions using Cobb-Douglas (CD) type production function. Also much of the debate focussed on bank output.
2. These authors replaced Cobb-Douglas production function with more generalised production functions and found a significant U shaped average cost curve casting much suspitcion on the earlier work. More recently Clark (1984) and Kilbride, Mcdonald and Miller (1986) henceforth called KMM have specified a special version of a generalised functional form in which all variables undergo a box-cox transformation.

Indian Banking Sector Since 1969

Nationalisation of fourteen commercial banks in 1969 marked the begining of a new phase of development of banking in India. Later, six more banks were nationalised in 1980. From a mere 8262 bank branches in June 1969 total number of bank branches has increased over six fold to about 55000 in June 1988. Consequently, the average population served per bank branch has declined from 65000 in 1969 to less than 15000 in 1988, a decline of nearly 80 per cent. The level of deposits which stood at only Rs.46460 million has reached Rs.1320,000 million and in the process deposits as a per cent of gross national product has gone up from 15.5 to 49 per cent. The level of advances has increased from about Rs.36000 million to Rs.700,000 million. During the same period credit debit (CD) ratio has come down from 77.5 per cent to 59.6 per cent and per capita credit has increased from Rs.69 to Rs.897 in 1988. With the increase in rural branches from 1832 to 30585 during 1969-1988 the share of rural branches in deposits has increased from 3.1 per cent to 14.5 per cent. The share of priority sector lending has increased from 14 per cent to more than 45 per cent in 1988. Also around 50 per cent of bank's funds are immobilised by way of statutory pre-emptions. Hence not more than 30 per cent of bank's funds are available for lending at higher but regulated rate of interest. Therefore the income of a bank as shown in the profit and loss account does not represent a true productivity indicator. However, it may give some rough idea about the trends in profitability. Data reveal that profitability defined as the ratio of net profits to working funds, has declined continuously from 0.23 per cent in 1975 to .09 per cent in 1984. Profitability has, however, picked up in the last few years (1984 onwards), mainly on account of diversification of banking activities into other areas such as investment banking, venture capital, credit cards, consumer credits etc. Working funds per rupee of man power expenses has shown a rising trend from 1974 only. This parameter declined by more than 50 per cent from Rs.71.22 in 1950 to Rs.33.80 in 1974 for all banks and then rose by about 58 per cent to Rs.52.69 for nationalised banks in 1978. Labour productivity has declined continuously since 1983 after remaining almost uniform during 1978-82.

On the other hand working funds per employee has risen continuously from Rs.4.2 lakhs in 1969 to Rs.24.3 lakhs in 1987. Table 1 depicts the annual compound growth rate of the number of employees, working funds and per employee working funds. In terms of expenses

Table 1 : Annual Growth Rates

Period	No. of Employees	Working Funds	Per Employees Working Funds
1961-69	8.4	12.7	3.9
1969-77	10.0	20.5	9.5
1977-86	7.8	20.0	11.4

on man power we find that the establishment expenses per employee has risen more than 4 fold from Rs.8020 in 1969 to Rs.35600 for SBG and Rs.32000 for all nationalised banks. On the whole one can say that there has been a significant growth after bank nationalisation in 1969 in terms of profits, business volume, establishment expenses and branch expansion.

The study is confined to public sector banks in India for the period 1969 to 1986. This covers around 90 per cent of total banking business in India. The study covers two segments; one related to State Bank of India and its 7 associates generally called State Bank Group (SBG). This group accounts for about 30 per cent of deposits and loans and over 20 per cent of bank branches. Other part is concerned with 20 nationalised banks in the public sector. The sources of data are basic statistical returns submitted by banks and statistical tables related to banking in India published by the Reserve Bank of India.[3] Data gaps have been filled up with the help of annual reports and balance sheets of the banks. Price indices have taken from Reserve Bank of India bulletins.

Some Issues in Measurement

Productivity measurement in banking centres round the basic issue of quantifying the output and operating cost of commercial banks. The output of a commercial bank is financial in nature and there are no tangible goods. This raises problems (sometimes may cause confusion) in distinguishing the ouptut from inputs of the banking activity. The output of banking may be treated as arising in two stages first may be characterised as a process which combine capital, labour and managerial services to generate deposits; second these deposits produce loans and investments. Hence this two stage treatment of banking activity gives rise to innumerable problems of final output measurements.

For the purpose of productivity measurement, output of a bank may be measured indirectly in terms of gross income received from loans and security investments. This measure will give a very rough idea about the trends in productivity as the accounting system still operates under public regulations and Indian banks operate under policy constraints dictated by the socio-economic objectives. Output of a bank may be measured directly in terms of final product of the banks that is loans and investments etc. However, it could be argued that deposits of a bank is its primary output while loans and investments are just consequence of having deposits. In this sense the output of a bank can be proxied in terms of total deposits. In the literature on Indian banking, output has generally been defined as total deposits or gross income or the total business of bank that is the sum of deposits and loans.[4] Then, should we treat bank as a multiproduct firm or the various products of the bank be aggregated to obtain a single composite commodity? A number of studies do not distinguish various categories of output and treat just one composite commodity. [Humphrey (1987), Hunter and Timme (1986), Nelson (1985), Shephard and David (1986).] Aggregation assumes that the cost function is separable in output; that is, the relative marginal cost of any two outputs is independent of input prices. If this assumption does not hold then the scale results may be biased.

We could consider various measures of output such as (i) deposits (ii) loans plus investments (iii) deposits plus loans (iv) gross income. However, we have considered income generated by deposits or reported gross income as measures of output. Again, a controversy arises about the treatment of interest expense. The disaggregated approach (separate cost functions for different products) excludes this expense from the analysis of cost-output relationship.[5] But this approach may be followed only when the data were available for each activity of the bank and its associated cost. Also separate cost functions are appropriate when the production of each product by a multi product firm is independent of the production of every other product. Alternatively if a weighted aggregate of various outputs is taken as the output measure then

3. Sources of Data :
   (i) Statistical tables related to Banks in India (1986), A Reserve Bank of India Publication and
   (ii) RBI Report on Trends and Progress of Banking in India 1988-89.

4. Kurup (1990), Varsha and Sampat Singh (1982), Desai (1982).
5. Benston (1972), Bell and Murphy (1968), Daniel et. al (1973) Guttenberg and Herwan (1967), Ranga rajan (1971).

interest cost has been included in the banking operating cost.[6] Again, the production approach measures output by the number of accounts and considers only operating cost while the intermediate approach measures output by the value of accounts and consider both operating cost and interest cost. As a measure of cost we have considered total cost excluding interest paid on deposits and borrowings.

The Model

Considering only two factors of production that is labour and capital we explain factor productivities such as output/labour (APL) and output/capital (APK) as well as total facor productivity (TFP) defined as the ratio of output to a weighted aggregate of inputs.[7]

TFP have been computed using the standard index number approach. There are two indices commonly used. They are (i) Kendrick index and (ii) Solow index. Since these productivity measures are well known in the literature they are defined as under without further explanations.[8]

$$\text{Kendrick index } KI_t = \frac{Q_t}{P_{ok}K_t + W_{oL}L_t}$$

where P_{ok} and W_{oL} are the base year (1969) costs of capital (K) and labour (L) respectively.

$$\text{Solow index } SI_t = SI_{t-1}(1 + g(t))\,t;\ SI_2 = 1$$

$$\text{where } g(t) = g_o(t) - \left[S_k(t)\, g_k(t) + S_L g_L(t)\right]$$

$$\text{and } g_k(t) = K_t - K_{t-1}/K_{t-1}$$

$$g_L(t) = L_t - L_{t-1}/L_{t-2}$$

Total factor productivity indices explained above though are quite useful to explain productivity growth has certain serious limitations. For instance, constant returns to sale is an assumption frequently made when estimating most of production functions. This assumption distorts the meaning of total factor productivity index because no distinction can be made between a pure Hicksian neutral technological change and efficiencies resulting from an increasing realisation of scale economies. Also, total factor productivity indices do not explicitly account for intermediate inputs or for the potential factor substitution between intermediate inputs and basic inputs like labour and capital. Other serious limitations in this approach includes the assumption of separability of inputs and outputs, marginal productivity theory of distribution and neutrality of technical change. Such ambiguities can be removed by estimating a non-holothetic production or cost function such as translog. (a form in which scale effects are distinguishable from the technology effect).

Technical Change and Economies of Scale

In the Indian banking sector the objective of the bank management is to minimise the operating cost subject to the given lending and deposit rates and a desired level of of banking services for the customers. Therefore in the present study a cost function has been used to measure technical change and economies of scale.

Let A = f (K, L, ...) define a bank's production function. Under the assumption of cost minimization and exogeniety of output and input prices, the general form of bank's total cost function can be expressed as C = g (Q, p_k, p_L.... T). A translog cost function has been used in the present study to derive estimates of technical change and its impact on scale economies.[9] We have followed the recent studies by Hunter and Timme, (1986) and allowed the branch variable B to enter the equation with other variables.

$$\log C = ao + a1 \log\left(P_L\right) + a2 \log\left(P_k\right) + a11.1/2 \left(\log P_L\right)^2 + a22.1/2 \left(\log P_k\right)^2 + a12 \log\left(P_L\right) \log\left(P_k\right) + \beta 1 \log Q + \beta 21/2 \left(\log Q\right)^2 + \beta 3 \log Q. \log P_L + \beta 4 \log Q. \log P_k + VIT + Y2.1/2\, T^2 + Y3 T. \log P_L + Y4\ T. \log P_K + Y5\ T. \log Q + \delta 1 \log B \quad ..(1)$$

It is expected that the variables Q, P_k, P_L and B have positive coefficient while trend has a negative coefficient.

6. Greenbaum (1967), Goldschmidt (1982).
7. An increase in TFP implies improvement in productivity. This may arise due to experience of the employee, positive change in work attitude and/or improvement in handling transactions.
8. Kendrick J.W. (1956) ; Solow R.M.(1957).
9. We have chosen translog cost function for the following reasons :
   (i) The failure of empirical research to detect u shaped cost curves stems principally from the misspecification of the production function. Most of the research work on production and cost functions has assumed Cobb-Douglas (CD) or CES forms as well as separability. These problems have been solved recently through the development of the duality theory, the theory of multiproduct firms (Baumol, 1977) and the introduction of flexible functional forms (Christenson, Jorgenson and Leu 1977,.). The most popular of these forms are the translog forms.
   (ii) Translog functional form is theoretically consistent, flexible, and computationally tractable. Also it does not make *apriori* assumptions regarding separability, substitution, returns to scale, homogeneity and homotheticity of input structure and neutrality of technical change.

Several paramteric restrictions can be imposed on the trans-log cost function for testing for homogeniety, separability etc. For instance, one of them states that the cost function is linearly homogeneous in factor prices which means that

$$\sum_{1}^{2} a_i = 1, \sum_{3}^{4} \beta_i = 0, \sum_{3}^{4} Y_i = 0, \sum a_{ii} = 0, Y_{ii} = Y_{ii}$$

$$\text{and } \sum \delta_i = 0$$

Using the above mentioned restrictions on parameters we obtain the following equation for estimation.

$$\log \left(C/P_k \right) = a_o + a_1 \log \left(P_2/p_k \right) + a_{12} 1/2 \left(\log P_2/P_k \right)^2$$

$$+ \beta 1 \log Q + \beta 2 . 1/2 (\log Q)^2 + \beta 3 \log Q . \log \left(P_L/P_k \right)$$

$$+ Y1T + Y2 . 1/2 \, T^2 + Y3 \, T \log \left(P_L/P_k \right) + Y5 \, T \log Q$$

$$+ \delta 1 \log B \qquad .. (2)$$

Technical change is defined as $= - \dfrac{\delta \log C}{\delta T}$ [10]

and scale economies are measured by

$$SE = \frac{\delta \log C}{\delta \log Q}$$

Interrelationship between technical change and scale economies is judged by

$$SE. * TECH = \frac{\delta^2 \log C}{\delta \log Q \, \delta T}$$

SE. * TECH = < o = > changes in technology increase scale economies and vice-versa.

Since banks can expand output not only by adding loans and deposits to the existing bank branches but can expand their business also by opening new bank branches (B), the scale economies measure may be modified by incorporating the effect of B on cost (C). The modified form is termed as augmented economies of scale (ASE) and is defined as:

$$ASE = SE + SEB . (d \log B / d \log Q)$$

where SE = scale economies as defined above

SEB = cost elasticity with respect to the number of bank offices

$= d \log C / d \log B$

and $\dfrac{d \log B}{d \log Q}$ = Elasticity of number of bank offices with respect to output.

Further, the literature suggests that total factor productivity growth (TFP) is linked to the effects of technological change (TECH), scale economies, and the effects of non-marginal cost pricing and rate of return regulations. However, we are leaving the effects of regulated industry on TFP on account of limitations of data and evaluate technical change and economies of scale only.

Empirical Results

Best fitted regression results using ordinary least squares method of estimation with panel data for the two bank groups viz. SBG and NBG are given below when the output of bank is considered as total depoists at constant prices and banking cost does not include interest paid on deposits.[11]

$$\log \left(C/P_k \right) = 3.986 + 1.054 \log \left(P_L/P_k \right) + 0.165 . 1/2 \left(\log \left(P_L/P_k \right) \right)^2$$

$$(7.322) \quad (13.58) \quad (1.33)$$

$$0.166 (\log Q) - 0.038 \, T + 0.0027 \log Q . T$$

$$(4.45) \quad (5.53) \quad (4.34)$$

$$+ 0.736 \log B$$

$$(7.19)$$

$$R^{-2} = 0.977 \qquad DW = 1.27$$

Regression results reveal that output, factor prices, bank branches and trend (T) are important explanatory variables in the cost function. Their coefficients possess the expected signs and they are all statistically significant. Explanatory power of the equation as depicted by R^{-2} is quite high. Results do not change much when gross reported income is used as a measure of output.

Results suggest that the operating cost of the bank increases with the increase in the prices of inputs like labour and capital, increase in the volume of work handled by the bank and an increase in the number of bank branches. At the same time it suggests that technical change in the functioning of banks has resulted in reducing

10. Negative Sign has been used for converting TECH into a positive measure only.

11. Results of translog cost functions for the other measure of output are given in Appendix 2.

the operating cost. Thus there are evidences of the presence of technical change in public sector banks. The term log Q has a positive coefficient which is less than unity indicating the presence of economies of scale but the coefficient of the term log Q.T is again positive suggesting that economies of scale have declined over time. This is attributed to the increase in operating cost to the extent that volume of business per rupee of man power expenditure has declined over time.

Elasticity of cost with respect to output, i.e. scale economies (SE) and technical change (TECH) are determined as under :

$$SE = \frac{\delta \log C}{\delta \log Q} = 0.166 + .0027\ T$$

$$ASE = S.E. + S.E.B. = S.E. + 0.736$$

$$\left(\text{Assuming } \frac{d \log B}{d \log Q} = 1 \right)$$

$$TECH = -\frac{\delta \log C}{\delta T} = 0.038 - .0025 \log Q$$

Economies of scale and technical change have been computed over time for the two bank groups and results presented in table 2. Results show the presence of economies of scale and technical change in both the bank groups. Results do not change much when gross income is used as the measure of output.

Table 2 : Economies of Scale and Technical Change

Year	SBG		NBG	
	SE	TECH	SE	TECH
1970	.1849	.01173	.1849	.00997
1971	.1875	.01133	.1875	.00964
1972	.1900	.01073	.1900	.00909
1973	.1925	.01053	.1925	.00884
1974	.1950	.01042	.1950	.00887
1975	.1976	.01009	.1976	.00836
1976	.2001	.00898	.2001	.00682
1977	.2026	.00853	.2026	.00636
1978	.2052	.00812	.2052	.00610
1979	.2077	.00762	.2077	.00562
1980	.2102	.00707	.2102	.00474
1981	.2128	.00697	.2128	.00451
1982	.2153	.00703	.2153	.00452
1983	.2178	.00634	.2178	.00402
1984	.2204	.00619	.2204	.00402
1985	.2229	.00593	.2229	.00382
1986	.2254	.00571	.2254	.00350

Regression results are further supported by partial and total factor productivities as presented in table 3. All of them show an upward trend for both the bank groups.

Table 3 : Partial and Total Factor Productivities

Year	APL	APK	KI	SI
State Bank Group				
1970	.164045	.613582E-01	1.01624	1.00000
1971	.172395	.672065E-01	1.09231	1.16740
1972	.196223	.768445E-01	1.24634	1.80886
1973	.190580	.746933E-01	1.21101	1.59110
1974	.182941	.755335E-01	1.19511	1.50007
1975	.201492	.823531E-01	1.30928	2.63179
1976	.307245	.103607	1.79560	23.2687
1977	.339486	.959149E-01	1.78529	15.3059
1978	.352492	.917497E-01	1.76076	11.2070
1979	.407922	.890809E-01	1.81573	11.8077
1980	.467946	.110400	2.19324	110.691
1981	.448847	.106727	2.11460	70.1608
1982	.414269	.915426E-01	1.85875	8.75880
1983	.508180	.111468	2.26878	169.826
1984	.511181	.111967	2.27999	182.972
1985	.536389	.112102	2.31719	214.122
1986	.56365	.113660	2.37485	303.945
Nationalised Bank Group				
1970	.237288	.610882E-01	1.01251	1.00000
1971	.245199	.627710E-01	1.04242	1.06678
1972	.283562	.702558E-01	1.17977	1.59688
1973	.271612	.677979E-01	1.13564	1.34165
1974	.238158	.697628E-01	1.10380	1.15916
1975	.273810	.884649E-01	1.34771	4.06999
1976	.466550	.125065	2.04382	95.4398
1977	.498007	.126832	2.11001	115.883
1978	.488929	.120376	2.02570	70.3926
1979	.558787	.121345	2.12603	93.7941
1980	.650713	.146464	2.53763	982.445
1981	.661387	.159003	2.69698	2457.45
1982	.603325	.150535	2.52188	1095.37
1983	.685904	.160085	2.74172	3234.36
1984	.639066	.145770	2.51499	721.475
1985	.650614	.142577	2.49102	532.448
1986	.710332	.144364	2.58022	789.757

Conclusions

From the analysis of results we may conclude that productivity of public sector banks in India has grown over time. There is evidence of technical change although small in magniture. Elasticity of cost with respect to output is found less than unity implying thereby the existence of economies of scale but declining over time. Expansion of bank branches is found to have contributed to productivity growth. The study recommends a reduction in manpower expenditure for improving economies of scale and productivity growth.

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Appendix 1 : Variables

C : Cost variable, considered as the bank's total operating expenses excluding interest paid on deposits.

X_1 : Total deposits

X_2 : Gross income

P : Bank's lending rate of interest

Q : Value added = PX1 or X2

Q : Value added at constant price

L : Number of bank employees comprising of officers, clerks and sub-staff.

K : Total assets = Working funds - contra items

P_L : Earnings per labour = $\frac{\text{Establishment Expenses}}{\text{Number of employees}}$

P_k : Cost of capital = $\frac{Q - \text{Establishment Expenses}}{K}$

S_L : Share of labour in value added = $\frac{\text{Establishment Expenses}}{Q}$

S_k : Share of capital in value added = $1 - S_L$

APL : Average labour productivity = Q^*/L

APK : Average capital productivity = Q^*/K^*

Appendix 2 : Results Based on Gross Income as Output Partial and Total Factor Productivities

Year	APL	APK	KI	SI
State Bank Group				
1970	.167811	.627669E-01	1.01587	1.00000
1971	.182921	.713099E-01	1.13306	1.26606
1972	.184340	.721908E-01	1.14471	1.31030
1973	.184817	.724348E-01	1.14817	1.32815
1974	.191262	.789689E-01	1.22222	1.86792
1975	.185597	.758566E-01	1.17958	1.48701
1976	.222190	.749254E-01	1.26757	2.09882
1977	.250243	.707013E-01	1.28236	1.90599
1978	.249286	.648865E-01	1.21245	.95651
1979	.297294	.649224E-01	1.28637	1.68175
1980	.308162	.727032E-01	1.40502	4.74268
1981	.308647	.733901E-01	1.41461	5.23018
1982	.317334	.701224E-01	1.38422	3.39746
1983	.325267	.713468E-01	1.41169	4.52281
1984	.343853	.753165E-01	1.49090	10.7194
1985	.357824	.747831E-01	1.50205	11.6014
1986	.377124	.761259E-01	1.54512	18.5796
Nationalised Bank Groups				
1970	.223790	.576132E-01	1.01328	1.00000
1971	.242426	.619842E-01	1.09239	1.18068
1972	.250391	.620373E-01	1.10632	1.22977
1973	.249018	.621582E-01	1.10552	1.22610
1974	.256434	.751164E-01	1.25766	2.44081
1975	.243433	.776811E-01	1.24957	2.49141
1976	.282393	.756994E-01	1.31156	2.84979
1977	.290637	.740192E-01	1.30696	2.56917
1978	.280585	.690813E-01	1.23471	1.35958
1979	.328687	.713772E-01	1.33164	2.74931
1980	.323840	.728905E-01	1.34381	3.24415
1981	.315515	.758526E-01	1.36718	4.42190
1982	.311637	.777563E-01	1.38315	5.57398
1983	.325616	.759964E-01	1.38393	4.84695
1984	.343597	.783742E-01	1.43844	8.73339
1985	.363851	.797351E-01	1.48313	13.7555
1986	.391778	.795228E-01	1.51734	17.8765

* Star over a variable denotes its value at constant price)

Result Based on Translog Cost Function

$$\log\left(C/P_k\right) = 3.792 + 0.832 \text{ Log } \left(P_L/P_k\right) + 0.173 \cdot 1/2 \left(\log\left(P_L/P_k\right)\right)^2$$

$$+ 0.301 \text{ Log } Q - 0.0448 \text{ T} + 0.0036 \text{ Log } Q.T$$

$$(3.73) \qquad (5.66) \qquad (4.37)$$

$$+ 0.619 \text{ Log B}$$

$$(5.19)$$

$$R^{-2} = 0.975 \qquad DW = 1.20$$

Appendix 3 : Economies of Scale and Technical Change

Years	SBG		NBG	
	SE	TECH	SE	TECH
1970	.3177	.01840	.3177	.01644
1971	.3209	.01778	.3209	.01587
1972	.3241	.01741	.3241	.01553
1973	.3273	.01705	.3273	.01510
1974	.3305	.01668	.3305	.01462
1975	.3337	.01666	.3337	.01462
1976	.3369	.01603	.3369	.01387
1977	.3401	.01540	.3401	.01340
1978	.3433	.01502	.3433	.01314
1979	.3465	.01429	.3465	.01245
1980	.3497	.01392	.3497	.01187
1981	.3529	.01365	.3529	.01171
1982	.3561	.01338	.3561	.01147
1983	.3593	.01308	.3593	.01110
1984	.3625	.01273	.3625	.01071
1985	.3657	.01242	.3657	.01033
1986	.3689	.01214	.3689	.00998

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□

Ours is the age of substitutes: instead of language we have jargon; instead of principles, slogans; and instead of genuine ideas, bright ideas.

—Eric Bendley

Most managers do not love what they produce; they are defensive about it.

—Peters and Waterman

Some firms observably go through a healthy three-to-five years "identity moratoria" during which they decide not to decide what business they are in.

—W.J. Reddin

I do not like to have my managers think that they are a special breed of people elected by God to lead stupid people to do miraculous things.

—Akio Morita

Bulk Drugs and Formulations: Trade Off Between Low Price and Availability

Dutt Kumar Mittal

A non-existent industry during pre-independence years, the Drugs and Pharmaceuticals today constitute a significant industrial activity, in terms of both the quantum of output and the nature of the utility it renders. The bulk drugs production was around Rs.610 crores in 1989-90 which is expected to grow to about Rs.16000 crores in 2000 A.D. Presently, the industry is producing not only for domestic consumption but also for exports. Due largely to the rigid controls on prices and production mix, the growth of the industry has been stunted in recent years. Not only the investors shy away from this industry, but even the banks and other financial institutions place drug enterprises at a low rating, argues this paper.

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Despite the rigid and dual control by the government in respect of the pricing of bulk drugs and formulations and profitability of the producing enterprises, the Indian drugs and pharmaceutical industry has grown significantly, though not sufficiently, since independence. The production of formulations increased from a mere Rs.35 crores in 1952 to Rs.3360 crores in 1989-90. Production of bulk drugs was non-existent at the time of independence and was worth a mere Rs.15 crores in 1962. It went up to Rs.610 crores in 1989-90. The target of bulk drugs and pharmaceuticals for the year 2000 is a turnover of Rs.16000 crores. The number of units producing pharmaceuticals has increased from 1752 in 1952-53 to 9560 in 1985-86. Presently the industry is not only producing for domestic consumption, but also for exports both to the developed and the developing countries. Total export of bulk drugs and finished formulations has gone up from Rs.46.38 crores in 1980-81 to approximately Rs.600 crores in 1989-90. The dominance of FERA drug companies has also substantially reduced as their number had come down to 7 in 1986-87 from 45 in 1947-48.

However, the production of bulk drugs and pharmaceuticals had always been below plan targets, because of lower fresh investment in the industry due to a reduced profitability of the industry on account of rigid controls on prices, profitability and the production mix. Profit before tax as percentage to sales declined to about 3.5 per cent in 1989-90 from 15.47 per cent in 1969-70. No wonder, the investment growth in the industry, which had touched a rate of 23 per cent during the 60's and the 70's declined by half during the 80's. This decline in the growth of an industry - so essential for the health programmes, eradication of diseases and an improvement in the quality of life of Indian people— becomes all the more disturbing in a situation where India with 15 per cent of world population was producing only 1.8 per cent of world drug production in 1986 and its per capita consumption of drugs in 1984 was Rs. 26 on the average (being only Rs. 6 for rural India) compared to Rs.1650 in Japan.

It is more or less universally felt that the slow growth of drugs and pharmaceutical industry, particularly during the eighties i.e. after Drug Price Control Order 1979 (DPCO 1979), had been due to a rigid control on prices and profitability of the producing enterprises - first by not granting them remunerative prices and then again by delaying grant of price increase permissible even as per the price control order then in vogue. The situation worsened over a period of time because the prices of drugs and medicines have been artificially pegged at a level even lower than that of other administered prices. Between 1970-71 and 1986-87 the price of coal increased seven times while that of drugs increased only by two times. The increase in prices of drugs has been far below that of 'all commodities' or even 'all India consumer prices'. The earsthwhile Tariff Commission and other official bodies have confirmed from time to time that the drug prices in India have always been among the lowest in the world.

Rigid control on prices, profitability and the product-mix of drug enterprises with a view to make available to the people the essential drugs at reasonable prices, had a crippling impact on drugs and pharmaceutical industry in the wake of unabating cost escalation of all input items, including raw materials and personnel costs, repairs and maintenance, operating supplies, depreciation, electricity, water charges and furnace oil. This makes not only general investors shy away from this industry, but even banks and other financial institutions place drug enterprises at a low rating for financing their short-term and long-term capital requirements.

Preventing profiteering in an industry which is concerned with the production of a most important basic need of the people, viz, drugs, is unobjectionable, but simultaneously the price of such essential commodities required on a large scale should be remunerative enough, so that consumer protection is ensured all round in terms of availability, quality and price. Though the objective of keeping drug prices generally down has been met that of making abundant quantity of quality drugs available to the masses in the interiors could never be fully satisfied despite a rigid price control on 70 to 85 per cent of marketed drugs. Cost escalations without corresponding and timely price adjustments had sharply eroded the industry's earnings well below those prescribed by the government (8 to 13 per cent on turnover) and drove many companies to diversify into non-pharma activities. In the process, several critical drugs needed by the common man, especially in the context of prevalent disease conditions in the country could not be indigenously produced in sufficient quantities, leading to large-scale imports. Another outcome of low profitability had been a neglect of basic research in this research intensive industry. The R&D expenditure in the industry also tended to stagnate at around 2.3 per cent of sales and a major portion of it concentrated on formulations and simple process technologies rather than on technology derived from basic research (Ansari, 1989).

Conflict in Objectives

Reconciliation of diverse interests of making abundant quantity of essential drugs available to consumers at low prices and providing impetus to the drug industry to grow at a reasonable rate through profitability sufficient to finance replacement, expansion and research makes the price control, particularly in this industry due to its peculiarities, very complex. To the consumers themselves though the apparent major concern seems to be the low prices, there are several others which the drug policy has to meet successfully, such as :

(i) assurance of quality drugs

(ii) assured availability of those drugs which are not required frequently,

(iii) access to latest drugs with proven efficiencies, and

(iv) safety from hazardous and spurious drugs.

In the case of drugs and pharmaceuticals, quality is of paramount importance as the health and well-being are intimately involved in the use of pharmaceutical products. In addition to other consumer interests and those of the producers and the industry in general, this particular aspect cannot be ignored while evolving any price policy for drugs and pharmaceuticals.

Drug prices have been controlled in India since 1962. These were revised during 1970, 1979 and again in 1987, the last of which is presently under review. The determination of prices for drugs and formulations had always been very difficult due to a very large number of drugs and formulations and an equally large number of producers. In India there are over 350 bulk drugs available for around 30,000 single or multiple drug formulations in various dosages, forms, packs and brand names (CEW, 1989). This makes price fixation of pharmaceutical products much more complex than in the case of homogeneous industries like fertilizers, paper, cement, sugar, etc. In pharmaceutical industry, each bulk drug is a separate production activity in terms of technology, material requirement, market etc. As a result, organisation like the BICP has to treat each of these 350 and odd bulk drugs individu-

ally for purposes of price fixation. The enormous task involved in determining costs and prices for such a large number of bulk drugs and formulations coupled with non-cooperation of efficient producers generally results in undue delay in fixation of drug prices - a delay which is detrimental to the long run interest of consumers, producers and the development of domestic capabilities.

The determination of a price policy for bulk drugs and formulations has also to take care of the fact that this industry is not capital intensive when compared with fertilisers, petrochemicals, synthetic fibres, etc. As a result not only the barriers against entry are low but the exit of firms from the industry is also easier. Moreover, the bulk drug industry is very much raw material intensive. The share of raw material and utility cost in the retail prices is as high as 85 per cent in certain cases. In a situation of escalating raw material cost any delay in price revision, which is a frequent phenomenon, erodes profitability and therefore the expansion and sustenance of the drug producing enterprises, which leads to shortages of essential and life saving drugs. In the case of formulations this phenomenon generally results in proliferation of sub-standard drugs. Moreover, attempts to keep the prices of basic and essential drugs low encourage their import by shifting domestic production to formulations which enjoy higher margins and to other less essential drugs and formulations which are outside the price control.

The very process of collecting cost details and making in-depth cost studies is both complicated and time consuming. In a typical important drug the number of producers could be more than half a dozen. For fixing the fair price for each drug the price determining organisation has to obtain data from all organisations regarding each of their drug production. After obtaining the data, it has to verify this data, especially that relating to the cost and prices, by making on the spot studies and detailed discussions. Under these conditions, the delay caused even by one participant firm in supplying data delays the entire process of price determination. In addition, there are examples of deliberate attempts to supply data of only high cost producers to the BICP. Further time is, therefore, taken to persuade the lower cost producers to supply data to ensure that the consumers get the full benefit of low cost production. Government's decision making process takes its own time. No wonder, the Government could not fix even by 1987 (i.e. when new DPCO 1987 was announced) the fair prices of all the 347 drugs and their 4000 or so formulations where prices were to be fixed under DPCO 1979. These developments restricted the growth of domestic bulk drugs and essential formulations capabilities and the consumer welfare.

Fixing the price of 347 bulk drugs involves 10000 to 20000 imported or indigenously produced materials or product prices outside the price control regime. Each producer uses these materials in different combinations. All this not only makes price determination of bulk drugs very complex but also calls for frequent revision in prices to keep them in line with continuously rising input costs.

The price determination of formulations is even more complex. In addition to the above problems, the mere existence of around 4000 major formulations and if 15000 different dosages and packs etc. are considered, adds difficulties to their price fixation, particularly because there is an unavoidable trade off between the prices and the availability of quality drugs in adequate quantities. It is in this light the drug price policy, that price revisions and ensuing problems and the solutions regarding the fixation of drug prices need to be examined.

Pricing since the Sixties

It is only after 1962 that a kind of price freeze was exercised till 1966 when the Drugs (Control and Prices) Order was issued for the first time, requiring prior price approval. Tariff Commission studied the cost structure of eighteen essential drugs and sixty-nine formulations which formed the basis for the Drugs (Price Control) Order 1970. The entire question of costing for drugs was also studied by the Wanchoo Committee in 1972. Immediately thereafter, the study of cost and price structure of twenty-five bulk drugs and formulations not covered by the Tariff Commission was entrusted to the Bureau of Industrial Costs and Prices. The procedure adopted by the Tariff Commission, the Wanchoo Committee and the BICP followed the approach that price should equal the estimated cost of production plus a gross margin aimed at encouraging bulk drugs production than formulations only (Committee on Public Undertakings, 1976).

DPCO 1970

Drugs (Price Control) Order 1970 provided for a separate pricing formula for bulk drugs and formulations. Prices of bulk drugs were based on 15 per cent pre-tax profit on capital employed over and above the total cost. Formulations were categorised into essential and non-essential. Prices of existing drugs and essential formulations were based on 75 per cent mark up on manufacturing cost and a higher mark up of 100 per cent for a period of three years in respect of new products evolved as a result of special product development work and 150 per cent mark up for a period up to five years for new drugs produced out of original research and containing new therapeutical ingre-

dients. Non-essential formulations also enjoyed 150 per cent mark up on the manufacturing cost. Office and administrative overheads and selling and distribution overheads were expected to be covered out of the mark up.

An improvement over the above pricing scheme was introduced by the Hathi Committee (1975) through the concept of 'leader prices' which required that the profit margins and mark ups should be related to the cost of production of relatively efficient enterprise controlling bulk of the market. This arrangement took care of considerations of efficiency and was considered to be an administratively simpler substitute (though not a perfect substitute) for a detailed cost examination. Period between DPCO 1970 and DPCO 1979 witnessed a three fold increase in production of bulk drugs and formulations which had increased to Rs.1150 crores and Rs.226 crores, respectively in 1979-80 though the profit before tax to sales declined.

DPCO 1979

Most of the Hathi Committee recommendations were incorporated in the Drugs (Price Control) Order 1979 which provided for pricing based on a post-tax return of 14 per cent on net worth of bulk drugs used in the manufacture of categories I and II formulations and 12 perc ent on net worth of other bulk drugs falling in category III. However, with the object of promoting indigenous research it was provided that new drugs developed through such research would be exempt from price control for a period of five years after their introduction.

Formulations were divided in four categories under DPCO 1979. Essential formulations of mass consumption were covered under categories I and II for which mark ups of 40 per cent and 55 per cent respectively were allowed. In the case of category III formulations a mark up of 100 per cent on manufacturing cost was allowed; there was free mark up for category IV formulations.

The 'Leader Prices' for formulations in categories I, II and III which were based on production cost of efficient manufacturer including those in the small scale industry, served as ceiling prices. The small scale manufacturers who had a turnover of Rs.50 lakh or less per annum were kept outside the price control. The DPCO 1979 also prescribed an overall ceiling on pre-tax return on the sales turnover of formulations ranging from 8 per cent to 13 per cent.

With a view to maintaining low prices for formulations falling in categories I & II, it was notified that their prices should equal the specified mark up or the prices adopted by the efficient manufacturer (Price leader) whichever was less. The DPCO 1979 also provided that in case the price charged by manufacturers exceeded the predetermined prices or they made higher profits on the controlled drugs and formulations, than the prescribed pre-tax return on sales turnover, the Government was empowered to make recoveries of such extra collections into the 'Drug Price Equalisation Account' (DPEA) (Drug & Pharmaceuticals, 1988).

Low Profits and Slow Growth

The post DPCO 1979 era, i.e. the period of the eighties before DPCO 1987 became operative, was a period of all round difficulties for the drugs and formulations industry due to stricter price and production controls and inordinate delays in price revisions leaving input cost hikes uncompensated the rate of growth in the number of pharmaceutical units declined and the prices of shares of drug companies remained relatively low, despite tremendous boom in share market. The Government could not fix even by 1987 the fair prices of all the 347 drugs and their more than 4000 formulations for which prices were to be fixed under the DPCO 1979.

The gradual erosion of profitability in the bulk drug production led to relative stagnation in the growth of pharmaceutical industry. While during the sixties and the seventies the investment in the pharmaceutical industry had increased at the rate of 23 per cent after the DPCO 1979 it had come down to half of that till 1987. The drug production fell short of plan targets and cost increases outpaced price increases, particularly for sera and vaccines e.g., Anti Snake Venom Serum, Anti Tetanus Serum, etc. This led to the shortages of these essential drugs which were felt more acutely in the rural areas.

The pricing regime under the DPCO 1979 led to two more problems. It encouraged imports rather than domestic production as there could be no price control on the imported bulk drugs. Hence indigenous capacity creation suffered a set back. Secondly, the lower mark-up for essential drugs and higher mark up for less essential formulations and a complete pricing freedom as regards least essential formulations induced even the reputed pharmaceutical firms to divert their resources to products which were not price controlled. A misallocation of scarce managerial, technological and capital resources, away from essential drugs to non-essential formulations took place due to the pricing policy. The explosion in the production of cough-mixtures, balms, vitamins combinations, expectorants, etc. are natural outcome of this policy.

The pricing regime also encouraged the proliferation of unnecessary combinations of drugs as that helps the companies to circumvent rigid price controls. In addition, the exemption of small firms producing annually less than Rs.50 lakh worth of drugs and formulations from price control encouraged the setting of up captive small firms, a trend detrimental to the growth of an internationally competitive pharmaceutical industry. The provision that the producers had to submit cost details and the prices of even those drugs and formulations which were not subject to price control virtually meant 100 per cent control on drugs and pharmaceutical industry.

Drug Policy 1986 and Drug Price Control Order 1987

The hardships created by DPCO 1979 in the form of unremunerative prices and reduced profitability resulting in shortages of essential drugs due to slow growth of investment and the flight of existing resources from essential to non-essential drugs and formulations obligating heavier imports to meet the basic health care requirements led to a review of the drug policy. In pursuance of the new measures announced by the Government in December 1986 for rationalisation, quality control and growth of the drugs and pharmaceutical industry, a committee was constituted in January, 1987. The following overall objectives were set forth with regard to the pricing of drugs and formulations :

(i) Making the price control system less cumbersome but more effective by reducing the span of control.

(ii) Stimulating production of drugs and pharmaceuticals which are essential to the needs of large majority of the people of the country.

(iii) Ensuring reasonable return to producers of essential drugs while at the same time restricting undue increases in their prices

(iv) Ensuring adequate availability at reasonable prices of essential drugs to all sections of the community, especially weaker ones even in remote areas.

As a result of the Committee's through study of cost pattern, the demand and supply situation, the health care needs for various drugs and formulations, profitability of the industry and the need for fresh investment for its growth and after careful consideration of the views and suggestions of various interests in the drug industry, the new Drug Price Control Order 1987 (DPCO 1987) was announced on 26th August, 1987.

Under the DPCO 1987 prices of 161 bulk drugs were controlled. Formulation prices are controlled in two separate categories. The first category of formulations is based on the drugs used in the National Health Programmes[1], and the drugs included in category II are essential drugs as recommended by the Committee. In view of the inherent complexities and difficulties involved in fixation of drug prices and their proper administration it was decided to be selective in exercising price control as excessive control on large number of drugs could not only be ineffective but also led to shortages, higher imports and larger proliferation of sub-standard drugs. With a view to exercise a balance between administrative control and the skilful use of market forces, the Committee decided to keep the list manageable and implementable and adopted the following criteria of excluding drugs from the category II list :

(i) Exclude those drugs which are not produced in India, provided their present or prospective consumption is not significant.

(ii) Exclude drugs with the turnover of less than Rs.50 lakh.

(iii) Exclude all new drugs for which the process of manufacture were developed indigenously from the price control list for at least the first five years.

iv) Exclude those life-saving drugs and pharmaceutical products whose availability is far more important than the price i.e. the drugs which are required infrequently by the consumers but their non-availability is fatal as in case of sera and vaccines.

(v) Exclude those pharmaceutical products where the domestic production structure makes over charging by the producers impossible.

Under DPCO 1987 for all the bulk drugs falling under the controlled categories I and II, the manufacturers are given the following three options :

(i) 14 per cent post-tax return on net worth; OR

(ii) 22 per cent return on capital employed; OR

(iii) Long-term marginal cost with 12 per cent internal rate of return in the case of new plants.

In addition to the fixation of overall profit ceiling of individual manufacturers of drugs and formulations the price ceiling for drugs in categories I and II and imported formulations is as follows :

1. Scheme under National Health Programme include the following :
   (i) National Tuberculosis Eradication Programme,
   (ii) National Leprosy Eradication Programme,
   (iii) National Trachoma Eradication Programme and National Programme for control of Blindness,
   (iv) Programme on prevention of Dehydration under ORT,
   (v) National Malaria Eradication Programme and
   (vi) National Filaria Eradication Programme.

The maximum retail price of domestically produced items excluding excise duty would not exceed the ex-factory cost by more than 75 per cent in the case of category I formulations and by 100 per cent in the case of category II formulations i.e. Maximum Allowable post Manufacturing Expenses (MAPE) is 75 per cent and 100 per cent respectively for category I and category II formulations. In the case of imported formulations, selling and distribution expenses, including interest and importers profit is not to exceed 50 percent of landed cost.

Thus the retails price of formulations is to be calculated as per the following formula :

Retail Price = (Material Cost + Conversion Cost + Packing Material Cost + Packing charges) X (1+Maximum Allowable post Manufacturing Expenses in Percentage) + Excise Duty.

The overall operation of price control and the control on product-mix is expected to operate in such a way that the ceiling on pre-tax return on the sales turnover of formulations is maintained within the range of 8 percent to 13 per cent for different categories of manufacturers though the average return even after DPCO 1987 is around 4 per cent.

DPCO 1987 heralded an era of pragmatic liberalisation as the number of drugs under price control were brought down from 347 under DPCO 1979 to 161 which were further reduced to 124 by the end of 1989. It encouraged production, marginally improved profitability and enabled the industry to emerge as a net earner of foreign exchange, though there was an increase in prices, primarily due to delayed cost revisions resulting in accumulation of permissible cost escalations and a review of conversion cost and other cost norms after a gap of fifteen years since 1974. Production of six major drugs went up by 51.3 per cent during 1987-88. The index of industrial production of 13 drugs provided by the Central Statistical Organisation showed an increase of 53.3 per cent during the same period. However the higher price paid by the consumers under DPCO 1987 benefits the retailers most, followed by the Government and the wholesalers. The manufacturers, for whose encouragement and cost compensation the price increases are basically intended, benefit the last and the least (Ansari, 1989).

Licensing and pricing policies alone are not sufficient for simultaneous fulfilment of short-term and long-term interests of the poor masses and the industry. They need to be complemented by appropriate fiscal policy measures designed to progressively reduce imports to the minimum possible levels. It is also to be ensured that the cumulative incidence of duty on bulk drugs is higher than that on the inputs and drug intermediates so as to encourage cost efficient indigenous production of bulk drugs and of high quality formulations.

Recommendations for Effective Implementation of Drug Price Control :

(i) A price escalation formula should simultaneously be prepared whenever a fair price is recommended for the controlled drugs.

(ii) Price escalation formula should be implemented by a Price Revision Committee, by whatever name called, chaired by Secretary, Department of Chemicals and Petrochemicals. Drugs Commissioner, Director General of Technical Development (DGTD), the BICP, the industry and bulk consumers should be represented on the Committee.

(iii) Price increase of less than 10 per cent in a year can be approved by the Price Revision Committee and can be announced promptly after careful study of cost escalation.

(iv) In case the cost escalation in a year is more than 10 per cent the Price Revision Committee should send its detailed proposals with cost calculation to the Ministry for review and final action.

(v) After promulgation of Drug Price Control Order the prices of drugs and formulations should be fixed and announced in the shortest possible time. For this purpose BICP should set up a Task Force with experts from various agencies e.g. IDPL, HAL etc.

vi) Pricing norms for conversion cost and packaging charges, process loss, etc. should be periodically reviewed and revised on regular basis.

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Computer Peripherals: Monitors & Key Boards

Directorate General of Technical Development

During recent years office automation has been undergoing massive changes and improvements across the world. India has also been witnessing major changes in this sector. In this report, the existing technology in the computer peripherals has been studied in terms of quality of design and manufacturing techniques vis-a-vis the present international scenario. Technology gaps have been identified so that the long term and short term technology goals for upgradation can be arrived at. This is the third in the series.

Excerpts from a recent Report by the DGTD.

MONITORS

Monitors are the display devices from which information is read. Due to increased use of office automation equipment and computers, demand for monitors/terminals is growing rapidly. Different applications which require monitors are :

- PCs/Office automation
- Terminals to Mini/Mainframe computers
- Printing and Publishing
- CAD/CAM
- Process Control
- Point of sale
- Laptops
- Image processing and medical diagnosis

Current Technologies

There are four different technologies in vogue internationally. They are :

CRT : It is the oldest and most commonly used display technology. The CRT displays produce an image by directing an electron beam on a phosphorescent coating on the glass face of the tube. When struck by electron beam the phosphor glows producing the light that reaches our eyes. When the electron beam stops hitting the phosphor the light quickly fades. Different phosphor compositions control how long the glow lasts, their persistence and in colour CRT what colours are produced.

Most video monitor CRTs use electromagnetic focussing and deflection coils, the windings of which are referred to as yoke. Turning the electron beam on and off via the control grid produces a glowing pattern on the tubes face. The displays can be monochrome or colour. For monochrome displays the phosphor can be any colour - White, Green, Amber, etc. But only one colour can be obtained. Full colour displays add complexity to the basic

CRT design. A typical colour CRT has three guns, one each for red, green and blue; a tube face covered with many tiny triads of red, green and blue phosphors and a shadow mask. The shadow mask is made of metal and has tiny holes in it that must be precisely aligned with the phospor triad to prevent the beam from striking and illuminating other phospor triads.

A major technological advance has been the introduction of multifrequency scanning capability. The flexible scanning approach allows the monitor to be adapted to different graphic display standards. Basically as the scanning frequency increases the image quality also improves.

LCD : This technology offers many advantages like :

- Flat screen/no distortion
- Small size
- Low power consumption
- Good resolution (640 x 480)

Colour LCD are currently available in relatively small sizes (4" diagonal with 480x220 resolution) and are used in portable TV receivers. Larger colour LCDs are still under development.

When voltage is applied crystal molecules untwist changing the polarization of the incident light. When the light is able to pass through the crystals, it strikes the back polariser and is absorbed; thus the addressed pixel looks dark compared to the rest of the panel. Unfortunately, incident light scattered in the panel layers and reflected back through them diminishes contrast. These problems of low contrast and poor readability have been eliminated by using a rear lighting or back lit approach. The back lit LCD displays consume a lot more power. A new development is the active-matrix or Thin film transistor (TFT) LCD. Rather than using standard multiplexing techniques (e.g., time sharing of pixel electronic drivers) to address the matrix of crystals, the active matrix LCD includes a thin film transistor fabricated along with each pixel. These transistors act as switches to turn on individual pixels. The TFT method eliminates the time dependency associated with multiplexing (diminishing contrast as more lines are displayed) and allows direct address of each pixel. Colour is added by using organic filters and backlighting.

Small LCDs are extensively utilised for calculators, watches, automobiles and measuring instruments. Larger colour LCDs are under development. These large LCDs could be used for personal computers and word processors. LCD are also beginning to be used in automobiles and traffic signals. The Japanese produced some 2 million active matrix LCD pocket 3 $^1/_2$" TVs last year.

Gas Plasma Displays operate by exciting a gas, usually neon or argon-neon mixture, through the application of voltage. There are two types of displays AC and DC. In both cases a matrix of electrodes, separated by the gas allows a certain point or pixel to be addressed. There are still a number of problems faced by gas plasma displays and a great deal of effort will be expended before large full colour gas plasma panels are ready for mass marketing.

Electro Luminiscent Displays operate on the principle of electro luminiscent phospor emitting light in the presence of an alternating electric field. EL displays are becoming increasingly popular in military and industrial applications requiring portability and reliability in hostile environments. Their truly solid state construction makes them rugged. A typical EL display consists of a thin film of EL material (phospor) sandwitched between thin films of insulating dielectric material. The front material is transparent while the rear material is reflective. The Zinc Sulphide with manganese phospor emits a bright yellow light when subjected to approximately 200 V AC. The voltage is applied via a grid of electrodes, each pixel of which can be individually switched on . Other phospors can be used for different colours.

EL displays range in size from 2 by 2 inches to 12 by 14 inches with resolution ranging from 320 x128 to 640 x 480. EL displays offer better contrast, broader viewing angles than gas plasma and LCD displays. They are also much more reliable. Manufacturers claim an average MTBF of 40,000 hrs. as compared to 10,000 for typical CRTs. Cost and colour problems have restricted the usage of EL.

Application Areas

Displays other than CRTs are called falt displays. Each display device has, unique features that determine its application as shown in table 1.

Table 1 : Main Applications of Flat Display Devices

Technology Type	Feature	Main Application
LED	High brightness & low cost	Lamps and outdoor display services
LCD(D)	Low power consumption & low voltage drive.	Calculators, watches, measuring instruments, office automation equipment
LCD(A)	Full colour and fine grey scale display	Colour TVs and video projectors.
PDP	High definition and high speed response.	Office and factory automation equipment
EL	High definition and high speed response	Office and factory automation equipment

D - Duty drive
A - Active drive

International Scenario

CRTs have the highest level of development among all display devices. However, larger screens and higher resolutions are being demanded of CRTs to accommodate the high definition image displays of EDTV and HDTV, and improved performance of personal computers and workstations. With technical enhancements and better cost performance, CRTs will be around for a very long time.

- For large screen applications, however, CRT weight and volume are still hurdles that need to be resolved. Research now is being conducted on high strength glass, the application of CAE to design and manufacturing process and wide angle deflection by very large CRTs. Under current conditions, it is believed that CRT screen cannot exceed 50 inches.
- In terms of higher resolution, research and development is focussing on fluorescent materials to prevent any decrease in brightness, large caliber electron guns, astigmatism correction and fine pitched shadow-masks. Picture image quality also is being improved through various methods including digital signal processing for sequential scanning and Y/C separation.
- Attempts are being made to reduce the curvature of the tube to make it as flat as possible.
- A significant development in technology of monitors is the ability to vary the video input frequency. This is referred to a multisync or multiscan capability. The monitor can synchronise on any horizontal and vertical frequency upto the maximum supported by the monitors. Multisync capability adds significantly to a monitor cost but has significant advantages. When used in conjunction with a graphics board that supports multiple graphic resolutions, it enables support of a wide variety of application software with a single display system. Currently multisync monitors are becoming very popular world over mainly on account of the number of graphic standards used by different software packages. However, if a standard is established or the monitor is used for dedicated applications monosync monitors are preferable on account of their lower cost.
- LCDs : Rapid progress is being made in the development of LCDs both in terms of size and colour. As a result, emphasis in the application of LCD is being switched from calculator to watches to personal word processors, laptop personal computers, fascimiles and colour LCD TV receivers in Japan. Sales of word processors with large size LCD panels continue to be brisk. Various trends in LCD applications are shown in table 2.

Table 2 : Trends in LCD Applications

Year	Duty LCD	Active LCD
1972	Calculator	-
1974	Watches	-
1979	Electric transistors and LCD games	-
1982	Measuring instruments	-
1984	Word processors and personal computers	-
1987	Overhead projectors	Pocket TV
1988	Notebook word processors	Video monitors 14inch color TVs (Prototype)
1989	Laptop computers	Video projectors VCR combining LCD in one unit seat installed TVs.

- LCD makers in Japan are making energetic efforts to develop strong dielectric LCD which feature a good response time, memory function, and do not suffer from a change in contrast according to viewing angle. LCD panels are being developed in the form of active matrix and simple matrix LCD. 9" and 11" active matrix LCD displays should be available in a few years. LCDs are becoming popular as laptops are gaining acceptance.
- *PDP* are also finding their ways into a variety of application areas. The market of plasma displays in Japan is estimated to be around 20 billion Yen in 1989 and is expected to grow further this year. As it is easy to construct a large screen with PDP, than with other flat display devices, they are being used in bank terminals and indoor/outdoor information displays. PDP are also now used in office automation equipment due to simplification of structure, lowering of the drive voltage and reduction of power consumption leading to cost reduction. Efforts are also being made to further simplify the drive circuits through integration, and to develop a multicolour display function.
- Currently research is being conducted on discharge and cell structures for development of full colour and high grey scale PDP's using memory functions.
- *EL* displays feature self light emitting capacity similar to PDPs and offer potential for fine image display, so they are being used in personal computers, office automation equipment and measuring instruments. Application areas of EL displays are also expanding.
- To meet demand for colour display and high resolu-

tion display, various EL materials are currently being studied. The current focus of research is on lowering of the drive voltage, improvements in film deposition technology, dielectric materials, and organic EL materials.

Current Economies in Global Markets

In 1986, Japan produced 4890.00 million dollars worth of display devices. The value of display devices by year 1988 was 5815.00 million dollars (an increase of 19%). The sales turnover of different terminals manufactured in US are shown in table 3. Following observations could be made :

- Colour monitors sales growth rate has increased from 26% to 30% by year 1988 whereas, growth rate of monochrome monitors has decreased from 8% to 7% by year 1988 which means that in years to come, more colour monitors would be used than monochrome monitors in US market.
- Sales growth rate of remote job entry terminals has remained constant at 7%.
- All other type of terminals like CRT terminals, data terminals, graphic terminals, ASCII terminals have experienced 1% decline in sales growth rate from the previous year growth rate.

Table 3 : Sales Turnover of Different Terminals in US.

(US $ Millions)

Type	1986	1987	1988
CRT Terminals	3919	4387 (12%)	4872 (11%)
ASC II Terminals	2583	2815 (9%)	3040 (8%)
GRAPHIC Terminals	1336	1572 (18%)	1832 (17%)
COLOUR	480	650 (26%)	845 (30%)
MONOCHROME	856	922 (8%)	987 (7%)
REMOTE batch job terminals	890	948 (7%)	1014 (7%)
DATA terminals	4809	5335 (11%)	5880 (105)

Source : Electronic International Jan.1989.

The Future

The future market for display devices is expected to grow based on a number of technological developments. The market for flat displays will grow at a rapid rate and sales will match that of CRT by the late 1990s, thus significantly expanding the entire market for electronic display devices. In particular, the market for LCDs will experience impressive growth, and range of LCD application will expand considerably. CRT displays will continue to be popular for most of the applications like PCs/Office automation, terminals, CAD/CAM, DTP, Image processing etc. LCD and gas plasma growth will come mainly on account of portables/laptops.

Indian Scenario

According to the 8th plan projections (1990-95), there would be a requirement of 24 super computers, 750 mainframes, 9300 minicomputers and 1 million microcomputers. Based on these projections the estimated requirement of CRT monitors would be about 11,16,850 numbers. A major portion of this demand is going to be for 14" monochrome monitors. For graphic applications like CAD/CAM, the trend that is observed in market is while demand for 14" colour monitor at 800x600 resolution is strong, demand for 16" and 19" monitors at 1280x1024 resolution is also increasing.

Major Players in the Indian Market

Some of the major players in the Indian Monitor Market and their production figures for year 1988 and estimates for 1989 are shown in table 4.

Table 4 : Major Players in the Indian Monitor Market

Company	1988 (in numbers)	1989 (in numbers)
1. ESSEN	2500	5000
2. INDCHEM	4000	1000
3. SUJATA	N/A	1000
4. O/E/N	500	1000
5. NITUL DATA	3000	4000
6. 21ST CENTURY	1500	3000
7. WIPRO	6000	6000
8. DIGICON	3000	N/A
9. GEBBS DATA	3000	8000
10. NETRON	2500	3000
11. HCL	5000	18000
12. Tirupathi Video	3000	5000
13. Godrej & Boyce	200	500
14. Bhonika Drum	2000	4000
15. Electronic weighing & Level Controls Pvt. Ltd.	1000	2000
16. TVSE	1000	3000
17. VXL	-	10000
18. Small Scale Units	15000	12000
	53200	114500

Potential Application Areas

Based on a cross sectional study conducted among monitor manufacturers, the potential application areas for monitors would be in the following order :

1. PCs/Office automation
2. Terminals to Minis/Mainframes
3. DTP & Printing
4. CAD/CAM
5. Process Control Applications
   Demand for point of sale and laptop application has not picked up yet.

Technology Absorption / Gaps

The major components used in the manufacture of monitors are :

- ❑ Tubes
- ❑ Casings
- ❑ Yokes
- ❑ EHT Transformer

Technology absorption/gaps for monitors are :

I. *Tube* - No tubes for monitors are manufactured in the country currently, though TVS Electronics Plan to start buying tubes locally for their 14" monochrome monitors.

2. *Casing* - Some companies own mould for 12"/14" monitors , but mostly the plastics are imported as volumes are still low. While metal boxes can be made, acceptance by users is a problem.

3. *Yoke* - Yoke is a major deflection component in CRT. Indian manufacturers are making Yokes for their 12" offerings. Yokes for 14", 16" and 19" are being imported.

4. *EHT/LOT* - While indigenous content is fairly high for 12", 14" CGA monitors, it is very low for 14"EGA/14"VGA/ 16"/19" monitors. Volumes are still very low.

5. *Video Electronics* - While indigenous content is fairly high for 12" and 14" CGA/HGA monitors, it is very low for 14"EGA/14"VGA 16"/19" monitors. Volumes are still very low. Component availability from local manufacturers is poor.

Cost Structure

The BOM for a typical 14" flat screen softwhite mono monitor is as follows :

Components, PCB, Power Supply, etc.	Rs. 800/-
Final assembly incl. 14" tube (imported) + cabinet +packaging material	Rs.1,400/-
Total	Rs.2,200/-

The imported cost is only Rs.625.- i.e. 28% of total cost of the monitor.

Exports of Monitors / Terminals

- ❑ Countries to which monitors/terminals are exported are :
  1. Nepal
  2. USSR
  3. Bangladesh
  4. Western Europe
- ❑ Products exported are 12", 14" EGA/VGA colour monitors, 12", 14" monochrome monitors, and bilingual terminals.
- ❑ Some of the companies involved in exports of monitors/terminals are :
  1. Applied Electromagnetic
  2. S.S. Computer Galaxy
  3. Nitul Data Systems
  4. Computer Aided Learning Systems
- ❑ Percentage of exports to turnover of different monitor manufacturers vary anywhere from 5% to 40%.

About 12,000 monitors were exported in 1989-90.

Trends in India

Trends that can be sensed from the changing requirement in market place are :

- ❑ A major portion of the demand is for 14" monochrome monitors though the need for colour and graphic capabilities is slowly increasing.
- ❑ The need to run different software at different resolutions all the way from CGA/EGA to 1024x768 VGA has forced vendors of PC based CAD/CAM systems to use multisync monitors. However, as VGA is becoming a standard to which most software will confirm, a monosync VGA monitor - both monochrome as well as colour - is likely to become the standard at the lower end.

- Workstation applications still use monosync monitors because they are mostly used with dedicated graphics hardware.
- Dot pitch is the distance in mm between the phosphor triads. It determines the resolution of the monitor. For VGA resolution dot pitch of 0.31 mm is the standard.

Monitor Specifications

The specifications which differentiate the monitors are resolution, scanning frequency and number of displayable colours. The driving force behind these specifications is the changing adaptor standards. Tables 5 & 6 highlight the different specifications and applications as a function of different adaptor standards.

Table 5 : Monitor Specifications for Different Graphic Standards

Adaptor	Resolution	Frequency			No.of Colours
		HF KHZ	VF MZ	BW MHZ	
CGA	320x200 640x200	15.8	60	14.3	Mono/4
EGA	640x200	21.9	60	16.3	16
VGA	640x480	31.5	60	25.2	16
EVGA	800x600	35.0	56	30.0	16
EVGA	1024x768	48.5	60	65.0	16/256

Table 6 : Application Matrix for Different Monitors

Graphic standard	Resolution	TTL	Analog
CGA	640x200	Data processing office automation	-
EGA	640x350	Business graphics Low end CAD	-
VGA	640x480	-	Business graphics DTP CAD
	800x600 1024x768	-	CAD Workstation Image processing Medical imaging etc.

Suggestions

Suggestion 1 : Attempt centralised indigenisation. This can be achieved by centralised technology purchase by Govt. and setting up of technology cell for vendor identification and indigenisation. This will ensure standardisation as only a few models can be identified/selected and licensed to many manufacturers e.g. : we can standardise on :

(i) 14" mono chrome CGA

(ii) 14" monochrome VGA (Monosync)

(iii) 14" colour VGA (Monosync) indigenisation should be actively pursued only when demand levels reach a threshold level.

Suggestion 2 : Colour tube (14") manufacture to be encouraged. It is estimated that approximately 25% of the micro-computers go with colour monitors. This ratio is expected to change in favour of colour monitors in the coming year. It can be estimated that approximately 60% of the PCs would go with colour monitors by the end of Eighth Five Year Plan. This is mainly due to the high growth rate anticipated in the CAD/CAE and workstation segments. Colour monitors are currently imported as there are no manufacturers in the country. Latest trend is towards VGA and higher resolutions with dot pitch size of 0.31 or less. There is tremendous scope for the manufacture of tubes in the country and this should be encouraged. Multisync technology should be standardised.

Suggestion 3 : Collaboration for the manufacture of 16/19" monitors

- High potential area due to the high growth in workstation segment.
  - — Users require high resolution
  - — Larger display area (Windows)
- Falling prices and availability of powerful graphics cards will expand this segment.
- High technology
  - — 19", 1024 x 768 and above resolution, 64MHz bandwidth.

The high growth rate in the workstation market is expected to continue through the next five years. With the PC based CAD/CAE also showing same growth in volumes, 19" high resolution monitor requirement would increase substantially in the coming years. Almost all the workstation manufacturers offer 19" monitors along with their systems and this is met through imports. The graphic capabilities available to the user today is very high with adaptor cards with resolutions as high as 1280 x 1024 already in the market. Intelligent cards with built-in co-processor such as 8514A and Texas 34010 have been announced and the coming years would see lot more of manufacturers announcing compatible cards. Presently it is not possible to get these high resolutions on 14" monitors due to dot pitch size limitation.

Technology involved in the 19" high resolution market is very high and it will not be possible to develop them locally. They are downward compatible to other resolutions (mullisync), with bandwidth as high as 90MHz, and

capable of running in non-interlaced mode. Indian companies should be encouraged to sign up collaboration for the manufacture of these monitors - with minimum product specifications of 19" tube, capable of running atleast 1024 x 768 resolution in non-interfaced mode.

Suggestion 4 : Local manufacture of magnetic components to be encouraged. One of the main problems faced by the local monitor manufacturers is the availability of deflection components such as yoke, EHT, etc. This is true even in the case of monochrome monitors. Local manufacture of picture tubes should be complemented by availability of reliable magnetic components. Till such time local manufacture of magnetic components is stabilised, import of these should be allowed.

Suggestion 5 : Nodal agency for magnetic research. Design of magnetic components are the most critical and difficult part in the development of monitors. Picture quality and characteristics such as focus, linearity, alignment, etc., are directly dependent on the properties of the magnetic components. Lot of skill is to be developed in this area, especially in the case of colour monitors. A nodal agency should be established to carry out core research in this area and disseminate the technology to user industries.

Suggestion 6 : Test facilities are to be developed indigenously to test various picture tube characteristics such as dot pitch size. Also facilities should be built up for the evaluation of magnetic components.

Suggestion 7 : Indigenous vendors

- For making moulds, raw material for plastics
- For essential components

Major technological gaps exist in terms of mould making capabilities and quality of raw material (plastics) available in the country. Encouragement to this sector will help in reducing the outflow of foreign exchange as most of the mould making is currently done abroad. This will also help in easy indigenisation of plastic parts. Indigenous vendors are also needed for components like transistors, diodes, etc.

Suggestion 8 : Efforts should be made to modify the monitors produced locally so that they can be interfaced for process control applications. Though present volumes are not very high potential for process control applications is very large and users should be dissuaded from importing such monitors if they can be supplied locally.

Suggestion 9 :

- Approval from international bodies
- Availability of approved components
- Setting up of 100% EOU

The Government has already initiated steps to make available easy certification for UL, FCC, etc. The steps in this regard should be hastened in order to ensure that Indian products conform to international requirements. This would encourage Indian manufacturers to explore export markets actively. Presently, availability of components approved by various international bodies is difficult as facilities are not available for these approvals. Investments to make UL/CSA/FCC approved components and subassemblies available are recommended as this would enhance the export opportunities. Monitor is a highly labour intensive product. Foreign companies should be encouraged to set up 100% Export Oriented Units with 100% equity. This will make sound business sense in view of the low cost of labour in India.

Suggestion 10 : Monitor is a display device and the user spends considerable amount of his time in front of it. The strain that this puts on his eyes and the effect of RF emission on the user has to be studied and any new monitor before its release to the market should be evaluated and approved by an independent body.

KEY BOARDS

International Scenario

Key boards are the most popular input devices and an essential part of all computer systems. Keyboard manufacture by independent vendors as opposed to computer manufacturers is a phenomenon which is clearly perceptible world over. The relative shares of keyboard manufacturers and computer manufacturers is different in different parts of the world. At one end are countries like Japan and most European companies where keyboard manufacturers' presence is marginal while at the other end are countries like Taiwan where 100% keyboard manufacture is by independent vendors. US has a good mix of both. The major factors which lead to vendorisation are (i) Cost, (ii) Standardisation. Some of the major players in the US and their market shares are :

Keytronics	21%
Honeywell	12%
Alps	10%
NMB	7%
Fujitsu	5%
Make Switch	5%
Brother	3%
Others	37%

Key Switch Technologies

There are a number of technologies for the key switches, though only three of them are predominantly used - Mechanical, Capacitance and Membrane - in most mature markets. The parameters which can be used to evaluate/compare different technologies are :

1. Switch life
2. Cost of switch
3. Ease of design
4. Serviceability
5. Problem areas
6. Applicability in different environments

Different technologies for full travel switches are :

(1) *Mechanical :* Contact is made with the help of a spring. The spring could be of various types. Mechanical swithces are characterised by lower life (<25 million key-strokes) low cost and ease of design. The most common problem is the wear and tear of the contact point and serviceability is difficult.

(2) *Reed Relay :* The switch comprises two reeds in a magnetic field and change in the field intensity activates the switch. The major problem is in maintaining a uniform field. It has a low life and is also expensive. Design is also made tough on account of magnetic interference and hence is not much in usage.

(3) *Capacitance Switches :* The basic principle is that the proximity between two plates, one mounted on a moving plunger and the other on a PCB, is used to make the contact through principle of capacitance. It has a very high life (around 50-100 million keystrokes) and is only slightly more expensive than the mechanical key swithces. It is fairly easy to design using these switches and maintenance problems are minimal. The major problem is that PCB design is complex.

(4) *Membrane Switches :* Here the switch works on hard contact. There are two Milar sheets made of a special material on which there are switch deposits made of special conductive ink. The two sheets are separated by another membrane made of the same material with holes at the switch locations. The tension with which these membranes are held prevents contact under ordinary circumstances and ensures contact only when the key is depressed. These Milar sheets are also suitably processed to have the conductive ink in the form of a circuit thus replacing the need for a PCB. The cost of this type of keyboard is lower than the capacitive type and life is about 35 million keystrokes. The major problem is that in case of any defect in the membrane there is no question of repair. It has to be replaced. Maintainability of the keyboard is very good.

Indian Scenario

In India also, keyboard manufacture by independent vendors is very common though a large number continues to be imported. The major application can be categorised as follows :

1. PCs
2. Workstations
3. Terminals
4. Process control
5. N/C Machines
6. Laptops
7. Hand held terminals
8. Telex/Teleprinters

The keyboard used for these applications fall into two major categories :

1. Full travel type
2. Non-full travel type

Full travel types are used for applications1, 2, 3, 6, 7, and 8 while non-full travel type are used mainly for process control, N/C machines and other specialised applications.

PCs : Basically there are two types of keyboards from the point of view of applications - 84 keys and 101 keys. Both these could be made of mechanical or capacitive or membrane switch technology. In India mechanical switches are most common and account for almost 80% of the market. The major reason is that since the market is very price sensitive manufacturers are cutting corners wherever possible. The mechanical switches are becoming obsolete world over. Very few manufacturers have the technology to make capacitive or membrane type of keyboards.

Workstations : Keyboards for workstations are specialised products in themselves as they have lot more intelligence built into them. Keyboard for workstations like Silicon Graphics, SUN, etc are being made in India because the original manufacturer Keytronics are represented in India.

Terminals : Keyboards for terminals are fairly simple and are being made in India.

Laptops: Though basic technology remains the same the shape and size is different and since currently no Laptops

are manufactured in India, capability to produce Laptop keyboard has not been developed.

Hand Held Terminals : The usage of such terminals has not really caught on and hence there is no significant felt need for such keyboards. However as in the case of other special keyboards the kits can be imported and assembled if necessary.

Process Control and NC Machines : The keyboards used in such applications are usually non-full travel type and currently nobody is making such keyboards indigenously.

Keyboards used for process control applications are usually ruggedised. These types of keyboards usually have about 135 keys, comprising of alphanumeric, special code and graphic keys. Ruggedised keyboards are completely sealed so that liquids cannot seep into mechanics of the keyboard and disrupt its operations.

Telex/Teleprinter : Keyboards for telex/teleprinter applications are similar to the PC keyboard in their layout and design in principle. However, since the function is a specialised one, the PCB is accordingly different. Another major difference is that usually these keyboards are integral to the main systems and there is no need for a cable used in the normal PC keyboards.

Demand Situation

According to 8th plan projections (1990-95) there would be a requirement of 24 super computers, 750 mainframes, 9300 mini computers and 1 million micro computers. Based on this, the estimated requirement of keyboards for 8th plan period would be around 11,86,500 numbers.

Exports :

Countries to which keyboards are exported are :

- WESTERN EUROPE
- USSR
- USA
- AUSTRALIA
- EUROPE

Percentage of exports of Keyboards varyies anywhere between 2% and 50%.

Technology Absorption

Major components of keyboard are :

1. Keytops
2. Keyswitches
3. Switch Plate
4. PCB
5. Box
6. Cable

Key Tops : These are available locally for non-sculpted type of keyboards but continue to be imported for sculpted keyboards.

Keyswitches : These are also imported as good quality switches are not available locally.

Switch Plate : While it is fairly simple to make switch plate for mechanical switches where the tolerances are high there is only one manufacturer with capability to make plates for capacitive switches.

Box : Mould for making the box are available locally.

Cable : It has to be imported as the capability to manufacture the cable with desired properties does not exist. Major technological gaps exist in terms of mould making capabilities, quality of raw material (ind. plastics) and good recognised testing facilities for tests such as Electro Magnetic Interference (EMI), Electro Static Interference (ESI), Switch life test, colour test, etc.

Suggestions

Suggestion 1 : Standardisation of keyswitch technology :

1. There is currently no standardisation in terms of the mechanical properties of the keyswitches. Different brands of the keyswitches imported by different manufacturers have different dimensional specifications. As the keycap design and the mounting plate/ pcb design should meet these requirements, it may not be immediately possible for an existing manufacturer who has already invested in keycap and mechanical plate tooling to switch over to a new brand of keyswitch. Hence certain amount of standardisation would be required before manufacture of keyswitches is taken up.
2. Two factors (other than the electrical characteristics) decide the compatability of the keyswitch with an existing keyboard :

- Compatability of the keyswitch to keytop.
- Compatability of the keyswitch to mounting plate and pcb.

Suggestion 2 : Keyswitch manufacture to be encouraged :

1. Mechanical keyboards will continue to be in demand throughout the eighth five year plan.
2. Keyswitch constitutes 40% of the keyboard material cost.

Inspite of the new advances in the keyboard technology, mechanical keyswitches are here to stay for some more time. Keyswitch is the most critical component in the keyboard as the life of the keyboard is basically the life of the keyswitches used in them.

DOE estimates that the volumes of PCs during the Eighth Plan will cross a million mark. This essentially means that the volume of keyswitches required during this period will be substantial and this will justify the investment for the indigenisation of keyswitches.

Suggestion 3 : Membrane keyboard to be encouraged:

- ❑ Technology of the future
- ❑ Allows high indigenisation
- ❑ Membrane technology is getting popular in other applications as well.

The recent trend world over indicates a shift towards the membrane keyboards. Major manufacturers such as IBM, Fujitsu, etc. have shifted to membrane technology. The main advantage of membrane keyboard is its cost effectiveness. With the 84 key keyboard market fast shifting towards 101, the cost difference between a mechanical and membrane keyboard will be very less. Moreover on very large volumes membranes are expected to be 10 to 20% less expensive than mechanical key switches.

Latest developments elsewhere in the world have improved the life of membrane keyboards substantially and today membranes with life as high as 20 million operations are available. The other advantage in membrane keyboard is the ease of manufacturing as no soldering of keyswitches on the PCB is required.

Considering the wide range of applications that membrane type Key switch would have in other applications as well (e.g. Office Automation products such as fax, copier, printers, etc and consumer products such as washing machine), membrane keyboard manufacture should be encouraged. Membrane keyboards will have enormous export potential and will give an added advantage to the manufacturers.

Suggestion 4 : Keyboard test facilities :

Any encouragement to the manufacture of keyswitches should be complemented with facilities for testing of keyswitch life. Most of the existing keyboard manufacturers import keyswitches from established manufacturers abroad and indigenisation of this component can be taken up only after extensive testing by an independent body.

Test laboratories are to be delivered with facilites to test the conformance of the keyboard with respect to international standards such as DIN and Indian standards such as IS. The parameters include key travel, tactile force curve, reflectance, legend readability, etc.

Suggestion 5 : Indigenous vendors :

- ❑ for components
- ❑ for making moulds, raw material for plastics.

Indigenous vendors are needed for components like transistors, diodes, resonators, coiled cables, etc. Investments to make UL/CSA/FCC approved components and subassemblies available are recommended as this would enhance export opportunities.

Major technological gaps exist in terms of mould making capabilities and quality of raw material (plastics) available in the country. This is especially true in the case of two-shot injection moulding. Encouragement to this sector will help in reducing the outflow of foreign exchange as most of the mould making is currently done abroad. This will also help in easy indigenisation of plastic parts.

Suggestion 6 : With the micro computer segment expanding in the country usage of Indian Multi-lingual languages is becoming popoular. There is currently no keyboard, layout standard available for the layout of this standardisation keyboard. Each manufacturer has been using his own layout for the purpose. It would be ideal if Government can step in and evolve a standard for this purpose, which can be used by all manufacturers.

Suggestion 7 : Pathway for exports to be made easier :

Keyboards are one of the most standardised products and the technology involved is relatively low. Hence tremendous export opportunities exist for this product and given the right conditions India should do well to make its presence in the international market. But, the margin on this product is very low and most of the major manufacturers thrive on large volumes. The prices presently offered by Indian manufacturers are comparatively high and hence they find it difficult to sustain in the international market. Hence favourable conditions should be created for the export of keyboards.

Government has already initiated steps to make available easy certification for UL, FCC, etc. The steps in this regard should be hastened in order to ensure that Indian products conform to international requirements. This would encourage Indian manufacturers to explore export markets actively.

Suggestion 8 : In recent years, the emphasis of any office automation product has been shifted from one Agency to another for study of that is strictly functional to a concern with ergonomics and "user friendliness". This basically consists aesthetic aspect of two parts; one is the "feel" and second the "looks" of the product.

As far as the "looks" are concerned the main factors involved are the plastic raw material used and the pigment added to get a particular shade.

In the long run, if India is to become dominant in this market, agencies are to be developed which will be in a position to advise manufacturers on the above factors. There are currently certain organisations in the country that are involved in this kind of studies (eg. IIT Bombay and NID Ahmbedabad). But a much more concentrated study is required and research data should be available that will complement the efforts being put by manufacturers of OA/ consumer products.

□

Data Bank

Productivity Levels in Asian Countries

NPC Research Division

In an earlier study, international comparisons of labour productivity growth among select countries from Asia, Europe, Cananda and USA had been attempted at an aggregate economy level [Productivity, 30(4)]. In the present study productivity levels are compared among the Asian countries in the case of the following sections.

- Agriculture
- Mining (Mining and quarrying)
- Manufacturing
- Electricity, gas and water
- Construction
- Trade
- Finance
- Transport and communication
- Public Administration
- Others

The data given here are those arrived at by the Asian Productivity Organization and contained in their publication "Comparative Information on Productivity Levels and Changes in APO Member Countries, 1991". Labour productivity has been arrived at based on the GDP at 1980 constant US dollar and number of persons employed in each sector. The required price deflators have been arrived at by shifting the base year of the implicit price deflator series of the respective countries to the common base year, 1980. The GDP figures at the respective National currencies for some years are obtained by the APO Study from the 'Key Indicators of Developing Member Countries' of the Asian Development Bank (ADB). For a few years they have been secured directly from the country sources including the NPOs. The number of persons employed by kind of economic activity has been taken either from the Year Book of Labour Statistics of the International Labour Organisation (ILO) or those provided directly by the country sources including the NPOs.

The extent of inter-country comparability of input-output data utilised by the APO in computing the labour productivity could not be ascertained in detail. In particular the inter-country comparability might have been severely constrained by the varying nature of the primary sources, on which the secondary sources, including the NPOs are based :

(i) It is not clear as to whether the GDP figures are based on the National Accounts Statistics sources only, in the case of all the countries. In the case of India it is based on the National Accounts Statistics of the Central Stattistical Organisation (CSO).

(ii) It is also not clear whether the labour data are based on population censuses or sample surveys in the case of all the countries. In the case of India the labour data are based on the population census.

(iii) The APO study does not show the extent of use of projections undertaken by either the primary or secondary sources, e.g. Indian labour data has been based on the compound rate of growth of persons employed in each sector between 1971 and 1981 censuses. The sectoral shifts in employment that might have occurred after 1981 census had not been captured by these projecttions.

iv) The concept of persons employed usually varies across sectors and across the countries, e.g. 15-60 or 18-60 years of age. This is particularly relevant in the case of the unorganized and informal sector activities. The variations in employment status into gainful or otherwise, or primary or secondary activities might also affect the inter-country comparability seriously.

(v) There could be possible variations in the coverage of economic units across the countries i.e. whether all organizations irrespective of their size into large, medium, small or tiny. In the case of India, since both labour and output data are from the population censuses and National Accounts tables, respectively, all organizations and all activities are covered.

Table 1 : Productivity Levels at 1980 U.S. Dollars - All Sectors

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
China, Rep. of	6324	6588	6682	6981	7470	7713	8272	8957	9513	10058
Hong Kong	11532	11979	12198	12739	13377	13193	14424	16172	17281	17742
India	669	695	701	743	757	780	795	807	843	865
Indonesia	1415	1436	1337	1434	1474	1481	1481	1501	1530	1588
Japan	20609	21210	21666	22034	23031	24109	24267	25327	26496	28644
Korea, Rep. of	4577	4766	4987	5526	6078	6265	6798	7221	7804	7976
Malaysia	4847	5030	5398	5619	5900	5591	5577	5690	5989	6229
Pakistan	1028	1073	1112	1156	1219	1282	1353	1356	1408	1436
Philippines	2054	2055	2023	1962	1844	1682	1660	1754	1794	1872
Singapore	10963	11542	12035	12717	13690	13705	14022	14782	15825	16762
Thailand	1428	1638	1647	1666	1718	1747	1761	1857	1985	-

Table 2 : Productivity Levels at 1980 U.S. Dollars - Agriculture

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
China, Rep. of	2492	2518	2532	2507	2625	2670	2614	2940	3249	3352
India	373	386	372	402	394	388	371	361	421	407
Indonesia	625	638	602	599	602	624	581	577	576	591
Japan	5325	5560	5946	6255	6753	6827	6860	7189	7083	7506
Korea, Rep. of	2008	2225	2488	2865	3112	3385	3610	3443	3820	3864
Pakistan	602	612	620	589	634	692	667	708	723	729
Philippines	925	931	909	854	909	905	906	953	973	1018
Singapore	10665	11634	12204	12192	17163	16693	12567	10408	17595	15321
Thailand	468	587	610	585	584	617	592	605	602	-

Table 3 : Productivity Levels at 1980 U.S. Dollars - Manufacturing

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
China, Rep. of	6975	7523	7625	7950	8411	8739	9651	10122	10535	10993
India	1055	1116	1164	1253	1309	1401	1500	1582	1562	1578
Indonesia	1802	1751	1529	2003	2341	2676	3023	3222	3501	3122
Japan	22427	23223	24385	25037	26613	28250	27634	30030	32146	33538
Korea, Rep. of	6295	7149	7190	7705	8820	9026	9779	10062	10798	10793
Malaysia	6252	6396	6811	7224	7784	7395	7896	8328	8950	9399
Pakistan	1070	1181	1226	1430	1499	1567	1748	1700	1929	2018
Philippines	4649	4998	4810	5107	4676	4138	4220	4195	4191	4355
Singapore	10925	11044	10721	11415	12355	12560	13789	14707	15695	16442
Thailand	3820	3793	3377	3687	3939	3758	4127	3928	4812	-

Table 4 : Productivity Levels at 1980 U.S. Dollars - Electricity, Gas & Water

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
China, Rep. of	38564	37324	36410	39558	43036	48081	51915	56068	61901	66164
India	2481	2654	2772	3010	3311	3545	3837	4031	4374	4557
Indonesia	5432	6852	7860	4881	4619	4201	4328	5380	5772	5653
Japan	106124	106748	112725	118870	120243	129120	129669	131986	138877	145026
Korea, Rep. of	28148	44561	47065	62351	65181	66732	85727	87513	81340	78927
Pakistan	3327	3271	3398	2524	2512	4541	6643	5152	7162	7533
Philippines	6778	6574	7469	7531	7584	7340	11176	9715	8720	10479
Singapore	27000	37597	36909	37342	37148	46359	48288	57712	58188	70575
Thailand	5128	4713	5519	4025	4133	4836	4964	5346	6140	-

Table 5 : Productivity Levels at 1980 U.S. Dollars - Construction

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
China, Rep. of	4685	4496	4544	4739	4858	4977	5214	5414	5689	5922
Fiji	9944	15392	16954	16495	15580	15545	15008	18973	15771	-
India	2013	2082	1941	2036	2047	2110	2124	2149	2260	2170
Indonesia	2428	2390	2148	2497	2378	2249	2477	2572	2806	3361
Japan	19646	20676	20401	19043	19732	20382	21087	23512	24689	24866
Korea, Rep. of	6221	5683	7118	8755	8344	8655	9308	10138	9974	10337
Pakistan	978	1002	946	979	1038	939	1125	970	925	925
Philippines	4726	5316	5260	4851	3291	2533	2003	2105	2002	2148
Singapore	12967	13368	16815	18615	18093	14858	11912	11682	12263	12246
Thailand	3895	2890	2858	3164	3245	3156	3003	2821	3460	

Table 6 : Productivity Levels at 1980 U.S. Dollars - Trade

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
China, Rep. of	5206	5346	5393	5504	5905	6090	6662	7146	7345	7754
India	1281	1336	1381	1423	1452	1523	1555	1584	1771	1775
Indonesia	1526	1434	1342	1354	1318	1313	1362	1358	1455	1565
Japan	16152	16464	16722	16830	16975	17577	17717	17684	18160	16064
Korea, Rep. of	3037	3096	2916	3123	3463	3498	3957	4383	4819	4834
Pakistan	1398	1489	1565	1520	1646	1797	1923	1867	1970	2004
Philippines	3116	2900	2852	2876	2657	2444	2301	2444	2473	2541
Singapore	10373	11066	11187	11197	11856	11395	11574	12222	14037	14784

Table 7 : Productivity Levels at 1980 U.S. Dollars - Transport & Communication

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
China, Rep. of	6393	7058	7575	8529	9589	9981	10259	10707	11508	11809
India	1146	1213	1274	1334	1408	1517	1588	1644	1682	1702
Indonesia	2135	2188	2122	2481	2581	2468	2509	2558	2606	2784
Japan	22534	23515	23309	24329	26457	27588	27198	28273	29581	29942
Korea, Rep. of	7705	8144	8736	9218	9754	9699	10184	11050	11450	11936
Pakistan	2100	2205	2310	2577	2698	2472	3109	2634	2784	2824
Philippines	3012	3137	3196	2703	2582	2491	2697	2548	2385	2409
Singapore	13439	14613	15992	16918	19999	21341	23656	24196	26932	28070
Thailand	4056	4551	4007	3923	4462	4523	4727	4471	5033	

Table 8 : Productivity Levels at 1980 U.S. Dollars - Finance

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
China, Rep. of	37834	37752	36036	35412	38274	39649	38563	42370	42782	43238
Fiji	30971	33775	38759	38311	48576	52913	63483	64501	76402	-
India	7372	7557	7970	8168	8501	8859	9324	9532	10345	10695
Indonesia	10296	17746	36996	20073	20856	23127	21219	21008	20555	19106
Japan	73493	106708	75077	77872	81760	81241	80835	86435	91653	94946
Korea, Rep. of	14350	12579	13448	12866	12326	12572	12635	13248	14177	13672
Pakistan	8113	8807	9794	11896	12269	11869	11491	13840	14926	15186
Singapore	29191	31539	32852	34488	36495	41258	41132	46786	48882	53313

Pollution from Glass Industry

NPC Pollution Control Division

Presently, there are 120 glass units in the country, besides traditional glass bangle making and mouth blowing units specially in Ferozabad. While the production of glass has increased manifold, the number of glass factories has come down because a large number of small factories have been replaced by more economical larger units. The technology of glass making has also improved steadily and the first float glass unit is scheduled to be commissioned shortly.

Status of Pollution

As part of the project on Development of Environmental standards for Glass industry which was carried out by the NPC for the Ministry of Environment and Forests, detailed pollution monitoring studies were carried out in 18 representative glass units (and six units in Ferozabad region) during 1989-90. Based on these studies the status of pollution from glass industries was assessed.

The process of glass manufacture results in relatively higher atmospheric emissions than solid waste generation and liquid discharge.

Air Pollution

Source Emission

The single major source of air pollutants in glass industry is the furnace stack. The emissions from glass melting furnace are far higher as compared to other furnaces like annealing, bangle making, etc.

The emissions and other related parameters from a few representative glass melting furnaces are given in table 1.

Fugitive Emission

In addition to the source emission from glass melting furnace, fugitive emission also takes place from the following operations :-

1. Preparation of raw materials *i.e.* mixing, screening, etc.
2. Batch preparation *i.e.* mixing to form a homogeneous mixture and transportation of the mix.
3. Cullet preparation i.e. crushing of waste glass to acceptable size.

Table : 1 Air Emission & Other Related Parameters From Glass Melting Furnaces

Type of Product	Type of Glass	Furnace Capacity t/day		Flue Gas Data				Particulate Emissions		SO_2 Emissions		NO_2 Emissions		Fluoride Emissions	
		Draw	Hold	Temp. °C	Composition CO_2%	O_2%	Flow Nm^3/hr	Conc. mg/Nm^3	Load Kg/hr	Conc. mg/Nm^3	Load Kg/hr	Conc. mg/Nm^3	Load Kg/hr	Conc. mg/Nm^3	Load Kg/h/r
Bottles	SL	20-130	50-200	200-400	4-10	16-9	4000-17000	177	1.8	1140	16.2	847	6.78	2.2	0.02
Sheet Glass	GL	40-60	130-200	300-400	10-16	8-3	12000-18000	80	1.3	155	26.0	Not availabe		Not availabe	
Lamps, Tubes	SL	20-30	60	250-400	5-7	15-12	6000	90	0.4	1125	6.6	1509	8.87	1.5	0.01
Labware	BS	5	50	250-400	5-12	15-8	4000-12000	255	1.33	3200	1.8	Not available		0.7	0.008
Flask Refill	SL	8	35	250-300	10	8	2000-3000	200	0.42	3473	7.3	536	1.12	Not availabe	
Bangles	SL	NA	NA	300-400	15-17	5-2	4000-5000	736	3.2	100	0.43	Not available		4.1	0.18

Note : Soda Lime Glass — SL
Borosilicate Glass — BS

4. Raw material feeding to the furnace.
5. Annealing of the products.

However, the level of fugitive emissions is quite low. In the absence of established standard methods for quantification of fugitive emissions from such sources the same could not be carried out.

Water Pollution

The sources of water pollution in glass industry are :

1. Cullet washing.
2. Cooling water at different areas in furnace operation.

However the level of water pollution is generally quite low and depends on the quality of cullet. The analysis of waste water in a few glass industries is given in table 2.

Table 2 : Characteristics of Waste Water Effluent from Glass Industry

Parameter	Unit	Range
Flow	m^3/day	4 — 70
pH		7.2 — 8.0
Total Solids	mg/l	366 — 965
Suspended Solids	mg/l	42.8 — 450
Dissolved Solids	mg/l	324 — 515
Oil and Grease	mg/l	3.0 — 18.5
BOD	mg/l	14.6 — 70.5
COD	mg/l	26.3 — 110

Solid Wastes

The solid wastes from glass industries comprise :

1. Waste coarse sand from sand screens.
2. Cullet and reject glass generated at different stages but these are normally recycled to the process.
3. The metal and plastic components from purchased cullet.
4. Ash from coal fired furnace/producers.

Data pertaining to the quantum of solid waste generation was neither available nor could be monitored. In any case the solid waste from glass industries is mostly used for applications like road making and land filling or sold for subsequent usage by other industries.

Compiled by :

S.P.Chandak

□

Modern Poverty is not the poverty that was blest in the Sermon on the Mount. The objection to it is not that it makes people unhappy, but that it degrades them; and the fact that they can be quite happy in their degradation as their betters are in their exaltation makes it worse.

—G.B.Shaw

A mixed economy is a mixture of freedom and controls with no principles, rules or theories either. Since the introduction of controls necessitates and leads to further controls, it is an unstable, explosive mixture which ultimately has to repeal the controls or collapse into dictatorship.

—Ayan Rand

University. The net result can be fewer tenants and more labourers. Since tenants are usually better off than labourers, tenancy reform does not really help the poor. Tenancy is not necessarily inefficient and should not be automatically ruled out, said Professor Otsuka. Instead, tenancy regulations should be liberalized to allow a wider choice of contractual options. Furthermore, the hiring of labourers is an inefficient substitute for tenancy—fixed-rent tenants and owner-farmers tend to make better use of resources than owners who hire labourers.

An analysis carried out in Philippines by Professor Otsuka and two colleagues showed yields and residual profits per hectare were significantly lower on farms with laborer than those using another system. Thus, he concluded, restrictions on tenure choice under present land reform regulations in the Philippines have actually adversely affected both efficiency and equity.

In general, land reform cannot be a panacea for poverty alleviation, aside from the practical difficulty of its implementation.

The provision of credit for rural development by governments, especially that which is subsidized either explicitly or implicitly, is a traditional approach which now has few advocates among economists since it has had "disastrous results", according to Mr. Ammar Siamwalla, President of the Thailand Development Research Institute. Mr. Ammar said, credit should play a supporting role and is only helpful if it helps the poor engage in productive economic activities, producing marketable goods. To be competitive, these goods must be produced more efficiently. While credit can be useful in adopting new, more efficient technologies. Once the technology proves to be viable, there is no reason to provide soft credit to encourage use of the technology - it sells itself. The experience of the Grameen Bank in Bangladesh proves the poor can conjure up profitable projects, provided they design and implement ventures themselves, according to Mr. Ammar. But, he added, credit programs depend on a vibrant local economy as a precondition.

He suggested credit is not always the solution. Instead, offsetting losses the poor must absorb because of the risk they are forced to take might go further to reduce poverty. For example, public works programs can provide income during times of crop failure; subsidized health-care provision and, more importantly, increased availability and accessibility of health services can cushion the effect of illness; and targeted food subsides could tide the poor through times of adversity.

These measures imply giving grants instead of loans, which Mr. Ammar argued is appropriate when certain conditions are met such as "fairness and compassion" in implementation and the use of appropriate financing.

According to Dr. Kalpana Bardhan, the disadvantaged females often suffer more than their male counterparts. They tend to work harder and have less access to food, health, education and training. This creates a vicious cycle : overworked and undernourished mothers do not send their daughters to school and cannot care for their children. Studies show significant positive results follow better educational and employment opportunities for females, including the lowering of fertility and infant mortality, direct and indirect gains from shifts to higher-yield work and gains from adopting equipment and inputs which improve the efficiency of household chores.

Three broad sets of policies which affect the rural poor were described by Professior T.N. Srinivasan of Yale University. The first set concerns agriculture: policies affecting ownership and access to agricultural land by the poor, technology and extension policies influencing agricultural productivity and price and tax policies. The second set concerns the productivity of labour through investments in health and education. The third set concerns economy-wide policies, ranging from development strategies to macroeconomic, inflation, foreign trade, borrowing, monetary and financial sector policies.

"First, and perhaps the most important", said Professor Srinivasan, is that the incentive system matters and competition is the most reliable way of ensuring appropriate incentives for an efficient allocation of resources. This involves promoting the operation of competitive markets and responding to signals generated by such markets." He also said "outward orientation" - defined as a neutral trade regime advantage allowing the forces of comparetive advantage to determine production, capacity creation, foreign trade and investment - promotes sustained and efficient development, while a stable macroeconomic framework is "absolutely essential" for the incentives provided by competitive markets and outward orientation to be effective. Finally, the State has a vital role to play in establishing and maintaining a conducive environment for microeconomic incentives.

Source : ADB Quarterly Review, January, 1991.

PLUGGING THE TRAINING GAP

Learning does not take place without a reward of some kind, whether the reward is extrinsic of intrinsic to the learning itself, according to Dr. Jill Fairbairns, the well-known organisation consultant. This is such a simple truth that it often gets forgotten. Or may be it is not forgotten but avoided because it seems such a difficult thing to manage.

If the tactics of a particular training initiative in an organisation are to be soundly based, it is essential to know in advance about people's perceptions of what is likely to be rewarded.

In the midst of the turbulence in which we find ourselves, it is frequently the case that off-the-job training runs against the 'spin' of the organisation. This, by definition, takes place at the risk of being undermined immediately people return to their normal working environments.

Rather than blame employees for not learning or changing their ways, it is frequently more productive to look to the systems around them for blocks to change. It is there that the greater proportion of the blocks are to be found.

It is important that managers who make decisions about training should be excellent tacticians. Not only do they have to understand closely the context in which they are setting up 'counter-spins', but they have to do all they can to help the new learning to flourish once the course (or seminar etc.) is over, so that it is not swamped by adverse conditions.

Accordingly, where the required training is running truly against the current flow, trainers will expcet resistance and may be ready to respond to it. Ploys they may choose may include, for example, longer courses; the presence of top bosses to endorse the messages; paying more attention to action planning and dedicating more time to it; and thinking through 'after-care' services before the training take place.

Source : Personnel Management Feb. 1991.

BUSINESS WITH CHINA - NEGOTIATING WITH THE RIGHT DECISION MAKER

Few foreigners know China as intimately as the American consultant Mr. Sidney Rittenberg who spent past one decade doing business there. Rittenberg stresses that there is a future for business in China, the world's largest underdeveloped market. Occasionally things move faster: "If a foreign company has something that China knows it badly needs, and if China has something the foreign company wants, then a deal can proceed quite fast within two to three years". But generally says Rittenberg, it is unrealistic to think a quick kill can be made in China. Usually, the foreign company must invest and develop the market, a long-term process. Rittenberg advises foreign companies or investors to first establish a presence in China, but not to spend a lot of money on the venture. Rather, he says, it is important to make a small project work and establish a good track record.

A foreign company planning to invest in China must be attuned to the way business is done there. The corporate mentality that "China is just another country" will hit a stone wall just as impenetrable as the Great Wall, he declares. Thus the attitude of the foreign negotiator in China is of paramount importance. Rittenberg also advises that the foreign negotiator keep his CED out of China until his presence is needed to work out a few wrinkles or sign an agreement. Otherwise, the CED will be given the red-carpet treatment, meeting top Chinese officials few see. This, says Rittenberg, "May be carefully orchestrated ego-building designed to dazzle the CED into making promises and commitments. Once he has departed, his negotiator may be unable to keep them".

Rittenberg advises that every foreign business foray into China should begin the same way : before negotiations begin, the foreign company needs to identify the key Chinese decision maker who will authorize the project. Then it is imperative that the foreign negotiator talk directly with him at a very early stage to assess if the project has a good possibility of success. "Help is required to identify the key decision maker because the Chinese prefer that he not be present during the negotiations". Rittenberg warns that years can be wasted in discussions with upfront negotiators who have no authority to make decisions. "They do report the conversations back to the boss, but these are translated versions of the exchanges and may not truly represent what occurred or may have been deliberately edited".

The key decision maker is usually one person such as a vice mayor, a vice governor, or the head of a ministry or bureau. But getting to know him is only part of the picture, cautions Rittenberg. There is a whole network of people who need to be identified who will have some role to play in the venture. The network will consist of some organisations most foreign businesses would not think of involving. There are the more obvious ones, like the State Planning Commission or the Bank of China, but the local railroad bureau or the telephone company may also be part of the action.

Rittenberg says that it is quite common for two Chinese organisations to have no contact with each other and be unable to initiate anything together, or they may be even rivals. "But the foreign business person is in a neutral position and can invite everyone to dinner to get them acquainted or ease the tensions and get them talking," he says. Slowly a circle of people will be drawn together who

- Small Scale Industry
- Rural and Extension Work
- Entrepreneurship and Self-employment

For new emerging areas of science and technology like environment engineering, bio-engineering, micro electronics, satellite communication, non-conventional energy source development, computer system, and nuclear science and technology, manpower has to be produced by our technical education system. There is no doubt that tremendous strides have been made in this area.

The best qualified and/or affluent graduates emigrate to foreign countries for higher education in fields which most of the times are alien to Indian reality. Then there are others who join management institutes where the "engineering profession" is discarded in favour of a career in selling tooth paste or detergents. Students from lesser known engineering colleges go to better known engineering instittutes for getting a stamp" rather than quest for knowledge in a chosen field of specialisation. There are others who join engineering and other industries to discover that whatever they have learnt has no scope of application and whatever is needed in terms of relational and operational skills was never imparted to them.

The condition of a diploma holder is not very good, except for products of a few institutions. The way a "diploma holder" or an "overseer" is treated in the professional world makes the person totally frustrated and anxious to quit his "technician" status as quickly as possible through such means as passing bridging courses.

The engineering industry is more diverse compared to some of the primary industries like mining, jute, textile, tea, etc. It is comparatively easy to define manpower requirements in the mining industry based on the norms for output per man or for a process industry like fertilizers where the relationship between capacity-output-manpower needs is more definitely linked. In the engineering industry these parameters vary depending on various factors. In this industry these parameters vary depending on various factors. It is for this reason that aggregate manpower needs of the engineering industry, particularly at supervisory and managerial level, have not been properly assessed. This has led to distortions and under employment of engineers, technicians and trained craftsmen in certain fields from time to time.

In determining the kind of people that are needed by the engineering industry, the position is very complex. One of the factors is the "quality" of manpower produced by the educational/training institutions. For instance graduate engineers from IITs and some of the other premier degree institutions have no difficulty in finding employment. Unfortunately, products from such institutions form a very small proportion of 25,000 engineering graduates and 50,000 diploma holders being produced from different institutions each year at great cost to the public exchequer. The problem that industry faces in most of the cases is that inspite of the degree or diploma a student has acquired, he is, in many instances, not appropriately trained for the job that he should be doing in the industry. The result is that, in many cases, the job that should normally be done by diploma holders/technicians are assigned to graduate engineers and so on. There is, therefore, a built-in frustration situation for an individual.

As far as the engineering industry is concerned, the largest manpower requirement for jobs of supervisory nature needs to be satisfied through technicians. Polytechnic education, particularly in certain institutions, is not only poor in quality but also limited in variety. For instance, polytechnics are training electrical, mechanical and civil engineering students in most of the cases, rather than training technicians for process, electronics, chemical, steel, or aluminium industry. At the degree level, the variety has been adequately created but sufficient number of elective subjects are not available for a student to choose from in order to pursue to become a future design engineer, engineer scientist, production/maintenance engineer, or engineer-manager. When it comes to the question of post graduation and specialisation, the need of the industry and the academic inputs have yet to be properly matched.

Source : CEI - CBI Indo-British Industrialists Forum, February 1991.

ENERGY AUDIT SUBSIDIES

In addition to subsidies ranging from 25 to 100% for initiating energy audit studies offered by some of the state level energy development agencies, the Petroleum Conservation Research Association also offers subsidies up to 50% of the cost towards the conduct of energy audit studies. In 1988, the Industrial Development Bank of India (IDBI) has come out with subsidy schemes for energy audits and energy conservation investments namely, Energy Audit Subsidy Scheme and Energy Conservation Equipment Finance Scheme. The energy audit subsidy scheme promotes rational use of energy through energy audits in industries. The emphasis is on setting up targets or coordinating for specific energy consumption levels based on good housekeeping, operational and in depth energy audit exercise. The costs towards the energy audits by approved energy consultants would be sub-

sidised by the IDBI. A complementary scheme funds the energy conservation investments. The novelty of the scheme is the provision of soft loans with interest rates declining from 15% to 11% depending upon the percentage saving based on its own level of energy consumption. The scheme limits the promoters contribution to 10%. The energy audit costs borne by the units would be treated as part of the promoter's contribution, and there is a moratorium of two years on the repayment of the loan. However, the loans are limited to 5% of the gross fixed assets of the company and with a ceiling of Rs.40 million. The scheme has achieved limited success due to the following reasons :

(i) IDBI insists on unit being very profitable or with high resources to be eligible for availing this loan. The industrial sickness in India is fairly deep rooted. According to various sources like RBI, Ministry of Finance and Bank Officials (through informal channels) it has been found that about 60% of the units to whom banks have extended credit are financially in bad health. It is also estimated that more than 40% of the advances by the commercial banks is locked up in these units.

(ii) This loan is also tied down to existing debt/equity stipulations. Since many of the sound units have availed up to this limit they are not eligible for additional loans.

(iii) Interest rate is higher than in another scheme called modernisation scheme. Therefore, "good" units who are eligible on the above two counts prefer the modernisation scheme. Only those units who require larger sums approach IDBI for this loan.

Source : National Productivity Council, 'Rational Use of Energy in Industry : Select Information for Consid eration by GTZ Pre-Appraisal Mission' New Delhi, March 1991.

ENVIRONMENTAL TAXES

Countries are increasingly looking into the idea of imposing environmental taxes. The most talked about of all has been the idea of a carbon tax that might be levied on emissions of carbon dioxide, one o the 'greenhouse' gases thought likely to cause global warming.

Finland

From January 1990, Finland has imposed a tax on fossil fuels on the basis of their carbon content. Its rate is $6.10 per tonne of carbon emissions.

France

The Secretary of State has approved a decree extending the parafiscal tax levied on emissions of SO_2. The tax will now also apply to emissions of NOx and HCL. The threshold size of operation for the application of the tax has also been lowered from 50 MW. The number of establishments affected by the tax will rise from 480 to around 870.

The Netherlands

A carbon dioxide tax, in addition to an existing fuel tax, took effect on February, 1, 1990. The tax is higher on coal than on natural gas as coal produces more carbon dioxide per unit of energy than gas. The Dutch Government aims at a carbon dioxide emission reduction of about 5 per cent by year 2000 compared with the 1989-90 level.

Sweden

A COx tax of 0.25 Kr per kilogram of CO_2 emitted was to be introduced from April 1990. It will be imposed on all users of all fossil fuels except biomass and peat. Sweden will also levy a tax of 30 Kr per kilogram for sulpher emissions.

The United Kingdom

The United Kingdom is studying the possibility of introducting of carbon dioxide tax. Industries responsible for large-scale carbon dioxide emissions are main target for taxation.

The United States

The omnibus Budget Reconciliation Act of 1989 imposes a new excise tax on certain ozone-depleting chemicals and on the import of products made with or containing such chemicals. The bill defines eight chemicals as ozone-depleting and applies the new tax to them. The eight chemicals are those subject to production limitation under the Montreal Protocol and the implementing EPA regulation :

CFC-11	(trichlorofluoromethane)
CFC-12	(dichlorodifluoromethane)
CFC-113	(trichlorotrifluorethane)
CFC-114	(1,2-dicloro-1,1,22,2-tetrafluoroethane)
CFC-115	(chloropentafluoroethane)
Halon-1211	(bromoclorodifluoromethane)
Halon-1301	(bromotrifluoromethane)
Helaon-2402	(dibromotetrafluoroethane)

Additions to this list of taxable chemicals can be made only by Congress.

The tax is imposed on the following instances :

— Sale or use of imported products for which ozone-depleting chemicals are production material

— Ownership of floor stocks

Source : ENVIS News Letter (Central Pollution Central Board) Jan. 1991.

PROMOTING HR

1. To communicate with senior managers, HR execs should learn to talk the Language of the Bottom Line. In conversations with line managers, "HR execs have got to have a dollar sign in there somewhere, " says Philip Crosby, an expert on corporate qualify. Adds John Zimmerman, head of HR at MCI, "an HR person should be just as capable of talking about business and how it's financed and managed as anyone else on his or her level. Once you establish yourself as knowledgeable, people begin to deal you in."

2. Teach your HR execs how to interface between top management and their department. "Too many HR people see their mission as saying `no' and `why not'. My mission is to identify line management's needs and figure out `how', says Thomas Van Berkem, chief of human resources at Advo-System Inc.

3. Although their roles are changing, HR execs should never forget the basics. Since HR's role is in transition, the best strategy, for now, is to mix the strengths of both the old school and the new school. "Some HR execs don't want to get their hands dirty dealing with things they think are demeaning [such as planning hotel accommodations for a management retreat] to them," says Dale Winston, president of Battalia and Associates, an executive recruitment firm. "But if your department is a service organization, and the CEO thinks a job is important, you do it. Paradoxically, the best way to gain influence is through service."

4. Promote the HR department's credibility and authority. It's the only way to allow human resources to help managers develop and, in turn, empower and develop employees. Companies like Oryx and Du Pont, that are teaching managers to share leadership with employees, have a strong competitive advantage over companies with managers who are still stuck in a power mode.

5. Encourage the head of human resources to hire a progressive, bright staff. Try to do away with paper pushers and bureaucrats. Otherwise, even a strong HR chief will face an uphill battle. "The rest of the HR department must share their department head's vision," says John McCarthy, senior vice president of human resources at Eastman Kodak.

Source : Management Review March, 1991

ENERGY ALTERNATIVES

Natural gas with its abundance in India can offer a truly viable option to bail out the economy from the impending energy crisis. India's gas reserve today stands at 655 billion cubic metres and one thousand cubic meters of gas costs US$ 28 per barrel. In 1989-90 natural gas production rose to 17 billion cubic metres in India whereas poor demand management could tap only 11.5 billion cubic metres with the rest ending in flares. Increased use of natural gas and coal in power sector can release some oil for short-term use in other sectors where replacement is difficult. As a medium-term measure, use of Compressed Natural Gas (CNG) for transportation can reduce dependence on motor spirits and HSD (High Speed Diesel) as well. India can draw upon the expertise developed in other countries as well. There are of course techno-economic uncertainties which we need to experiment and ascertain. CNG requires attachment of highly pressurised fuel tanks, thus enhancing the vehicle costs; it can also be cumbersome. Further advances in technology may be able to offer more feasible solutions. As the demand over 50 per cent of our petro-products stems from transportation sector, nurturing of CNG technology assumes prime importance. Natural gas can also substantially replace Naphtha, the crucial feedstock for fertilisers and petrochemicals. This may require modifications in our existing plants. In future, it is better to design plants which can easily run on multiple feedstocks, so that we can be responsive to international markets and pick up cheaper feedstocks, whenever available.

Cracking of Naphtha to lower hydrocarbons as ethylenes and propylenes for polymerisation products has already been identified as an important option with high value-addition potential. Indigenous effort in this direction has been the establishment of 100,000 tonnes of Naphtha Cracker Complex at IPCL, Nagothane. Technology also exists in converting the natural gas to middle distillates (motor spirit, HSD, LDO etc.) though it awaits proper exploration. Natural gas substituting high sulphur fuel oil/coal for power generation is the other alternative route. Establishment of a national gas grid and an effective distribution management would be the primary infrastructural requirement to tap the resources.

Another important energy resource we have in plenty is coal, though it has its problems. In the short as well as medium-terms we should learn to cope up with our coal

and maximise its use. Coal plays the most instrumental role in Indian energy scenario as around 65% of the total energy generation is contributed by non-coking, high ash coal in pulverized form. It is projected that by the year 2000 over 300 million tonnes of coal will be consumed for power generation. Coal thus assumes the role of major vehicle for development for India and calls for application of emerging technologies towards its effective utilisation.

Coal benefication, practised incase of coking coal only at present, should be resorted to for power plants. It is estimated that for every 10% reduction in coal ash, boiler efficiency improves by 1%. Recent advances in benefication technologies include oil agglomeration and heavy densemedium cyclones. Benefication reduces maintenance problems in power plants and results in environmentally cleaner emission.

Circulating Fluidized Bed (CFB) technology can accommodate high ash Indian coal and offer higher combustion efficiency. Also, the process enjoys easy turn-down control for part-load operations. Fluidization can control SO_2 and NO_x emission and eliminates the need for expensive SO_2 scrubber. For small generation capacities ranging from 3 to 30 MW, micronized coal injection can offer an effective solution. Micronized coal is an extremely reactive fuel and the combustion efficiency as in gas and oil can be achieved. Small units using oil can be retrofitted with this new option minimal modification.

Coal Gasification Combined Cycle is the latest technology available for an integrated thermo-mechanical power generation. The process has high energy efficiency with more enviro-friendly approach towards gaseous and particulate emission. Technology options for dry or slurry based entrained bed and fluidized bed gasifier are available. Viability has been demonstrated for low/medium ash coal and the studies are under way for these processes using high ash coal. On analysing dry versus slurry versus fluidized bed gasification, it reveals that the fluidized bed process enjoys the best heat rate. Fluidized bed technology is capable of gasifying high ash coal subject to commercially establishing hot gas clean-up and air integration between the gasifier and gas turbine.

Apart from the methods discussed above, the following emerging options warrant further probing and commercialisation :

(a) Co-production of Electricity and Methanol
(b) Coal-water slurry transportation and combustion
(c) Underground coal gasification
(d) Additive for slurry stabilisation
(e) High Energy-density battery systems for automobiles

Source : Y.S. Rajan, Executive Director (TIFAC), Energy Scenario : Emerging Alternatives, Paper presented at the FICCI-CSIR Business Meet on Technologies for Energy Altrnatives, Feb. 18, 1991.

ENTREPRENEURSHIP FOR BUSINESS ALLIANCES

The unprecedented pace of business and technological changes render business diversifications based merely on a company's internal resource insufficient. In contrast to the conventional approach of fostering "intra preneurship", growing business in the 1990s should have the ability to incorporate outside resources for creating new products or business in interdisciplinary fields. Such kind of business alliances among partners can justifiably be called "Interpreneurship". These were emphasized by Professor Yoshiya Teramoto of the Graduate School of Systems Management, the University of Tsukuba, Japan, while presenting the keynote speech at the APO Top Management Forum which was organized in Kyoto, Japan, from 26 February to 2 March, 1991.

Prof. Teramoto said that conventional concepts of business alliances had been one of loss of management control and depletion of profits, and international business alliances was developed and largely between the developed and developing countries. This trend had been changing in recent years and there was a rapid increase in business alliances in North America, Europe and Asia. The essential factor for business alliances, he said, lied in the fact that individual enterprises could not easily keep up with today's social and economic changes by themselves alone.

The strategic considerations for business alliances, he said, were the economy of scope, economy of speed, and the "network effect". Economy of scope referred to the sharing of complementary resources which created values that a single enterprise could not produce. Economy of speed referred to the reduction in time for new product development through cooperation among companies. For example, the lead time for developing a new automobile model in case of Japanese manufacturers was three to four years, but it was six to seven years for American manufacturers. The difference was due to the close alliances among the various partners including the parts suppliers. The term "network effect", he said, did not only limit to the integration of such aspects as technology, production process, marketing techniques, and managerial know-how, but also the cross-cultural effects.

Three types of business alliances, said Teramoto, were in vogue in Japan. These were the exchange of expertise by companies of different fields; the alliances between the large and small and medium companies with examples of many car manufacturers tie-up with the small

and medium electronics companies; and international alliances among industries in developed countries such as the alliances of Toshiba Oliverti and Toyota-General Motors, which were aiming at mutual learning rather than sharing costs and technologies.

Source : APO News, April, 1991.

US INDUSTRIES : COMPETITIVE SUCCESS

In a quiet revolution, the United States, has become one of the world's low-cost manufacturers—lower in many industries than Canada, Europe and Japan. American factories now ship steel to Seoul, transistor to Tokyo, cars to Cologne and bicycle shorts to Bologna. Exports ranging from beer and boards to carpets and computer chips have surged by 76 per cent since 1986.

At home, domestically made machine tools, electronics gear and cars - some turned out in factories with foreign owners- are muscling aside imports.

As a result, foreign trade is likely to power the economy for years to come. "Export led growth may be the only feasible strategy," said Mr. C. Fred Bergsten, director of the Institute for International Economics in Washington. The shrinking trade deficit, now at a seven-year low,. offsets some of the spending lost in the recession.

Although exports have lately levelled off as growth overseas has slowed, forecasters at DRI/McGraw-Hill expect exports to grow 50 per cent faster than imports during the rest of the 1990s.

What is behind the resurgence of American Cost-competitiveness? Partly, of course, it is because the dollar, high-flying in the mid' 80s, returned to earth. Despite the dollar's recent bounce, its value is still one-third below its 1985 level. More enduring are the sweeping and painful changes undertaken by US managers and workers to revive factory productivity. For decades, American companies acted as though higher costs could always be passed on. The new attitude is captured by companies such as Gross & Trecker Corporation, a maker of machine tools based in Bloomfield Hills, Michigan, which intends to cut the cost of its products by five per cent a year.

How durable are the American gains? Certainly, an unexpected return to an overvalued dollar would wipe them out. So would slipping back into sloppy habits. And low costs by themselves cannot guarantee global competitiveness in a world of increasingly choosy customers who often care as much about quality, style, service and technical razzle-dazzle as they do about price.

Those who think of the United States as a good place to make burgers, Boeing aircraft and little else ignore a vast terrain friendly to the manufacture of nails, light bulbs and other old-fashioned goods.

The estimates of Mr. Peter Hooper and Ms. Karen Larin economists at the Federal Reserve in Washington, suggest that US unit costs are 60 per cent of those in Japan. DRI/McGraw-Hill, using different data and methods, estimates that American factory costs are about 10 per cent below those of Europe and Japan.

And the United States is almost certainly among the lowest-cost producers of basic commodities. It costs 25 per cent less to produce high-density polyethylene pellets in the United States than in Europe, and 15 per cent less than in Japan, according to Chem Systems, a consulting firm in Tarrytown, N.Y. Back in 1985, when the dollar peaked, US costs were no lower than in Europe and Japan.

The United States can make steel more cheaply than Germany or Japan, although Britain can make it more cheaply yet. Indeed, USS Posco Industries now makes money shipping 5 per cent to 10 per cent of the cold-rolled steel from its plant in Pittsburg, California, to the Pacific Rim. The average cost of producing a ton of steel in the United States is now about $535 against $542 in Germany and $614 in Japan, according to the WEFA Group, an economics consulting firm in Bala-Cynwyd, Pensylvania.

The United States also seems to have regained ground in industries that many people had written off. American textile mills, it turns out, are very competitive in products for industry and the home.

American factory productivity - which has remained the highest in the world—has been jackrabbiting along in the— 80s. Rising at an average rate of 3.6 per cent a year output per hour in American factories has been advancing faster than in the 60s and nearly three times as fast as in the, 70s.

Finally, United States manufacturing workers are no longer the world's fat cats in terms of pay and benefits. At current exchange rates, according to the Bureau of Labor Statistics, Americans earn $14.31 an hour in pay and benefits. German workers, in comparison, earn $17.58. In Japan, where pay has more than doubled in dollar terms since 1979, workers now earn the equivalent of $12.63 an hour. Thus, part of the price of greater American competitiveness has been paid by American factory workers. Their buying power has been sqeezed as blue-collar pay has risen at a slower pace in the United States than almost anywhere else.

Source : Times of India, 24 April, 1991

REORGANIZATION OF PUBLIC ENTERPRISES

The recent research on industrial competitiveness and industrial performance shows that ownership *per se* is less important for promoting efficiency than competitive inducements to efficiency and the macro-economic envi-

ronment. Large monopolies, operating in the domestic market without competition tend to be inefficient and rigid in their response to changes in the pattern of demand or technological innovation. The success of countries like Korea and Japan in promoting productivity, exports and technological innovation is largely due to their success in realizing the scale economies in production and learning, while at the same time enforcing competition and imposing a market discipline on large enterprises. Many of these successful enterprises are organized as conglomerates which operate in diverse fields and compete with each other, Korea has perhaps carried this strategy the furthest by promoting and protecting the giant 'Chaebol'.

The Korean example, with appropriate modificatiions, provides a useful model for the reorganization of public-sector enterprises in India. These enterprises should be organized in such a manner that economies of large-scale production can be realized without reducing competitive pressure and market discipline. This can be done by setting up five or six multi-product conglomerates in the public sector by reorganizing the existing enterprises in different groups. At the same time, monolithic and monopolistic enterprises can be broken up into four or five separate companies which would freely compete with each other. Through these mechanisms it is possible to visualize an arrangement whereby several conglomerates will operate in different areas, e.g. steel, oil, coal, telecomunications and engineering. These multi-product conglomerates could be organized with the largest company in a particular product at its centre, and several other associated companies operating in different areas. For example, conglomerate A could consist of the largest steel plant as its flagship company, and several other associated companies in oil, coal and other fields. Similarly, there could be an 'Oil Conglomerate' and a 'Coal Conglomerate', and so on, each of them with a number of associated companies from different product groups. Each conglomerate should have complete operational freedom to manage its own business, and its board of directors should have the authority to merge or sell smaller companies, change the product mix, and diversify into other areas, as necessary. These conglomerates should be under the administrative control of different production ministries. The primary responsibility of the administrative ministry will be to undertake an annual performance review of the enterprise, and to present this review to Parliament.

In order for this procedure to work efficiently, the major goals of plublic-sector conglomerates should be set out clearly. As far as existing enterprises and activities are concerned, the most important goal for the next decade should be an improvement in financial performance and the generation of surpluses for further investment. The country has been passing through a major fiscal crisis, which has affected capital formation in several crucial areas of the economy. In the nineties the primary goal of public sector managements should be to reverse this. As far as new investment is concerned, the Planning Commission should lay down the priorities, taking into account the considerations of regional dispersal and equity. These priorities should be discussed with the managements of the conglomerates. While the decision on overall investment priorities should rest with the Commission, the views of the enterprises regarding their implications for operations and profitability should be known to the public and to Parliament.

This sort of arrangement will radically alter the present dispensation *vis-a-vis* the management of public-sector enterprises. This will also run counter to two old premises that have guided the management of the public sector in India over the last forty years. It is generally believed that profits, if they occur, are all right, but that the public sector is generally not supposed to work for financial profits in view of its 'social' role - whatever that may be. Similarly, competition has been seen as the antithesis of planning, which consisted of setting targets for the industrial capacity of each product and distribuing this capacity among a limited number of producers.

The suspicion of competition has been a guiding premise of India's Plans, although there has been some change in emphasis in our later Plans. There may have been an understandable reason for this view, for a country in a hurry, in the early stages of planning, when there was little experience to go by. But our experience since then, and the performance of public enterprises in India as well as in other countries, demonstrates that monopolistic structures and the lack of proper management structures are among the important reasons for the unsatisfactory behaviour of these enterprises. The time has now come to make a radical departure, to put the old theories on their head, and reorganize public enterprises along competitive lines. The best method of implementing this change would be to appoint a Public Sector Reorganization Commission, with specific terms of reference, and with a political mandate to implement the reorganization within a given time frame.

This sort of organizational structure will remove what one writer has referred to as the 'dysfunctional interface' between government and public enterprises. Management responsibility. will shift exclusively to professional managers, and competition will ensure accountability. This new structure will not, of course, solve all problems. It will, however, create the necessary conditions for a more functional and efficient organization of enterprises in the public sector.

Bimal Jalan,
India's Economic Crisis,
Oxford University Press, New York, 1991

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Book Review

Personnel Profession in Transition : *K.B. Akhilesh and R. Sekar. New Delhi, Wiley Eastern Limited, 1990. ix + 115 p.*

Any profession, be it engineering or administration or personnel, faces in its cycle of continuation the problem of transition at one time or the other. The demand for transition is, indeed, a sign of dynamism within the profession. But in the transitory process the end object as well as the means of transition must be clear to the change agents. Alternatively it becomes a practising cliche for the professionals.

The human resource management function has moved through several phases of transition - from parental benevolence to welfare to personnel functional stage. And presently an unwarranted confusion, at times, is created by an attempt to equate personnel function (PF) with human resource development (HRD).

Personnel function and HRD differ in their basic approaches to the problem. While PF emphasizes on welfare and human relations aspects, HRD takes a systems approach and considers the human component in relation to technology and other resources of the organization. According to HRD concept human resources, as suggested by Edgar Schein, are not the only ones to be managed for effective organization. The human element forms an integral part of the resource accountability for organizational effectiveness/ineffectiveness and so it needs constant monitoring for growth and development. From behavioural sciences point of view also, we find the differences in approaches between PF and HRD. The human resources model is more concerned with motivation of the employees while human relations model lays emphasis on employee morale. There are some more differences between the two. All these are mentioned not to ascribe any comparative status to one or the other but only to point out that the two terms cannot be used interchangeably as is often done. One can observe that PF and HRD cannot be competitive elements, they are complementary to each other. Hence human relations model and human resources model combined together become relevant in modern management practices.

The book under review is an attempt to diagnose the current situation and the expected state-of-art of the emerging future in the process of transition of personnel profession. The book is based on a study designed to investigate the "changing scenario and crystallise the views" regarding the transitional process in personnel profession. The data source of the study is the answers given to a questionnaire mailed to a sample of corporate members of NIPM.

Chapter 1 provides an introduction and some explanatory notes on the different areas of personnel functions investigated in the study. Chapter 2 discusses the objective and methodology while Chapter 3 presents the data relating to the sample characteristics. The next three chapters analyse the respondents' answers to the questionnaire and in each summarises the conclusions in three areas of transition, perspectives and challenges, education and training and structure, content and processes of personnel function. Based on the results of the empirical study, Chapter 7 suggests the role of NIPM in the process of transition. The book ends with Chapter (8) on summary and conclusions of the whole study. The text is precise and a matter of fact presentation of the material and so appears to be sketchy. One specific form of presentation that intrigues the reviewer is that the books referred in the text do not find a place in the list of books provided in the bibliography and vice versa. More care ought to have been taken to avoid certain syntactical lapses that obviously affect the quality of the presentation.

The book may serve as a source for data in introducing transitory changes in personnel function. However, it would have been better had the authors provided some theoretical explanations of their empirical findings. Any innovative practice should have a neatly formulated philosophical rationale as its starting base. If NIPM is expected to redefine its role to meet the challenges of present day advances in technology it needs to have the knowledge about ground realities of the state-of-art of the subject matter from the professionals in the field supplemented by theoretical inputs from the academician. Thus an introduction a conceptual basis of the study and a brief discussion on the theoretical aspects of the empirical data would have added the desired dimension of the book.

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Human Resources Development in Japanese Companies : *Hideo Inohara, Tokyo, Asian Productivity Organisation, 1990, 293 p.*

Ever since the rise of Japan as a global economic power, Japanese management has acquired something akin to a mystique. Books and theories have abounded popularising the tenets of managerial practices which supposedly characterise Japanese organisations. Almost as a rule, these publications mostly highlight the theories and principles underlying the Japanese management, neglecting, in the process, the actual facts about these practices (barring a few anecdotal accounts). This trend has contributed to two outcomes : one, it has helped building a kind of esoteric aura around Japanese HRD practices; and two, it has encouraged a theoretical debate as to whether these practices would be equally valid in other cultures or not.

It is in this context Hideo Inohara's book is a welcome change. The book is an objective attempt at presenting a realistic picture of the HRD practices in Japanese companies. The aim of this book, in author's own words is "(1) to clarify myths and realities of Japanese personnel management and industrial relations, and (2) to shed light on the controversy over "transferability" of the Japanese system to other countries." The book proceeds to fulfill these objectives through presenting findings of various surveys, attitudinal studies and cases of Japanese companies. This data-based approach, besides lending credibility to the contents, also dispels some of the widely accepted beliefs about Japanese management.

The book is divided into three broad parts. The first part deals with the broad socio-cultural and economic context within which Japanese organisations exist and which influences its HRD systems and practices. This part describes the structure of labour market, the nature of corporate organisations, the manner in which corporate philosophy integrates social values and gets translated into actual work systems, and the role of personnel management function/department in this milieu. While this part provides a confirmation to many popular beliefs about Japanese practices, it also clears away many misrepresentations about them. For example, contrary to a widely accepted "fact", no Japanese company has a formal system of life-long employment (Labour Standards Law prohibits an employment contract for more than one year). In practice, however, life-long employment does exist, but it is based on an informal understanding and trust between the individual and the organisation.

The second part of the book gives a detailed account of the personnel systems and practices. For the practising managers, this is a valuable exposition about the actual personnel procedures (i.e., recruitment, training, salary administration, discipline, etc.) which translate the Japanese HRD principles into concrete managerial actions. In the process, it also clears quite a few misunderstandings about the popular image of Japanese systems (one prevailing misconception about Japanese promotion system, for example, is that it is seniority-based. The actual criterion for promotion, however, is the merit accumulated by the employee over the years (nenko), and not just the number of years in service). The usefulness of this description is enhanced because not only the author goes into the details about these systems but also because he provides empirical data to support his statements.

The last part of the book describes case studies of organisations like Canon Corporations, Isetan Department Store, Oril Company, and a few Europe-based Japanese subsidiaries. These case studies help in understanding the Japanese practices in day-to-day work environment. They also highlight the need to make necessary cultural adaptations while "importing" these practices to different social milieus.

The notable strength of this book is that, unlike most other writings on the subject, it does not glorify the Japanese principles and systems. Rather, it deals with the subject in an objective, scientific and detailed manner (to some readers, this approach may appear somewhat too detailed and prosaic). It highlights both the positive and negative aspects of Japanese HRD practices. It is for this reason that this book would be useful as a reference text for serious-minded academicians and practising managers who are interested in understanding and experimenting with these systems and practices.

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Human Resource Development in the Building Industry—A Study in Bombay: *Vinita Shah. Bombay, National Institute of Construction, 1990, 132 p, Rs. 150.*

The study is an investigation into the technical skills, social quality and job market conditions of building workers in Bombay. The findings which have emerged are useful in suggesting startegies of skill formation and human resource development with the objective of improving productivity and quality of building and standard of living of workers.

The research was based on a survey of building workers conducted in October-December 1988 followed by a survey of building contractors and interviews with selected industry experts.

The findings revealed that of the total sample 46% were skilled, 15% were semiskilled and 39% were unskilled, the job market in Bombay was large, flexible and accessible to all kinds of workers. The study brought out that 85% of the respondents had no formal job training. There was a general lack of institutional inputs in the process of skill formation except for the limited contributions of a few large size construction firms who offered on-the-job training to their workers. 56% of the skilled workers felt that skill improvement would contribute to higher productivity. An equal percentage of unskilled workers perceived just contrary. Apparently the quality of work, experience and level of job conditioned workers' perceptions of productivity improvement through skills upgradation. The study revealed that regular work, training, better tools and equipment and better site conditions were the facilities that workers felt necessary for them to make contributions to productivity improvement. There was unanimity amongst contractors that institutional training was a basic necessity of the building Industry, it was essential to establish building trade schools for training and a mechanism for certification of skills. The research also revealed that the level of literacy among building workers was lower than the national average rate for urban working population. It brought out that basic literacy was more important for skill formation than years of schooling. Thus young age, illiteracy, landlessness back home, origin from economically backward districts, larger family, more earners per family, assetlessness, lower wages, lower family income and frequent spells of short duration stay in Bombay were the features of unskilled workers.

The building industry does not use mass production technology. It is labour intensive and relies heavily on unskilled labour. Any industrial system that is not geared to the use of advancements in technology will breed low productivity and poverty. There are several preconditions to productivity improvement in the building industry. These are : regulating entry in industry, employment of workers whose skill categories are certified, offering training courses on the building Industry, ensuring quality of structure and human resource development through skill formation and upgradation of building workers.

Acquisition of skill begets higher rate of wages, it also improves the individual workmanship and thereby the quality of work. Skill also calls for better tools and methods of work. This in turn may lead to changes in the technical and organisation system of contractors firms. Thus skill is a change agent to break the stagnant and static social system and is more likely to lead to higher proudctivity.

The author has recommended special studies on women workers in the building industry to find out their socio-economic working conditions, skill needs and contributions to productivity, creation of a comprehensive data base of skills and social quality of building workers for national policies on skill formation and productivity in the building industry, evolving standard job descriptions and full time and part time training courses.

The research has limitations which the author herself mentions. Firstly the operational definition of human resource development used in the study is worker training and skill formation though the concept is much wider and encompasses education and personal development as well as the organisation development process. Similarly productivity and quality refer to labour only. Secondly building activity in Bombay is not typical of smaller towns and rural areas. Thirdly in the absence of certification of skill standards, workers skill status as recorded by the contractors was accepted. Fourthly the sample does not reflect the relative strength of women workforce in the building sector. Finally due to absence of secondary data it is difficult to estimate demand for building workers and trade categories.

Despite the limitations, the study brings out significant findings to enable evaluation of appropriate strategies for human resourc development in this industry. It is necessary to replicate smilar studies in other cities, towns as well as in rural areas so that a comprehensive data base for national policies on productivity and HRD in building industry can be created.

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Appropriate Remuneration in Developing Countries ; Three - dimensional models for executives and workers *by Rama Murthy Kuppachi, New Delhi, Sage Publications India Pvt. Ltd., 1990, 262p, Rs. 195/-*

If you are preparing a bibliography on Job Evaluation, you may add this book as a useful reference. But if you are searching materials what the title of this book suggests, you will be disappointed. The problem of "Appropriate Remuneration" goes far beyond the mechanics of establishing wages or salary differentials at the unit level. The problem that the developing countries are facing is not so

much to perfect the tools and techniques of job evaluation; instead, the problem of `appropriatness of remuneration', at least, in the Indian context revolves around the two most vexing questions, namely ;

- What should be the basis of determining minimum wages which is mutually satisfactory to both employers and trade unions ?
- With which the periodic revision in wages and salaries be linked ? Should it be; capacity of industry to pay, or the achieved or contemplated levels of productivity, or the overall prosperity of the national economy, or should it be left entirely to the vagaries of trial of strength ?

It is these dimensions which are completely missed by the author while dealing with "Appropriate Remuneration". Surely, it is not by mistake or oversight but the choice and design of the author.

Nevertheless, the book breaks some new grounds in job evaluation by extending its scope to cover the executive cadres. Till now subjecting executives to job evaluation was almost a taboo. By further adding a few more factors like working conditions (as is considered necessary for workers), the technique can be used to resolve the bickering over the existing arbitrary salary differentials between managers engagd in direct production related activities and their counterparts responsible for providing indirect support to the production activities.

The other concept suggested by the author and which could be put to a practical use is the interfirm job evaluation in a multi-unit organisation. Again, after resolving the central problem whether profitability of different units under the same holding company should be a relevant factor or not in determining the inter-unit wages and salaries differentials, the concept could bring some rationality in the existing disparities in larger and smaller public sector undertakings, on the one hand, and states and central government employees, on the other. In these two concepts lie the value of the book.

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Information Technology-Led Development—A Report: *Tadao Saito, Takyo, Asian Productivity Organisation, 1990.*

Rapid technological development in computer and communications during the last two decades and their inter-marriage have given rise to what is known as information technology. It has set a new stage in societal development. A new era of information society has been ushered in, triggering vast potentials and opportunities for economic development.

The development of an economy led by Information Technology has been nicely presented in this book. The book is a product of a basic research study undertaken on behalf of APO, under the guidance of the Chief Expert, Prof. Tadao Saito. APO, has taken a lead in discussing a subject of topical interest. Unlike other studies on Information Technology (IT) the book focussed attention on the skills. The approach is based on expressed opinions regarding the beneficial and active role IT should play in the years to come.

The book presents itself in 4 parts; the first one dealing with the concepts of development of Information Technology with perspectives ranging from general to social and political aspects. The emerging field of Human Resource Development, the rural and urban problems, the management system needed and the telecommunication developments with specific reference to Information Technology are dealt with in Chapter II. Definite action plans have been worked out which are enumerated in the subsequent Chapter. Lastly, individual country reports which form the basis of the study are presented neatly in the last Part.

While enumerating the obstacles for IT development, the editor has taken special care to deal with aspects such as IT illiteracy, insufficient infrastructure and cultural inertia specific to countries in APO region.

"Obstacles Complex"—is the term used indicating the gravity of the situation arising out of interrelationship of such factors. The book goes to the extent of warning that National leaders must understand that they might unintentionally impede IT-led development even when they want to pursue it. The need for National leadership to pursue this goal is presented in-depth.

The differences and similarities among the APO countries are stated by dividing the countries into two in which India is grouped along with countries like Bangladesh, Indonesia, Nepal, Malaysia and Pakistan while Japan, Hong Kong, Republic of Korea, China and Singapore seem to be far superior. The interesting feature of this comparative study is the set of indicators considered such as GNP, energy per capita, electricity per capita, etc.

The most attractive part of the book is the one which deals with the specific issues highlighting the impact of Information Technology applications, especially for the APO region. These are supplemented with a case study. As the title suggests, the full presentation of the general principles of Information Technology applications are

available from numerous publications, the show is stolen by Part-I which categorically spelts out Information Technology-led Development viewed from general to social and political aspects.

The most important portion of this book pertains to the country report from India. Mr. Utpal K. Banerjee deserves commendation for his lucid handling of the scenerio emerging in our country. Though the proposals outlined may require further studies, the areas identified seem to have been covered quite well. The significant part of this particular report is the enumeration of major constraints on Information Technology-led Development in our country. The report consists of five areas viz., Public Administration, Natural Resources, Environmental, Social Justice and Economic Development. The presentation based on SWOT analysis, will benefit the policy makers to act immediately on the issues outlined.

The other country reports, while are exhaustive, seem to provide a lot of clues regarding the gap India would face if timely actions are not taken. Finally in all, the book presents the role of Human Resource Development and productivity as an important subject in the growth path of information society as envisaged for Information Technology-led Development of a developing economy. It is an excellent piece of document for policy planners.

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Wood Energy Systems : O P Vimal and M.S. Bhatt. New Delhi, *K.L. Publications, 1989, 251 p, Rs. 360.*

This is divided into 8 chapters and 6 appendices.

The first chapter deals with the general wood energy situation. The estimates of consumption and wood removal are based on official statistics. The definition of sapwood stated on page 4 is not correct. Chapter 2 deals with the Production Systems. This chapter has not been written well. Amongst the typical species for India mentioned on page 9 are Casuarina equisetifolia, Eucalyptus spp. and Leucaena leucocephala. The latter two are exotics. The notable advances mentioned in this chapter indicate compression of five year growth cycle to 18 months. This is an incorrect statement. Table 2 gives comparison of conventional and firewood forestry systems. The authors seem to be wholly confused about this system. The pattern of growth of trees whether grown for firewood or for any other purpose does not change the basic tree growth system. The reason for low yield indicated on page 11 is lack of intensive practices. This is not right. Reason of low yield is the removal of forest biomass which gets converted to meat rather than wood. On page 15 it has been mentioned that "Eucalyptus camaldulensis gave a mean annual increment of 10.^{3}m^3/ha against only 1.96m^3/ha for Eucalyptus hybrid". These are based on productivity of sites which are not comparable. Eucalyptus hybrid itelf has E. camaldulensis as one of the components. On page 16 the state must that "forestry programme will restore spring wells and raise water levels" is not true. The authors seem to be unaware of the resarch carried out in this field. The popular belief is supported by good experimental data. Table 5 in this chapter indicates some spacing for optimum firewood yields. This is a misleading term. All man made plantations need financial inputs. The yields depend on several edaphic climatic and genetic factors. On page 18 authors indicate the planting multi use species or mixtures increase productivity. This is an incorrect statement. The term Non Commercial Energy Plantation (NCEP) is a misleading. Table 12 gives a list of certain tree species with their wood and yields in some climatic conditions of India. Callandra calothyrsus has been shown to grow between the altitudes of 500-1500 m. The information has been taken from page 36 of Firewood Crops (NSA publication) and is true for Java and not for India. The authors indicate on page 29 that for short rotations intensely managed silvicultural systems, will drain nutrients and fertilization will be required. Inspite of this they advocate these short rotation plantations of firewood. Chapter 3 deals with Wood Energy Conversion Processes. This is a well written chapter and briefly gives some technical parameters for the different conversion systems. Different alternative systems practised in various parts of the globe have been covered and relevant technical information has been given. Chapter 4 deals with Wood Energy Utilization Systems which include several uses of wood energy. This is again a very well written chapter and will be useful to persons involved in this type of research. Chapter 5 deals with power and steam generation from wood. The chapter has been well written and gives lot of useful information about various types of engines both run on electricity and diesel and possibility of using firewood for this purpose. The chapter also deals with Dendro-thermal projects in Philippines. The information given here is very old. The authors may have been unaware that the whole programme has failed. All Dendro-thermal projects in Philippines are now closed. Any advocate of this programme will be mislead by the information given here. Chapter 6 deals with wood Energy Programme in India—A system Approach and largly based on the Government information and various programmes of developing wood

energy. It deals in detail with the DNES funded projects in the country. Not much technical information has been given. In Table 67, the yields mentioned are highly exaggerated and not even theoretically possible. For example, the yield of Casuarina equisetifolia is mentioned as 75-200t/ha per year. Such yields have not been obtained anywhere in the world and are not possible. This chapter also deal with the Chulha programme and the biogas programmes. The chapter has primarily been written as an annual report of the DNES funded projects. Chapter 7 deals with Wood Energy Development Programme in Asia. This is primarily based on the report of the the Regional Wood Energy Development Programme (RWEDP) of the FAO, Bangkok. It is based on very preliminary work as the programme itself is new. Chapter 8 deals with perspectives and strategies. Initial part of the programme advises high density and short rotation forestry. All the arguments given are not based on any experimental evidence and are contrary to the findings of the research carried out by the forestry departments.

Appendix 1 deals with definitions. There are standard definitions in Indian forestry but the authors seem to have invented their own definitions. Under the definition of 'Lopping' what authors have mentioned is pruning . Similarity, under harvesting the definition indicates the removal of the entire tree plus roots. This is contrary to the definition used in forestry. In Appendix 2 certain measures of yields are given. Definition for oven dry weight mentions this to be 6 per cent moisture. This is incorrect. The definition of m.a.i. given here is also incorrect. In Appendix 4, the authors have mentioned rotations cycles for 5 years for Eucalyptus and Casuarina. These are incorrect. In fact this practice has resulted in disenchantment of people for planting trees in several states of India. Appendix 5 deals with water and solar energy consumption. It takes the water requirement of Eucalyptus per ha. as 40, 250m^3 and that of Casuarina as 275,000m^3 . These are not correct figures.

Overall, this book is good in certain chapters, fair in certain aspects and bad so far as science of tree growing and harvesting is concerned.

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Drought-Prone India : *Kathakali Bagchi, New Delhi, Agricole Publishing Academy, New Delhi, 1990.*

Droughts are a recurring phenomenon in large parts in India. These not only affect the economic development of the country but also have a bearing on the socio-economic fabric of the people. While a large number of measures have been taken to both prevent recurrence of droughts as well as mitigate the conditions of the affected people during drought years, there is no way that the unfavourable impact of droughts can be completely eliminated. It is therefore essential that drought prone areas are clearly delineated and schemes drawn to ensure that the disruptions and destruction due to droughts are minimized. The book titled "Drought Prone India Problems and Perspectives" by Kathakali S. Bagchi is a modest effort in this direction.

The book provides the resource information about various drought prone districts in the country. The book in two volumes covers 92 districts spread over 13 states and provides description as well as relevant information on various resource items. These include general feature, physiography, climate land use, agriculture, vegetation, rivers/drains, soils and profile of various drought prone destricts. The district projects provide information about the location, administrative divisions, physical features, rivers/dams, area, population, livestocks, land use, agriculture, irrigation, climate, water resources and soils. The above information is supplemented by tables and maps. At the end of each chapter, a list of prominent non-governmental organisations and Voluntary Agencies is also given which can take up work in wasteland development and other similar projects.

The treatment of the material by the author has been very lucid and brief. At the end of Vol.II she has given a chapter on management of natural resources of drought prone areas through some examples. Afforestation and forage production on problem soils in Gujarat, management of alkali soils in Haryana, management of usar and ravine soils in Uttar Pradesh are some of examples taken by the author to illustrate the use of new technology to develop wastelands.

The book can serve as a valuable resource material for planners, development agencies and researchers who are looking for relevant data about the drought prone areas to analyse various features and draw up suitable development plans. A brief description of various programmes already completed or the progress achieved in order to reduce the severity of droughts or their impact on local population in each of the drought prone districts would have provided additional valuable information to the users. The author could have also included some of the socio-economic parameters of the local populace to help

the planners better in working out suitable schemes for them. The chapter on management of resources for drought prone areas needs to be further strengthened considering the vast information already available in the country.

Overal, the auther has made a commendable effort in compiling all information about drought prone areas in the country. The book may be used for reference by all those who are concerned with the development of drought prone areas in the country or seeking some information about them for other purposes.

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WISDOM

- THINKING is easy, acting is difficult, and to put one's thought into action is the most difficult thing in the world.

  Goethe

- LIFE would be dull and colourless but for the obstacles we have to overcome and fights that we have to win.

  Tagore

- SPEECH without the backing of experience based on action will lack clarity and refinement.

  Mahatma Gandhi

- DON'T tell me how hard you work. Tell me how much you get done.

  J. Ling

- NINETY-NINE per cent of the failures come from people who have the habit of making excuses.

  George Washington

- WHEN you are successful, don't think you'll be able to sit back and enjoy it. Npbody will let you.

  Mauro Mota

- STRENGTH does not come from physical capacity. It comes from the indomitable will.

  Jawaharlal Nehru

- BECOMING number one is easier than remaining number one.

  Bill Bradley

- EVERYONE is trying to accomplish something big, not realising that life is made up of little things.

  F.A. Clark

Productivity Abstracts

NPC Documentation

A study of bank jobs in relation to work motivation, job and work involvement, Akhilesh K.B. & Mathew Mary, *Indian Journal of Industrial Relation*, Vol. 26(3), Jan. 1991.

The paper attempts to understand employees perceptions about the job and the relationship of job characteristics to the desired work behaviour. The study has been carried out on 114 bank employees of a non-nationalized bank in Bangalore city. The questionnaire used for the study has been adapted from the Organisational Assessment Instruments (OAI), The study which has been carried out on officers as well as the clerks finds that among the former work motivation could be improved through increasing job authority and accountability. At the clerical level, reward and sanctions are significantly associated with job involvement. The author hopes that these findings may help the banks to redesign their policies. However, the results should be taken as exploratory and these need to be further validated by more studies.

Breaking through Rational Leadership; Kiser Glenn A, Humphries Terry and Bell Chip, *Training and Development Journal*, Vol 44(1). Jan. 1990, p. 42-45.

According to the authors leaders must learn to manage with their hearts as well as their heads, for their own good and their organisation. The article is a case study of a program that helped utility - company managers to do just that.

Corporate financial reporting practices in India-Concepts and current issues, Denarajan S., *The Chartered Accountant,* Vol. 39(12), June, 1991, p. 983-994.

Recent happenings in the corporate world have brought out the fact that the persons who are really in control of major public companies do not hold significant portion of the equity. Their natural and logical inclination is to retain power and control. This desire introduces human bias in financial reporting. In the forbidding environment of corporate compromises, disclosure practices will require great efforts to be made for improvement. Abridged financial statements which have come to stay have only added to the problem. The author fervently pleads for a thorough review of the entire matter so that erring managements may be pulled up by shareholders with the aid of effective audit.

Devising a sexual harassment policy, Rubenstein Michael, *Personnel Management,* Vol. 23(2), February 1991, p. 34-37.

Ten years ago sexual harassment at work and its effect was considered an issue of minor concern by employers. Since then it has gradually been recognised as a widespread and deep-rooted problem, with varying definitions. Now a new European Commission's code of conduct on the protection of the dignity of women and men at work is expected to be issued on 1 July, and will cover a very broad range of behaviour. The author has been assisting the commission in drawing up the code. In this paper the author sets out the key components of a sexual harrasment policy and explains why taking steps to prevent sexual harassment is increasingly a priority for personnel managers.

Dreamer and achiever, Anne Giam, *Mirror*, Vol. 27(11), June 1, 1991, p. 8-9.

The world is full of people with great ideas. Really it is. It is not full of people who got rich from them. Because the most brilliant idea—no matter how unique, how useful—is not enough. Those who succeed know how to implement their idea, how to promote it, market it, and make it believable. Ideas are important, but only if they are converted into goods and services that help people by satisfying their unfilled needs. There isn't scarcity of good ideas, but what is scarce is people who have the energy, know-how, daring and persistence to convert ideas into goods and services. In other words, ideas don't develop businesses; entrepreneurs do.

Earnings and percentage female : A longitudinal study, Gerhart Barry and Cheikh EL Nabil, *Industrial Relations—A Journal of Economy & Society,* Vol. 30(1), Winter 1991, p. 62-78.

Comparable worth advocates assume that the relation between earnings and percentage female in an occupation is due to crowding or other forms of discrimination. An alternative explanation is that the relation stems from women freely choosing different occupations. Using longitudinal data to control for time-invariant omitted variables, as well as cross-sectional data (for comparison with previous research) the authors found that although men's estimated penalty is not reduced, the percentage female penalty falls substantially for women and is not statistically significant. These results imply that estimates of the percentage female effect based on cross-sectional data may be inflated for women—except for those with intermittent labour force participation. This group does not experience a sizeable penalty for working in female-dominated occupations. Hence, the authors feel a comparable worth policy would most likely benefit with discontinuous employment.

Enforcing OSHA : The role of labour unions, Weil David, *Industrial Relations - A Journal of Economy and Society*, Vol. 30(1), Winter 1991, p. 20-36.

This study examines the role of unions in implementing the Occupational Safety and Health Act (OSHA) by using a data set that provides information on regulatory enforcement. The analysis demonstrates that unionized establishments are more likely to receive safety and health inspections, face greater scrutiny in the course of these inspections, and pay higher penalties for violating health and safety standards than comparable nonunion establishments. Implementation of OSHA therefore seems highly dependent upon the presence of a union at the workplace.

Environment, corporate ideology, and employee involvement programme, Goll Irene, *Industrial Relations—A Journal of Economy and Society*, Vol. 30(1), Winter 1991, p. 138-149.

Corporations are implementing employee involvement programmes in both union and nonunion settings in response to growing environmental pressures. This study examines the relationships among environmental pressures, corporate ideology, and participative practices in union and nonunion settings and tests two industrial relations model. Multiple regression undertaken by the author showed that environmental pressures exert little effect on corporate ideology, but ideology has a significant effect on participative practices in both union and nonunion settings.

Garbage Management : A case study, Ali Sabir, *Yojana*, Vol. 35(6), April 15, 1991, p.20-22.

The author feels that garbage management involves imaginative and workable arrangement of disposal facilities and suitable use of available men and materials. In addition, community hygiene consciousness should be inculcated through the co-operation of concerned people and training programmes for all.

Getting the job done over there—Improving expatriate productivity, Dunbar Roger and Bird Allan, *National Productivity Review*, Vol. 10(2), Spring 1991, p. 145-156.

Despite increased participation in international markets, poor performance and failure rates of U.S. expatriate managers remain high. Major factors contributing to failure include a manager's inability to adjust to the job, inability to adjust to the new culture, or a manager's spouse and family's inability to adjust to the new assignment. In this article the authors have tried to evolve strategies to improve expatriate productivity which include organisational support in the form of improved job training, cultural and language training, predeparture and post arrival mentoring, and health and stress-reduction training. This support should also be extended to the spouse and other family members.

How to revitalize planning, Weiner Edith, *World Executive's Digest*, Vol 12(5), May 1991, p. 41-42.

According to the author the key is not learning but forgetting : You must risk unlearning much of what you think you know. He has described in length six principles to help one forget in his articles.

Improving productivity in service operations on an international basis, Blumberg F. Donald, *National Productivity Review*, Vol 10(2), Spring 1991, p. 167-179.

Although there has been increasing attention given to improving service productivity and quality, the focus has been spotty and fragmented, with the greatest emphasis in Europe. Productivity improvement is much more difficult to assess and promote in service industries than it is in manufacturing because of the lack of standards, targets, and measurable parameters, and the need to deal with service as viewed from the customer's perspective. New developments in service quality standards are helping to provide a standard base for improving service productivity according to the author.

Job Analysis : The Composition of SME Sample, Landy J Frank, Vasey Joseph, *Personnel Psychology*, Vol. 44(I), p. 27-49

It is common for job analysts to solicit information from incumbents and supervisors (Subject Matter Experts or SMEs) when conducting a job analysis. These SMEs are

asked to provide ratings on salient dimensions (e.g. frequency and importance of tasks that comprise the job). The present paper considers the possible influence of SME demographic characteristics on task rating of frequency. The tasks comprising the job of patrol officer in a large city were rated for frequency by approximately 700 incumbents. These ratings were gathered in two different years, 1982 and 1984. The total data set was used to conduct a components analysis of the 444 item task inventory. The first eight principal components were considered the dependent variables and four demographic characteristics the independent variables in an analysis of the 1982 data set. Analysis of variance and follow-up tests indicated that incumbent experience had a substantial influence on task ratings. Educational level and race had minimal effects on ratings. The sex factor was confounded by the experience factor, making interpretation of the sex effect equivocal. Mechanisms that might account for the experience effect are discussed. It was concluded that incumbent experience is a salient issue in job analysis using SME group.

Leadership, Total Quality and Cultural Change, Atkinson Philip, *Management Services*, Vol 35(6), June 1991, p. 16-19.

In this article the author reports that 80 per cent of total quality initiatives in the UK will fail because they do not have the backing of the senior management team. The senior team in many cases do not realise that they have to change the way they manage, including their style. Many think that public exhortation of the TQM philosophy is their only responsibility. When TQM dies because of their failure to lead by example, they move onto the next 'managerial gimmick' hoping that it will give them the success they crave but have failed to work for.

Managing high reliability organisation, Roberts Karlene, *California Management Review*, Vol. 32(4), Summer 1990, p. 101-113.

On a worldwise basis, a growing number of organisations operate in ways that can result in catastrophic consequences. Within this set of potentially hazardous organisations, there are a number that have operated nearly error free for long periods of time.

This article examines what characterizes their operations and how managers can know whether organizations are hazardous or potentially hazardous. The article also explores the steps that can be taken to ameliorate the potentially negative effects of design strategies that might result in catastrophic outcomes.

Participation, producitivity, and the firm's enviornment, Levine I. David, *California Management Review.* Vol. 32(4), Summer 1990, p. 86-100.

While increasing worker participation in decision making can often increase productivity, it remains relatively rare in the United States. This article discusses how the product, labour, and capital market conditions that firms face can work against participatory firms and why the free market may provide too little encouragement for worker participation.

Productivity of the expanding service employment, Ramana D.V. & Kumari Krishna D.B., *The Indian Journal of Labour Economics*, Vol. 33(2), April-June, 1990, p. 133-144.

Shift of workforce from agricultural to secondary and tertiary activities involving a change in the employment structure is a concomitent of economic growth. But, during last four decades this process has assumed a new dimension whereby the majority of the workfoce are employed not in the secondary, but in the tertiary sector. This tertiary revolution had started in the United States economy during the mid-fifties, after the introduction of computers and the accompanying information revolution. The paper discusses the extent, nature and some of the important economic implications of the phenomenon in the United States.

Regional variations in rural non-agricultural employment—an exploratory analysis, Unni Jeemol, *Economic and Political Weekly*, Vol. 26(3), January 19,1991, p. 109-122.

According to the author the determinants of rural non-agricultural employment need to be studied within the broader framework of the structure and functioning of labour markets. This is because the non-agricultural activities in rural areas play a crucial role in providing simple consumer goods and services to the rural households. Secondly employment and growth in agriculture are dependent on and also determine employment and growth in the non-agriculture sector. This paper explores the factors which affect the inter-regional variations in the percentage of non-agricultural workers in rural areas and analyses the reasons for the inter-regional variations in non-agricultural employment.

Staying competitive in the 1990s, Eade Rober, *Cutting Tool Engineering*, Vol. 42(5), Aug. 1990, p. 18.

The force that reshaped manufacturing in the 1980s, such as the demands, for higher quality, lower costs, and

faster throughput, will become markedly stronger in the 1990s. Simply put, the 1990s will be different. Recent conversations with principal players-tool suppliers, machine-tool builders, manufacturers, technical educators-provide a preview of what's to come.

Strategy and the new American organisation, Tregoe B. Benjamin, Tobia M. Peter, *Industry Week*, Vol. 239(15), August 6, 1990, p. 28.

American organisations are in transition. The old command-and-control model that once was the organizing principle of the military and industrial orders has gone the way of the three-martini power lunch. The new paradigm emphasizes the decentralization, flexibility, and influence more than power, and participation more than one-man or elite rule. "Decentralization" and "Participation" sound good, but the key according to the authors is in developing a strategic vision for the direction you're heading-and then making it work.

Telework : A new way of working and living, Martino Di Vittorio and Wirth Linda, *International Labour Review*, Vol. 129(5), 1990/5, p. 529-554.

The rapidly developing, wideranging phenomenon of telework has redrawn the traditional boundaries of work. Telework is part or full-time, on-or off-line electronic work performed at home by employees or the self-employed or (increasingly) in central offices, customer sites and satellite centres in various combinations. Advantages stressed by the authors include enterprise flexibility, cost savings, productivity increases, easier recruitment and retention of staff and reduced commuting time. They examine the nature, extent and impact of telework on working conditions and work organisation and explore the complex legal status of teleworkers, changing attitudes of employers and trade unions, and various government initiatives. They call for urgent consideration of the implications of the spread of telework above all to avoid the dangers of reduced social protection.

The Big Five Personality Dimensions and Job Performance : A Meta-Analysis, Barrick R. Murray, Mount Michael, *Personnel Psychology*, Vol. 44, (1), Spring 1991, p. 1-26.

This study investigates the relation of the "Big Five" personality dimensions (Extraversion, Emotional, Stability, Agreeableness, Conscientiousness, and Openness to Experience) to three job performance criteria (job proficiency, training proficiency and personnel data) for five occupational groups (Professionals, police, managers, sales and skilled/semi-skilled). Results indicated that one dimension of personality, conscientiousness, showed consistent relations with all job performance criteria for all occupational groups. For the remaining personality dimensions, the estimated true score correlations varied by occupational group and criterion type. Extraversion was a valid predictor for two occupations involving social interaction, managers and sales (across criterion types). Also both openness to experience and extraversion were valid predictors of the training proficiency criterion (across occupations). The authors found that other personality dimensions were valid predictors for some occupations and some creterion types, but the magnitude of the estimated true score correlations was small. Overall, the results illustrate the benefits of using the five factor model of personality to accumulate the communicate empirical findings. The findings have numerous implications for research and practice in personnel psychology especially in the subfields of personnel selection, training and development and performance appraisal.

The performance measurement Manifesto, Eccles G. Robert, Havard, *Business Review*, Vol. 69(1), Jan.-Feb. 1991, p. 131-137.

The leading indicators of business performance cannot be found in financial data alone, argues the author. In this article he calls for a revolution in what companies track, including quality, customer satisfaction, innovation and market share. To make the shift to these metrics, companies must develop an information architecture, put in place the technology to support the architecture, align incentives to the new system, draw on outside resources and design a process to implement the new programme.

The phases of the Chief Executive's Career, Piercy E. James and Forbes J. Benjamin, *Business Horizons*, Vol. 34(3), May-June 1991, p. 20-22.

This article tries to trace the Chief Executives (ECOs) career path to the top. Careful analysis of 230 CEOs career paths has been done by the authors to find the pattern of career development. The author's have classified the path in VI Phases - Exploration, Development, Commitment, Verification, Payback and Payoff.

The Real Cost of Energy, Hubbard M. Harold, *Vigyan Scientific American*, Vol. 2(7), May 1991, p. 22-29.

According to the author, gas prices only seem high when you say "fillup", you pay but a fraction of the actual cost. Not included are the tons of billions (close to $50 for each barrel of oil). The military spends annually to protect oil fields in the Persian Gulf. To this is tacked on the hidden costs of environmental degradation, health effects, lost

employment, government subsidies and more. Sooner or later, the public pays the entire price. The author feels that bringing the market prices in line with energy's hidden burdens will be one of the great challenges of the coming decades.

Total Quality Managment in the Public Sector, Milakovich E. Michael, *National Productivity Review*, Vol 10(2). Spring 1991, p. 195-213.

The failure of government productivity efforts to improve the quality of public service has prompted calls for the complete overhaul of management procedures. Increasingly, elected and appointed officials recognize that productivity enhancement efforts alone do not lead to improved service quality. Past government efforts have proven to be ineffective in motivating employees to continually improve quality. Total Quality Management (TQM) is a theory-based option that allows public managers to reward truly exceptional individual performance, yet increase the capacity for agency-wide cooperation and process improvement. According to the author, the current interest in applying TQM techniques to public services provides a promising model for launching a Total Quality Management (TQM) improvement strategy for the American public sector at all levels. This article examines the origins of TQM, describes how the philosophies of leading quality theorists apply to the public sector, suggest ways to overcome barriers to implementation, and presents a brief overview of current federal government total quality improvement efforts.

Transferring core manufacturing technologies in high-technology firms, Galbraith S. Craig, *Calfiornia Management Review*, Vol. 32(4), Summer 1990, p. 56-70

This article examines the successes and failures of thirty-two different high-technology intrafirm core manufacturing technology transfers where a technology was either replicated at or completely relocated to another facility. In addition, the study investigates the impact various factors have upon the economics of such transfers. These factors include : distance between facilities, complexity of the technology, communication and transferred technology, and other resource costs.

Trends and issues of industrial relations : a case study of Bihar, Atmanand, *The Indian Journal of Labour Economics*, Vol. 33(2), April-June, 1990, p. 161-172.

The paper analyses the trends and issues of industrial relations in the State of Bihar. With the comparative analysis being made against India as a whole, the paper explores some of the factors operating as barriers in the industrial peace of the country. The industrial relations scenario continues to be marred by mutual distrust, hostility and unabated loss of millions of mandays due to strikes, lockouts and other forms of industrial actions. Instead of creating a new machinery for the settlements of industrial dispute, if proper resort is made to arbitration, conciliation or tripartism with the addition of the Labour Appellate Tribunal in the present structure of adjudication, industrial relations are bound to be more harmonious and peaceful.

What Price Friendly Computers ? Lillywhite Colin, *Management Services*, Vol 35(6) June 1991. p. 12-14.

In this article the author looks at the recent changes in personal computer technology and tries to specify exactly what is a 386, how can it help us work more efficiently and how can we benefit from it without scrapping existing computers.

Work organisation and local markets in an era of flexible production, Storper Michael and Scott J. Allen, *International Labour Review*, Vol. 129(5), 1990/5. p. 573-591.

The authors describe the crisis of Fordist mass production and the rise of flexible production since the 1960s. They propose a simple taxonomy of employment practices in flexible production systems, paying particular attention to internal (intra-firm) and external labour market flexibility, and show how these practices affect worker's security. Paying particular attention to local labour markets in flexibility, and examine three main kinds of flexible agglomeration craft-based complexes, high technology complexes, and business and financial complexes. The analysis ends with a discussion of some important policy problems associated with the increasing flexibilisation of employment.

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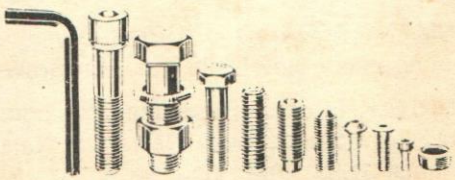

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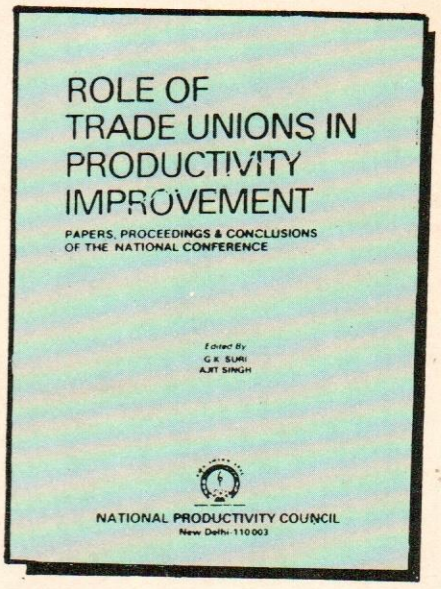

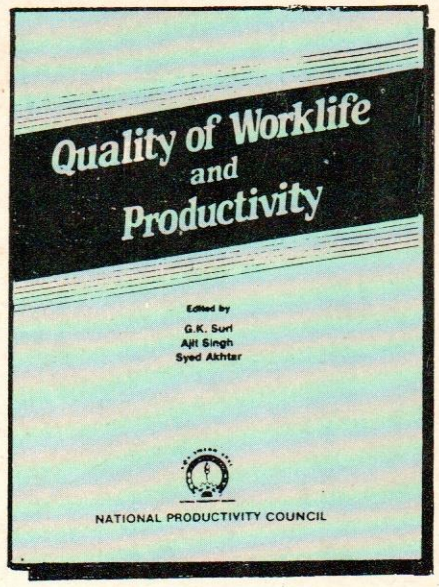

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