I

SCIENCE AND TECHNOLOGY POLICY AND THE STRATEGY FOR ITS DEVELOPMENT

1.1 India has a heritage of highly skilled artisans, a rich culture and a people with a scientific temper. The artisans formed the base of indu trial activity during the pre-colonial and the early colonial periods in India. They were the most important segments of the society which took care of all material requirements of the society from items of daily utility to those required in war. Social, economic and political events that overtook history have made their impacts on different segments of society, and the state of science and technology as much as on art, culture and patterns of living. This stream of developments has displaced the skill-base in the country warranting a whole new order.

1.2 The colonial rule in India had set different range of priorities for development which was dictated by political, economic and commercial objectives of the British Government. The need for finding markets for the products of the indu trial Revolution in Britain had to cut down competition from indigenous sources of supply. There was no scope for any positive development of Science & Technology inputs for improving the traditional system. Even the education system was to create such manpower as the Briti h would require in India and not any technical manpower the local industry would require.

13. Despite these factors various scientific organisations got established from the middle of the 19th Century and a scientific consciousness was created in the country. The scientific and technological infrastructure created in that period has opened opportunities in promoting a self-generating scientific and technlogical tradition. The two world wars gave a new inpetus for the creation of organisations for research and establishment of industries.

The Shaping of the Science Policy

1.4 The independence movement in India had, among other things, laid great empha is on indige nising industry and creating educational facilities in science and technology. This spirit is incorporated in the Constitution of India under the Directive Principles of State Policy. India is amongst the few countries that have started on a firm foundation of science and technology on achieving political autonomy. In 1958, the Science Policy was evolved and the scientific policy resolution passed by the Parliament of India.

Different Phases of S&T Development in India

1.5 The first phase of S&T development, spanning a period of nearly a quarter century, i.e., 1947 to 1960 can be termed as the infrastructure and capability building phase; the second phase stretching over a decade (1970 to 1980) a the assessment and re-orientation phase; the third phase, i.e., after 1980 as the performance and accountability phase.

1.6 The first phase concentrated on the creation of manpower and infrastructure. However, S&T capabilities with requirements of agriculture, industry and other economic sectors have remained weak during the fir t phase.

1.7 During the second phase, the dwindling sterling balances and low investments in certain critical sectors compelled the Government to take a new look at the science policy and plans. A National Committee on Science and Technology was set up in 1973 and given the task of preparing a plan for science and technology on the basis of priorities of economic development. A separate Department of Science & Technology was created to follow up these plans and programmes. Fiscal incentives were also provided to promote in-hou e R&D in industry. This brought science and technology plans as integral parts of the five-year plans. A large number of R&D units got established to bargain for reduced payments for technology through Indian engineering consultancy organisation. With the reorientation of the policy and plans the R&D programmes could cover the entire innovation chain, i.e., from invention to innovation to diffusion or delivery of specific products and services. The Technology Policy Statement was announced by the Govt of India in 1983 with the objectives of development of indigenous technology and efficient absorption and adaptation of imported technology appropriate to national priorities and resource . The announcement of the Technology Policy ushered the third phase which looked for accountability and performance. Its major aims also include provision of maximum gainful employment to all strata of society, especially women & weaker sections, u e of traditional skills with focus on measures to make them commercially competitive & preservation of ecological balance. In addition, six technology Missions were launched between 1985-88 for meeting the immediate needs of drinking water, literacy, edible oils, immunization, rural communication and dairy products. Other steps envisaged for linking R&D with economic activities have been the setting up of technology development fund and risk investment mechanisms within the financial institutions and the Science & Technology Advisory Committies in Economic Ministries.

The Imapect of the Science & Technology Strategy

1.8 It is, however, clearly understood that the Science & Technology Policy alone does not influence the scientific and technological developments. The sectoral policies like the Industrial Policy Resolution, The Health Policy, Electronics Policy, Computer

Policy, Education Policy etc., play a very important role in determining structures concerned with developments in technology. Consequently a full fledged Ministry of Science & Technology was created in 1985 encompassing various departments. In addition, the Science & Technology Advisory Committees (STAC) in various Ministries are coordinated by an inter-sectoral Science & Technology Advisory Committee serviced by the Department of Science & Technology.

The Impact of the Science & Technology Strategy

1.9 Commensurate with the economic models of development accepted in the Five Year Plans, the concentration of Science & Technology inputs have been in Defence, and the Core Sector of Industries apart from Agriculture. The Services Sector and Health were also given some attention. The manpower development concentrated on building the technical manpower in the country in higher institutions of learning. It was only in 1980s with the advent of the Sixth Five Year Plan that the failure of the trickle down theory was accepted and a direct attack on poverty made through poverty alleviation programmes which looked at the poor man and his economic problems in the rural areas. The avalanche of schemes and programmes with science and technology inputs operated by a large number of Government agencies have been pursued. However, it is very clear that the majority of them are not very relevant to the rural labour. The major thrusts are available only in the programmes under Agriculture. Even here it has not made an impact on removing their poverty. Though science and technology in Agriculture has contributed to attaining self-sufficiency in food production, the benefits have not percolated to all the farms. The increase in food production has been from the regions well endowed with infrastructure facilities. The rate of growth of employment in Agriculture has been far below the rate of growth of Agriculture. Higher production, therefore automatically did not bring higher employment. The new technology in Agriculture also displaced the artisans supporting Agriculture and lost markets for some of their production. The pure science approach followed in the laboratories did not benefit the artisans and other self-employed persons who got outposted from agriculture in the developed areas. It also created a flow of labour from the less developed agricultural areas into the better developed areas for unskilled work.

1.10 The conclusions of the joint seminar of Scientists, Technologists and Social Scientists held in New Delhi in November, 1988 clearly underlines this vast gap between the developments of science and technology in the country and the neglect of the rural people who have not been found relevant to that development.

Need for a Micro Approach in Harnessing Science and Technology for the benefit of the Rural Labour

1.11 Village level studies have borne out irrelevance of the developments to the traditional artisans. The potter, the cobbler, the black smith have no jobs to sustain them in the villages in their traditional roles and modes of production The traditional artisan has become costlier & non-competitive in his present state of art.

The Infrastructure for S&T Development

1.12 A very huge institutional infrastructure for research has been created. The major complex is Council of Scientific and Industrial Research with forty two research institutions. The Indian Council of Agricurtural Research and the Indian Council of Medical Research are other major research organisations. About 496 research institutions have been identified under the Central Government Departments and about 178 institutions under State Governments. About 1085 institutions carrying out R&D activities comprising associations of industries, research foundations set up by industrial houses or philanthropic organisations, voluntary groups and professional societies have also been identified. Apart from these, there are 155 universities engaged in research. It has been assessed that the total stock of science and technology manpower generated by the education system increased to 2.6 million in 1985 from a mere 0.2 million in 1950.

1.13 There are 27 Ministries/Departments currently providing science and technology inputs for rural development.

1.14 The expenditure on research and development is estimated at around 1 per cent of the GNP with Government funding 85 to 90 per cent.

1.15 In spite of all this the quality of life in rural areas has not improved. Majority of village do not have basic facilities. Consequently, there is a tendency to move to the urban areas which are congested.

1.16 The Concurrent Evaluation Studies of the implementation of IRDP, which aims at a direct attack on rural poverty have shown that marketing is the major constraint, even when credit has become available. Much needs to be done on the tie up with skill and other backward and forward linkages. The skill support programme viz. Training of Rural Youth for Self Employment (TRYSEM) has not given the support it should. Amongst those that have gone into self-employment after training under the TRYSEM, only 15 per cent have training under the ed on the training imparted.

1.17 Organisations like NISTAD and over 36 voluntary agencies that have worked in rural areas have established the need for intensive linkage building and catalytic action in coordination. The experience of BAIF, Gandhigrsam Trust and a host of others who have taken up grass-root level organisation has proved that each rural pocket is a micro socio-economic environment that requires specific treatment. A number of successful interventions and practical methodologies of technology transfer are pursued.

1.18 The Science Advisory Council to the Prime Minister who were involved in preparing an "Approach to a Perspective Plan for 2001 AD . Role of Science and Technology", have come to the conclusion that the science and technology agencies have not been able to fully participate in the economic development of the country through a well planned mechanism of integration of Science and Technology with development planning. Many of the specialised agencies have functioned in isolation and sometimes even at the cost of one another. According to them there is an urgent need for integration of science and technology plan with development plans to achive the social and economic goals set before the country. Their main recommendations are :

(1) Plans for S&T must be geared directly towards meeting the basic needs of the population. (Food, Housing, Health, Employment & Education) and modernisation of infrastructure in such major service sectors as energy transport and communications: besides, support for relevant research and development in adequate measures.

(2) Careful planning of material technology is essential for national development, ranging from housing for the poor to chips for new computers.

(3) Development in information technology to be harnessed for the national efforts in all areas ranging from health to technology assessment and forecasting

(4) To ensure that industrial growth goes hand in hand with greater technological capability.

(5) There should be no conflict between working towards the primary social goal of the nation and promoting an efficient internationally competeitive industry with a certain export orientation.

1.19 They have suggested the establishment of a National Science & Technology Commission, to help in integrating S&T into planning, to identify appropriate technology missions, and to coordiante and whenever necessary to manage collaboration between the different agencies of the Government concerned with technological development, economic planning and financial resources, as well as with private and public sector industry. They have also recognised that a concerned effort is necessary to identify specific S&T inputs required for achieving the targets set in the economic sectors.

1.20 As pointed out by the National Committee on Science & Technology in 1973, overall funding of scientific research should be decided by considerations of the economic or social importance of the fields rather than by considerations of absorbtive capacity of the agencies and institutions. To ensure this it would be very necessary to bring harmony in the development of various S&T sectors relevant to the national needs and assess the inter se priorities between them, to optimise financial resources and time utilisation. Priority areas would have to be identified and time-targeted goals defined, to make the right interventions.

II

TECHNOLOGY INTERVENTIONS & WORKING AND LIVING CONDITIONS OF RURAL LABOUR

2.1 The main findings of the study show that rural labour has certain definite characteristics, and that technology to suit these, are few, and the existing ones are inefficiently disseminated. Largely, the process of technology development itself, has not been adapted to cater to the needs of the rural worker. Sections of these workers who need priority focus are women and child workers and hill and forest labourers. The results after the analysis show that institutional and procedural changes would be required to change the present situation. Besides, the direction of R&D would have to focus more on rural labour needs and on certain specific activities and occupations.

2.2 Rural labour, both of agriculture and non-agriculture dependence, have been identified as a group largely in need of the support functions which can improve their efficiency and productivity at work, and their quality of life. Technological interventions have to be designed keeping in mind the large numbers of rural labour and that different regions have specific labour problems with varying growth patterns. The dimension of the problems being wide, priorities need to be established for systematically addressing it. Technology intervention can do following things, raise productivity to generate a surplus, diversify work possibility for alternate employment, review & improvise on traditional activity & practices. Technology use and adoption is severely hampered by low affordability among t rural workers. Design and dissemination of technologies must be done, keeping this into consideration Contributed by M|s. Development Alternatives, New Delhi. Innovative and improved credit mechanisms are required to extend the reach of the labourers.

Technology for Special Categories amongst Rural Labour

2.3 There are certain special category of rural labour which require specific treatment. The largest percentage of women workers in rural areas are engaged as agricultural labourers, traditionally doing activities like transplanting, winnowing, cleaning and grading which are unskilled, low paying and ardous. Amongst the crafts, a large number of women are found in textile related work and in other handicrafts. The division of labour, especially in agriculture has displaced women towards unskilled work. Small and marginal cultivators amongst women find themselves ill-equipped with very little information. The role of technology in the lives of women workers in rural areas must be specific to the major activities they are engaged in and help improve their quality of life. Information technology has a special role to play amongst women workers. Technology intervention must provide enough income to the household so that child get an opportunity to educate themselves and eradicate child labour by devising innovative methods to replace children specific activity, e.g. bangle making. Hill and forest regions have certain special charactristics. By carefully examining the requirements of these people, innovative technology and better water resource management practices can be adopted. Additional opportunities through forest related industries and through plantation work to reforest land may be created.

Imperative of Technology for Rural Labour

2.4 Due to seasonality of work amongst rural labour simultaneous work in two distinct directions, both of which are not possible to achieve without suitable technology intervention, is required. They are increasing prouctivity and returns from present activity and diversification into other income generating activity. Technology to suit rural labour should be economically viable, affordable, adaptable, relatively simple level of technology, have low level of external dependence and should be in consonance with socio-cultural factors.

Technology for Agriculture

2.5 The information on traditional and contemporary technology used in agriculture is given at annexure I & II With the use of advanced equipment agricultural workers are displaced. The category of labour which is affected most are women and child workers who are first to be displaced. To increase the efficiency of traditional equipment some improvements are necessary, R&D in this area are either at a semi-proven or lab stage of development. Contemporary tools and equipment developed are economically viable only at a scale of 7 to 15 acres of land holding and intensive cropping patterns of 2-3 crops—making them less applicable for rural workers and for small and marginal farmers.

Technology for Resource Management

2.6 Another important area to be considered for small and marginal farmers, is one relating to resource management. Soil and water are of special relevance here. Traditional practices and contemporary technology are reviewed in Annexure-III. Contemporary developments in the area of soil management relevant for small and marginal farmers are either semi-proven or field tested but small farmers are not aware of them.

Technology for Artisans and Crafts-Persons

2.7 In the case of rural artisanal activity, both skill and methods adopted for work have primarily been

traditional. Information is passed from one generation to another by word of mouth and the scale of work found in a limited geographical area is not sufficiently large to adopt capital intensive, mechanised techniques. As may be seen from the annexure IV the technology development in the area of artisanal work and craftsmanship has been few and far between except in weaing, tanning and pottery.

Technology for Infrastructure and Service

2.8 As shown in annexure-V these areas in rural India have been flooded with indigenous techniques and local material use. Advanced and newer technologies have not reached the target group due to reasons of affordability, lack of access to information, socio-cultural practices.

Recommendations

2.9 Following recommendaions are made in specific areas for technology interventions to improve productivity of rural labour and their quality of life :

Agricultural Activity

2.10 The major areas where interventions must be made are :

- „ The adoption of mechanised agriculture, must be accompanied by programmes for diversifying employment opportunities, to absorb the displaced labour.
- „ Adequate agricultural equipment and technology should be made available for a land holding size of 2-5 acres so that it is affordable for small and marginal farmers and rural labourers.
- „ Technologies to reduce drudgery, specifically in the areas of inter-culture and plant protection, cleaning and grading are required. These should be designed to meet the needs of women workers.
- „ Less attention is given to storage, packaging and transparing of grain. Equipments and affordable machines need to be developed to remove the inadequacies and minimise losses of foodgrain, occuring due to lack of proper facilities in these areas.

Resource Management

2.11 The major steps required for this are—

- „ Information on newer pracices developed, needs to be disseminated more efficiently. Training facilities need to be both widespread, and area specific.
- „ The provision of seeds, manuring material, and information on cropping alternatives must be stepped up for small and marginal farmers.
- „ R&D needs to be done in the areas of erosion control, land reclamation and water lifting techniques to suit the requirements of small and marginal.

Artisanal Activity

2.12. Technology upgradation and development in this area has to keep the following aspects in mind:—

- ” Increase of productivity and efficiency is necessary for assuring higher returns.
- ” Product diversification is necessary in this area to assure marketability and procurement of better prices.
- ” Support facility while disseminating upgraded technologies and tools eg. financing, marketing and training are to be incorporated in the technology package. This can be area specific.
- ” For traditional skill and craft to be preserved, supported and upgraded it is necessary that technology specifically caters to the exact needs of artisans. Detailed need identification studies would be needed for this.

In the present context, there are few programmes and projects that are engaged in specifically catering to the needs of artisans, crafts persons. A case study of potters and fire-clay technology has been presented. (Ref. Case Study 3), as one such R&D project undertaken, which establishes links with needs of the potters, provides innovative technology and directs product diversification to cater to a basic need.

Work in these areas should be initiated by starting work on documentation research on technology upgradation and product diversification should be given importance.

Infrastructure and Service

2.13 Technology intervention in each of these areas needs to be looked into separately.

Drinking Water

- ” Step up the distribution of information and accessibility to proper drinking water facilities.
- ” Programmes implementation for sinking wells and pumps must be carried out effectively.
- ” Simple and inexpensive methods of recharging ground water levels are important, for which innovative technology needs to be developed. These methods must be explained to the people in rural areas.

Health and Sanitation

- ” Manufacture and distribution of medicines for rural areas needs, must be increased.

" Social belief and community attributes play a major role in the acceptance of a technology eg. in sanitation. Awareness programmes and information transfer are necessary to be undertaken. Communication technology has a role to play here.

" Traditional health find greater acceptance amongst these people. These skills and knowledge should be upgraded and promoted.

Shelter

" Use of low cost and energy efficient materials and designs should be promoted for both formal and non formal housing practices Regional variations and resource availability are important aspects to be kept in mind while building.

Fuel and Fodder

" Due to shortage of firewood and restrictions on timber use, alternate fuel sources must be provided. Their use must be promoted through local production.

" Provision of facilities for fodder and grazing is necessary for livestocks to prevent indiscriminate grazing and cutting of grass, which denudes the land. Rotational grazing and community based management practices of grasslands is important.

Communication

" This field is extensively covered by highly sophisticated means, their application for rural areas is increasing. However, access to this is difficult and expensive. R&D to reduce costs must be done.

" Infrastructure and service development should be incorporated in employment generation programmes.

Education

" The thrust has been towards literacy in rural areas, with the educational programmes constituting of opening of more schools— without their proper management. This should be altered to include socio-economically relevant subject areas.

ANNEXURE I

TRADITIONAL AGRICULTURAL TECHNOLOGY

S.No.	Activity	Approx. % Labour Utilisation	Traditional Eqpts. with Improvements/Modifications	S.No.	Activity	Approx. % Labour Utilisation	Traditional Eqpts. Improvements/ Modifications
1.	Tillage	90	Ploughs wooden and iron Harrows & 'Bakher' or 'Guntuka' wooden land-levellers.	5.	Winnowing, Cleaning and Grading	80	Hand winnowing manual operation Sieves
2.	Seeding Machinery and Planters	60	Wooden 'tifan' Seed drills Manual Transplantation	6.	Crop Processing	80	Chaff-cutters Disinfection Neem leaves
				7.	Storage	95	Farth compaction structures or 'Kuthia
3.	Inter Culture and Plant Protection	90	Khurpi 'Spade Hoe— 'Mummuty' Hand driven Weeder	8	Packaging	100	Gunny bags.
4.	Harvesting and Threshing	90	Sickle, Stone Thresher Annreals for Pounding	9.	Transporting of Grain	60—75	Carts Bullocks Horse driven

NOTE : 1. Cost of equipment varies highly due to local production
2. The status of this technology is 'proven', being traditionally used.
3. Activities performed by women & children.

ANNEXURE II

CONTEMPORARY AGRICULTURAL TECHNOLOGY

S.No.	Activity	Approx. % Lab Utilisation per Activity	Contemporary Methods & Technology used/Developed	Status of Technology	Initial Capital Cost in Rupees Operational Hand-Driven	Range of costs Exclude Power-Driver
1.	Tillage	90% Animal	Chisel plough, Land leveller, Trencher, Ridger, Blade Reuddur, Rotavator	Semi-proven	200—400	800 —18000
2.	Seeding Machinery and Planters	60%	Seed drills, Applicators, Paddy transplanter, Potato/ Sugarcane planters.	Semi-proven	250—400	900—16000
3.	Inter-Culture and Plant Protection	65%	Weeder, Digging Of, Rotary dusters and sprayers	Prototype prefield Tested/proven	8—150	250—10000
4.	Harvesting and Threshing	60%	Olpad Thresher, Agro-stickles, Potato digger, Paddy thresher, Combine harvester	Proven	60—200	3000—20000
5.	Winnowing, Cleaning and Grading	75%	Sack holder, Seed cleaner cum Grader, Paddy winnower	Lab stage/Semi-proven	350 —2500	5000—20000
6.	Crop Processing	80%	Dehuskers, Decorators, Shellers, Handchaff cutters	Semi-proven	8—250	2500—10000
7.	Storage	95%	Bamboo structures/Rins/Silos/ Passive ventilateo structures	Semi-proven	15—150	175—5000
8.	Packaging	100%	—		Variable Rs. 2000 To Rs. 5000/- (Approx.)	
9	Transporting of Grain	60%—75%	—		Rs.15000/- To Rs. 2000/- (Bullock Cart) (Approx.)	

NOTE : 1 Intensity of its utilisation per activity is taking into account all scales of agricultural activity.
2. Capital cost calculations are manufacturing costs, they will vary over states.
3. Cost estimation is on 1980 prices.

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ANNEXURE - III

SOIL AND WATER MANAGEMENT (TRADITIONAL & CONTEMPORARY PRACTICES)

No	Resource	Traditionally used Technology Practices	Contemporary Technology Practices Developted	Status of Tech Unit	Implementation	Cost per unit Cost Range In Rs.
SOIL MANAGEMENT						
1.	Soil sampling		Soil testing pots/Soil sampler	Manufactured/		—
2.	Soil fertility and cultivation	Dung pits, slarry Humous	Farm yearthare Biogas Green marking, Green & Blue Algae, Seed-coating	Semi-proven Field tested.	Hectare	250—400
3.	Soil conservation	Gully erosion control, Mixed cropping.	Soil erosion sample, sedimentation—control, cropping alternatives.	Semi-proven,	Hectare	9,000—10,000
4.	Erosion control	Bench terracing, contour-Bunding	Grasses & Seed cultivation Contour burnding, terracing techniques.	Semi-proven	Hectare	400—800
5.	Reclamation	—	Correction of acidity, Tree plantation on alkali soil, etc.	Field tested	Hectare	2,500— 5,400
WATER MANAGEMENT						
1.	Water conservation	Gully Plugs, Check dams, Mulching.	Patter Discanarow, Moisture conservation, valley lands.	Semi-proven Field ested	Unit	3,000—8,000
2.	Water lifting	'DHENKLI', Swing Basket Persian wheel, WHOT.	Lift Handpump, Lift irrigation Proven pumps, Rotary pumps.	—	—	70,000—150,000 20,000—25,000
3.	Water Irrigation	Drip irrigation, Inverted Siphon.	Tile/Mole grains, Open ditch Improved irrigation practices	Field testing	—	—

*Average cost from Integrated watershed Development Programme study funded by World Bank-India/HP/J&K/Orissa.

ANNEXURE IV

TECHNOLOGY (ARTISANS & CRAFTSPERSONS)

S.No.	Craftsmanship & Artisanal Skill	Traditional Technology/Equipment used.	Upgradations & Improvements on
1.	Carpentory	Adze, Chisel, Plan, Screw Driver, Marking Gauge.	Electric Saw ; drills.
2	Blacksmith	Hammer, Tongs, Chisel, Tapes & dias files, polishing rig.	—
3.	Pottery	Wooden/Stone wheel, Wooden Mallet, Sticks, Convey Stones, open hearth firing, glazing with natural oils etc	Improved klin, extrusion press, design & clay wax moulds and glazing techniques
4.	Masonary	Plumline, Hammer, 'KANNI' wooden battons	
5.	Stone cutting & carving.	Trowels' Chisels, Stone breakers. Files, Drill, RASP. Iron headed Mallot Templet.	—
6.	Leather works	Knives natural vegetation (babul bark) & Oils	Mechanised training & spinning techniques
7.	Weaving	Wooden Spindles, Charkhas, Frames for warping, natural dyes, & bleaches, wooden Bobbins, Shuttles, and Bamboo pedals & Combs.	Improved looms, Pirni, Shuttles and pedals & combs using durable material & with better design.
8.	Local Handicrafts, wood carving, ivory inlaying bidri, chikan)	Traditional tools	

SOURCE : —Art in Industry through Ages—Monograph series Bengal, Bombay & Madras Presidencies.
—Metalcraftesmen in India-Meera Mukherjee
—SRUTI Report

ANNEXURE V

TECHNOLOGY (HUMAN WELFARE & COMMUNITY SERVICE)

S.No.	Objective	Traditional Methods and Technologies used (Some Examples)	Contemporary Methods and Technologies used (Some Ex mples)	Status of Technology
1.	Better drinking water	Wells—Kutcha/Pucca Natural resources	Water resource & lifting devices, water purification/Well development Ground water extraction techniques, etc.	Proven/Manufactured
2.	Better h alth, Sa nitation dispo al	Herbal, Ayurvedic, local medicines.	Disinfectant use, innoculation, vaccination, medical welfare, women & child care, sewage & waste disposal techniques & devices.	Proven/Manufactured
3.	Improved shelter	Locally found materials, wood Biomass/Mud/Stone/Home cased structures.	Improved earth construction Roofing materials & prefabricated material. Fired brick ACC, GI Sheet, etc.	Proven/Manufactured
4.	Access to Energy, Fuel	Wood, Sawdust, Coal, local Chulhas.	Windrills, Solar water heating, Drivers, Timber Kilns, Cookers, Photovoltaic pumps & Bulbs, energy efficient Chulah, Biomass, Micro-Hydro Turbines, briquetting from Biomass.	Proven/Field tested
5.	Access to Fodder and Manure	Traditional Humus/Manure production.	Biogass slurry, Manure processing techniques, improved variety of grasses & Fodder.	Field tested
6.	Better communication, information & transport	—	Remote sensing, Telecommunication means, Radio, Television etc.	Proven
7.	Education	Practical, Indigenous knowledge usually transferred informally	Educational devices, better and relevant programmes. Use of media, Puppetry, etc. for innovating programmes of	Semi-proven.

III

IMPROVEMENTS IN LIFE OF RURAL WORKERS THROUGH APPLICATION OF ERGONOMICS

3.1 Ergonomics is the scientific study of the relationship between man and his working environment. The application of ergonomics is particularly concerned with the design or redesign of working method, equipment and physical as well as organizational environment within which work takes place. The main aim of ergonomics is to heighten the quality of life of human beings in work conditions (Grandiean, 1982, September, 1984).

3.2 The application of ergonomics can help in the following three ways to improve the life of agricultural workers :—

(a) By increasing the productivity per man-hour.

(b) By reducing the drudgery involved in various operations.

(c) By minimizing the occupational health hazards.

These three objectives can be achieved by adopting the following techniques :—

(i) Use of equipment|job aids for manual operations.

(ii) Use of improved equipment for various operations.

(iii) Ergonomic design of equipment and work method.

(iv) Improving the physical work environment and provision of personal protective wears to the workers.

(v) Adoption of proper safety measures.
(vi) Educating the workers and employers.

The text ahead discusses these techniques in detail.

(i) Use of equipment|job aids for manual operations.

3.3 There are many operations in agriculture e.g. transplanting, groundnut decortication. By using equipments, the drudgery in these operations can be reduced and the productivity will increase.

(ii) Use of improved equipment for various field operations.

The traditional agriculture utilized mainly manual and animal power whereas use of mechanical power also came-up recently. Equipment for different agricultural operations and suitable for manual, animal and motor power are commercially available in the country and many more are being developed in various research institutions.

(iii) Ergonimic design of equipment and work method.

Ergonomic principles should be followed in the design of agricultural equipment and work method. It will help in fitting the job to the capabilities and limitations of the worker. These basic principles are:

(a) Use of anthropometric data of user population in design of equipment and work places.

(b) Use of Bio-mechanical principles in equipment|work design.

(c) Adoption of work physiology principles in equipment|work design.

(d) Job design as a basis for motivation of workers.

(iv) Improving the physical environment and provision of personal protective wears to the workers.

3.4 Here the term physical environment includes thermal environment and other work conditions such as vibration, noise, dust, chemicals and exhaust ommissions.

(a) Thermal environment.

In agriculture, most of the operations are carried out in sun, rain, or cold (for e.g. tillage in summer, puddling and transplanting in rainy season, threshing in winter etc.). If the ambient conditions are extreme, the work output can be improved by making suitable changes in work timings, during summer, by arranging rainwears in rainy season and by providing warm garments during winter. These steps will help in minimizing the health problems of agricultural workers. For the tractor drivers, it is important that tractors are provided with hoods to give protection from extreme weather conditions.

(b) Vibration.

A particularly important source of danger to which a worker is exposed in machine operation is mechanical vibration. The low frequency ride vibrations in tractor operation,

and power tiller handle vibration, are the matters of serious concern for work output and operators health. In the operation of power operated knapsack sprayers also vibrations are transmitted to human body through back and discomfort is felt. The greater the capacity of mechanical vibration for setting up synchronous vibrations in the body or parts of the body, the more dangerous they are.

Vibrations of the handles of power tiller are generally in the frequency range of 20 to 250 Hz and cause arm ailments. Proper handle design needs to be done to isolate these vibrations so as to remove the drudgery in power tiller operation.

In case of powered knapsack sprayers operation, vibrations mainly arise from engine. With the engine speeds in the range of 3000 to 8000 rpm, vibrations are most likely to peak at 5—130 Hs. These vibrations can be attenuated before reaching the users back by resilient engine and pump mountings and cushion pad between the machine's frame and users' back.

Thus, there is a need to bring the vibration hazards to the notice of research engineers and manufacturers of tractors, power tillers and power sprayers for making necessary improvements so that operators' health is safeguarded, drudgery reduced and productivity increased.

(c) Noise :

Chronic exposure to noise may lead to hearing loss depending on the source intensity, frequency content and time duration. Audiological surveys have been carried out on tractor drivers in many countries and it has been established that there was hearing loss due to tractor noise. Tractor and power tiller manufacturers should be asked to give due attention to this problem. At the operators' level, use of ear protectors can help to reduce the noise hazards to some extent.

(d) Dust :

Dust is often unavoidable in agricultural work. During land development and tillage operations (especially with dozers, tractors and power tillers) soil dust cause a lot of irritation to the operator. Threshing and chaff cutting are other operations where the operators are subjected to organic dust ex-

eyes ..

necessary, suitable protection in the form of cloth of face mask may be provided to the operator for avoiding the dust problems.

(e) Exhaust emmissions.

Exhaust gases are much more dangerous than dust. All internal combustion engines give off toxic gases. In open also, there is enough concentration of exhaust gases near the engine to give harmful effects such as headache, nausea, weakness, dizziness, and irritation of lungs and eyes. When it is feasible, the best arrangement is to discharge the exhaust upwards and well above operators' head.

(f) Chemicals.

While operating the plant protection equipment the workers are subjected to pesticide powderspray which cause skin and eye imitations. If inhaled, there is a problem of poisoning also. It has been reported that in our country, 193 people were affected in persticide application operations and 713 of them died during three years i.e. 1986—89. By the use of gloves, apron, mask and goggle, these possibilities can be averted to a large extent.

(g) Lighting.

Lighting is an important factor affecting the performance and workers' safety. For agricultural work in the open, there is always sufficient light in normal working hours. Howeven in closed spaces (eg. chaff cutter installations, Dal mill) or while threshing during night, the lighting is often poor. Minimum light intensity i.e. 300 lux should be available at the work place during such operations.

(v) Adoption of Proper Safety Measures.

During the operation of various agricultural machines, accidents take place resulting either in loss of life or making the people physically disabled or causing injuries. As per one survey, such injuries account for nearly a third of all rural injuries. Two of the major equipment which are involved in accidents are threshers and chaff cutters. Studies on thresher accidents reported that 73 per cent of the accidents were caused due to human factors like inattentiveness unskillfulness, overwork, physical incapability, 13 per cent due to machine factors like improper feeding system, 9 per cent due to crop factors like short crop, and about 5 per cent due to environmental factors like inadequate light, very hot weather etc. Such accidents can be reduced by providing safe feeding system, designing suitable work place layout, training the operators properly, following proper work-rest

sufficient light during night

weather, avoiding

wearing loose garments, and carrying out the operations properly.

(VI) Educating the Workers and Employers.

A man doing physical work is looked down in our society. There is a need to establish 'Dignity of Labour' (Dewan, 1982). Ergonomics is still a new concept in Indian agriculture and it is necessary to create greater awareness about its contribution in improving the quality of life of workers. The equipment designers/work managers employers need to be persued for giving due regard to ergonomic principles. Programmes highlighting various ways of improving productivity and removing drudgery should be prepared and shown on national T.V. Network.

Improvement in productivity and reduction in drudgery by use of improved equipment (manual and animal operated)

S.No.	Operation	Existing equipment system	Improved equipment system
1.	Land development	Spade and pickaxe are used to dig the soil for land levelling, channel making, bund formation etc. Output is about 3 to 4 m of soil handling per manday. A lot of drudgery is involved.	For land levelling animal drawn soil scoop/bnck scrapers are available. Out is to 2 to 4 m of soil movement per hour. For channel and bund formation, animal drawn furrower and bund formers are available. Capacity is 20 to 30 m of soil movement per hour. Drudgery is reduced.
2.	Seed bed preparation	With an animal drawn country plough a man has to walk 200 km to cover one hectare area (as three passes are required for complete ploughing). Capacity of the plough in a single pass is 0.05 ha/h.	With an animal drawn mold board plough a man has to walk 67 km to cover one hectare area (as only one pass is required for complete ploughing). Capacity of the plough in a single pass is 0.05 ha/h.
3.	Stubble/trash collection	Operation is done manually in bending posture. Output is about 0.04 ha per man-day.	With the help of an animal drawn patela harrow, a person can collect stubbles/trash from one hectare area in a day. The worker does not have to bend excessively and thus drudgery is reduced.
4.	Sowing	With country plough, a person has to walk 33 km for sowing of one hectare area (for 30 cm row spacing) and 2 persons are required. Output is 0.06 ha/h.	With three row seed-cum-fertilizer drill, a man has to walk only 11 km/ha. Output is 0.12 ha/h.
5.	Irrigation	For operating swing baskets, 2 persons are required. Discharge at 0.6 m head is about 5 m /h.	For operating Archemedian screw one person is required. Discharge at 0.75 m head is 20 m 3/ha. Low lift high discharge hand pumps are also available.
6.	Plant protection	With spray-cans a person has to walk about 33 km (for 30 cm row spacing) for covering one hectare area.	By use of sprayers 2 or 4 lines can be covered at a time and walking effort is reduced to half or one fourth.
7.	Weeding and inter-cultivation	With hand hoe, the operation is done in squatting or bending posiure. Output is 0.025 ha/man-day.	With wheel type weeder, operation is done in standing posture. Output is 0.1 ha/man-day.
8.	Harvesting	For harvesting of wheat output with a local sickle is 0.07 ha per man-day.	For harvesting of wheat, output with an improved sickle is 0.09 ha per man-day.
9.	Threshing	In wheat threshing output with manual beating is 20 kg/day. With bullock treading (4 bullocks – 1 person) the output is 280 kg/day.	With animal drawn Olpad thresher, output is 280 kg/day. Here operator sits on thresher and walking is eliminated.
10.	Maize shelling	By beating or by using sickle output is 5 kg/h. The operation involves a lot of drudgery.	By using hand operated maize sheller, output is 80 kg/ha. With a tubular maize sheller, the output is 20 kg/h.
11.	Grain cleaning	Operation is done manually using sieve by one or two persons. Output is 80 kg/ha for 2 persons.	With hanging type or pedal operated cleaner, output is 1.5 q per man-hour. Drudgery is also reduced.
12.	Coconut dehusker	Manually, with sickle a person can dehusk about 1000 nuts per day. But the work involves heavy drudgery and risk of injury.	Using the husker, output is about 1000 nuts per man-day. Drudgery is reduced and risk of injury is minimized.

Note : (i) This list is not exhaustive. It only illustrates the role of some improved manual and animal drawn equipment in improving productivity and reducing drudgery.

(ii) Power thresher have become very common in rural areas. Their use increases labour productivity.

(iii) Source : Shamugham, 1982; Ojha, 1984; Singh and Bhardwas, 1985; CART, 1986; Kachru etal, 1986; Shrivastawa and Duse. 1990.

IV

EMPLOYMENT, WAGES AND EFFICIENCY : THE IMPACT OF TECHNICAL CHANGE ON RURAL LABOUR

4.1 In accordance with the policy objectives of employment generation and poverty alleviation,[1] there is considerable concern that technological progress in India follows the inappropriate pattern of substituting scarce capital for labour. Inappropriate in the sense that the productivity of labour—and correspondingly wages—have been raised for only a small part of the labour force. Inappropriate also in the sense that not only may systemic inefficiencies arise (e.g. interrupted supplies of necessary input such as power or insufficient training of workers), but, over the long term, the ecological balance (for example in agriculture and fisheries) is severly dislocated. Changes in the ecological balance increase the cost of production and effectively set an absolute limit to potential output.

4.2 There is particular concern that the labour displaced in the process of technological modernisation is female. Investment in capital intensive industries such as rice mills, textile mills, plastics production have superceded cottage industries and home-based activities which traditionally provided an income for women. Moreover, the introduction of improved techniques and technologies aimed at increasing productivity have often resulted in men taking over women's traditional occupations—and assuming the upgraded skills and higher returns that come from working with the new technology.

AGRICULTURE

4.3 Irrigation and the HYV Technology

By itself this has a positive impact on labour use. Irrigation coupled with HYV seed, allows more intensive use of land. Relative to traditional crop varieties HYV would need greater care in sowing, transplanting, weeding (if pesticide and weedicides are not also introduced). The higher yields would require more labour for harvesting and threshing (if these operations are not mechanised). The shorter duration HYV enable multi-cropping thus again increasing labour use. The actual increase in labour demand differs from crop to crop and region-wise. However, the net impact of HYV technology on labour absorption is difficult to compute for the reasons discussed below.

4.4 Mechanisation usually accompanies the use of HYV technology, though the pace varies across regions. While mechanisation is not a necessary condition for the adoption of HYV technology the two grow together because of the skewed distribution of cultivated area and the biases in the credit market favouring investment in machines by large farmers. (The negative effects of mechanisation are discussed later). Hence it becomes difficult to gauge the positive effects of the HYV in isolation from the effects of mechanisation.

4.5 There are three categories of labour employed on farms family, permanent and casual. As noted above, the overall demand for labour increases with HYV technology. But the effect it has on the various types of labour varies.

4.6 As HYV increases labour demand, it also increases income level. While increased labour demand acts as an incentive for more family labour to work on the farm, the higher incomes of medium and small (rather than marginal) farmers, with accompanying higher status and capability to hire labour, tends to make family members especially women withdraw from farm work. As a result there is a steep decline in the number of women workers on the farm. There is a decline in the number of male workers also but this is not a great.

4.7 There is an increase in the size of the permanent labour force which is almost exclusively male. With the higher peak labour demand, the permanent worker, ensures at least minimum availability all year long. With more intensive cropping it becomes worthwhile for the farmer to keep permanent labour. And finally permanent labour which would be more responsible as compared to casual workers, becomes necessary because of the need for constant supervision involved in the improved farm practices which go with HYV technology.

4.8 The involvement of casual labour also increases because of the higher labour demands during peak seasons for transplanting, weeding and harvesting. Since these operations are normally done by women it would follow that there would be an increase in the employment of casually hired female labour.

4.9 The above conclusion which are drawn from a study of sample farms in the states of Andhra Pradesh, Tamil Nadu and Orissa (Bina Agarwal, 1984) would with some minor variations, apply generally to the introduction of HYV technology elsewhere.

4.10 At the same time, a distinction need to be made between labour time (flow) and labourers (stock). While the latter reflects the rate of participation, the former signifies the intensity of employment (Rakesh Basant EPW 1987). Thus an increase in labour demand can be compatible with a decline in the level of participation and an increase in the duration of employment. That is a smaller number of workers may work for longer hours.

4.11 It has also been found that there is an inverse relationship between farm size and overall labour use per unit of cultivated land under HYV technology. (A S Oberoi and Ahmed, 1981). This would be partly because larger farms would have greater mechanisation, but not wholly so. Smaller farms do lend themselves to more intensive use, with corresponding higher labour input. However, despite more intensive use of labour the smaller farms do not succeed in achieving higher output per unit of land (Oberoi & Ahmed, ILO 1980).

4.12 Agricultural Mechanisation

The use of tractors for agricultural operations has now become fairly widespread. Ploughing|land preparation, threshing and transport have largely been taken over by tractors. However, even though this should have a negative effect on labour use the findings are not entirely conclusive. According to one study (Oberoi and Ahmed, 1981) there doe not appear to be either a decrease or increase in labour use per unit of cultivated land. Another study (NCAER 1980 Volume II) covering seven states Punjab, Haryana, U.P. in the north, Gujarat, Maharashtra in the west and T.N. and A.P. in the South, shows that, in some cases, the use of tractors has increased labour input per hectare while, in other areas, it has decreased depending on the size of the farm. In Maharashtra, for in tance, for farms of more than 10 ha. the labour input is 219.7 man days for tractors owners, 130.2 man days for tractor users and 114.3 manday for bullock farmers. For farms of less than 2 hectares the respective figures are 298.3, 204.6 and 109.5 mandays. In fact both in western as well as in southern India there is an increase in labour inputs with tractor use. Only in the North is there some decrease in the labour input, taking all farm sizes together. These results are supported by the findings of other studies (Shanmugham, 1981 and Patil, 1985); both concluded that tractorization increases productivity as well as labour use Combine harvesters have been called "self propelled job destroyers", and hence require detailed examination. The advantages of the combines are significant : quick harvesting reduces the risk to crops from rain hailstorm: it makes the land available for the next crop quickly and in time; earlier marketing of produce results in a saving on working capital, and there is also a 6 per cent higher yield from the crop through the reduction of harvesting losses. The other crucial advantage of the combine harvester is that it diminishes the risk involved in labour shortages during the peak harvesting season. This factor has been highlighted in a study of Punjab (Morehouse, 1982). It has been argued that even if as at present, the cost of mechanised harvesting is costlier, the over-riding factors favouring combine harvesters—timely harvesting|sowing and less dependence on hired labour—are crucial to the Punjab farmers. The uncertainty of labour availability—mostly migratory from Bihar and East U.P. has been a cause of great anxiety to the farmers. The present disturbed condition in Punjab have made matters worse.

4.13 Nevertheless combine harvesters are very significant job displacers. A study of Ludhiana, Karnal and Ganganagar district in the States of Punjab, Harvana and Rajasthan shows that 95 per cent of the labour employed in harvesting and threshing of wheat as well as paddy is displaced when combine harvesters are used.

4.14 According to figures available for Jaunpur District (U.P.) of the total mandays required for the various operations in paddy and wheat cultivation, harvesting and threshing accounts for around 20 per cent in the case of paddy and between 35 and 50 per cent in the case of wheat. As much as 95 per cent of this labour force is displaced by the combine harvester.

4.15 As early as in 1982, 700 combine harvesters were estimated to be functioning in India (Morehouse, 1982). According to the discussion above the labour displacement cost to the country would be quite staggering. Since then a large additional number of more combine harvesters would have come into operation. However, the displacement in Punjab is not significant as far as the Punjabis are concerned; migrant labour from U.P. and Bihar has borne the brunt of it. Yet the migrant labourer is reported not only to earn, in 3|4 months, enough to subsist through the whole year but also has a small surplus with which he repays old debts or, in some cases, is able to acquire, over a period of time, some land in his own village. Hence the loss to him is considerable.

4.16 Rice mills are another major cause of job displacement and almost exclusively those of women. There were estimated to be about 1,00,000 rice mills in the country in 1987 (Kumud Sharma, 1987). A micro study in Maharashtra has shown that a typical rice mill displaces about 1,500 women's jobs and creates about 45 jobs for men.

On the basis of the above discussion some conclusions can be drawn :

1. HYV technology, comprising irrigation and bio-chemical inputs, is a major factor in increasing labour demand. The mechanisation of agriculture on the other hand has a negative impact. However, the intensity of this is determined by the operations mechanised.

2. Small farmers continue to devote more labour per hectare of land cultivated and the inverse relationship between labour use and farm size persists.

3. The proportion of hired labour employed tends to increase and family labour decreases with the adoption of HYV technology.

4. While there is an increase in the total labour input per unit of land cultivated as a result of HYV technology the labour input per unit of output is reduced most drastically as a result of mechanisation.

5. Though the daily wage rate has increased over a period of time it has not kept pace with the rise in prices As a result the real wage has gone down Moreover the

wage rate by itself is not a satisfactory indicator of the annual income of the labour household; daily wage rates may increase but if the number of days of employment decreases the net effect may be negative.

The Efficiency of Technical Change in Agriculture

4.17 While technological modernisation is proceeding rapidly, the efficiency and sustainability of the Green Revolution is affected by some critical aspects which have recently come under study These relate to issues of ergonomics and ecology.

4.18 Issues of ergonomics concern conditions of operation of new machines affecting the efficiency (productivity), the health and the safety of the operator. In operating equipment such as tractors and power-tillers, men are subject to stress-inducing levels of vibration, noise, exhaust emissions and dust. Health is directly affected by exposure to pesticide chemicals and sprays, whilst thresher accidents—of which there are at least 1000 reported every year, lead to loss of limbs and in some cases to loss of life (Gite, 1988). The design and operation of farm equipment requires far more attention than it has received so far.

4.19 Ecological issues relate to the exploitation of natural resources, such as, in the case of agriculture, water and soil. With the massive expansion of tubewell irrigation on which modern agricultural techniques depend, there is evidence that the water table is declining as groundwater withdrawals begin to exceed rechargeable levels. In Punjab and Haryana, the increase in tubewell irrigation peaked in the mid-seventies and then fell because there was not enough groundwater to go around. In Malerkotla district, in the Punjab, a CGWB study concluded that annual groundwater withdrawals were about 58,000 hectare metres against a yearly recharge of only 49,000 hectare metres. The water table had declined from a depth of 12-15 feet to more than 30 feet.

4.20 As the State of India's Environment, 1984-85 : The Second Citizen's Report (CSE, 1985) points out, the decline in the water table affects poor farmers more than richer farmer who are able to dig deeper to postpone the impending disaster. Users of dugwells, who rely on traditional manual or animal operated water lifting device "are left high and dry". In Maharashtra the depletion of groundwater in the early 1980s rapidly increased the number of villages with a problem of drinking water from 17,000 in 1980 to 23,000 by 1983. The adverse impact of the unbridled and, often, unscientific use of groundwater on the efficiency of agriculture and the quality of human life is obvious.

4.21 Overuse of groundwater also causes the intrusion of saline water, particularly in the coastal areas making it unfit for drinking or for irrigation. In the plains of Saurashtra in Gujarat between 1971 and 1977 the saline water affected area increased from 35 000 hectares to 100,000 hectares. Similarly, the use of surafce irrigation systems in areas with high groundwater levels (such as the terai areas of U.P.) leads to waterlogging and thereby to soil salinity and consequent degradation of large tracts of agricultural land. The distributional impact of these problems on the rural poor is disproportionate to their holdings of agricultural land.

4.22 Further, studies have shown that intensive cropping is removing crucial micro nutrient elements—zinc, copper, manganese, magnesium, molybdenum, boron—from the earth. Even though these elements form only one per cent of the plant's weight, they play an important part in the growth processes of the plant. Because of the deficiency of these micronutrients many farmers have started using zinc as fertilisers. Zinc deficiency is the most widespread followed by that of iron. Making up the deficiency by adding one micronutrient in a chemically pure form can lead to the deficiency of another nutrient. Thus, the application of zinc has been known to cause iron and manganese deficiency in one case and copper deficiency in another. Recent research at the Post-Graduate Institute of Medical Sciences, Chandigarh has shown that micronutrient deficiency affects the quality of food and, in turn human and animal health. It can lead to such problems as retarded growth and defective wound healing. Again, it is the relatively undernourished rural labour which suffers the most.

Women and Agricultural Modernisation

4.23 It is generally felt that the impact of agricultural modernisation has been particularly adverse for women. Preharvest (weeding, transplanting), harvest and post-harvest (processing) are operations in which women play a predominant role. As a result of technological modernisation their roles have been marginalised. Even when the overall demand for labour has increased "the women prone" jobs are often the ones which required less skills and if these are upgraded by technical innovation they are immediately converted into male jobs (Kumud Sharma, 1987).

4.24 It has also been argued that there is an inbuilt bias against women in the social-political environments of the country as it obtains today (Agarwal May, 1981). The fault according to this argument, does not lie with technical innovation per se. Women lose out to men because they are under privilleged to begin with. Similarly, the HYV technology has favoured the larger farmers, already privileged, in comparison with smaller farmers.

4.25 In conclusion, it is clearly understood that the process of modernisation is well under way. It can neither be reversed, nor halted. As a symposium organised by the Asian Productivity Council in 1981 noted, the important consideration is that the adoption of agricultural mechanisation is done in such a way as to minimise the adverse effects of the dislocation of farm labour. While in the short term, the introduction of farm mechanization should be in the direction of increasing both the capacity and efficiency of labour, in the long term, the only solution is to find alternate channels for labour absorption. in rural

activities such as animal husbandry, forestry, fisheries and non-agricultural activities supporting agriculture.

DAIRYING

4.26 India has the largest cattle and buffalo population in the world, estimated at 200 million and 75 million respectively, and accounting for about one-sixth of the world's cattle, half the world's buffaloes—and approximately 5 per cent of the world's milk production. The livestock sector accounts for around 18 per cent of agricultural output in the country, of which two-thirds derives from dairy activities. The production of milk and milk products such as ghee, khoya and dahi have always been the primary reason for keeping buffaloes. Cattle, on the other hand, are traditionally kept primarily for their draught power as bullocks; cows milk is viewed as a by-product; a by-product less important than dung which has always been critical source of fertiliser and fuel.

4.27 In the last few decades there have been major changes in the dairy sector Operation Flood, also known as the "White Revolution", was launched in 1970 to meet the growing—particularly urban—demand for milk. Based on a system of village-based producers' cooperatives—modelled on the Anand Co-operatives developed in Kaira district, Gujarat, in the 1940s and 1950s, Operation Flood incorporated an organised system of collecting, testing transporting and processing milk from rural areas for sale in urban markets. In addition to increasing aggregate milk production, the programme aimed to promote dairy production as a means of income generation fr the rural poor, ensuring that small producers—including landless households—had access to membership in cooperatives and to dairy support services.

4.28 Oeration Flood represents a professional and uniquely integrated approach to dairy development with important and ambitious implications for rural development. In recent years, it has been held up as a model for the organisation of the dairy industry in developing countries. As such, it has generated an equally professional and development focussed critique. Part of this relates to the new technologies introduced.

4.29 The technological components of the Operation Floor Strategy are :

1. Cross-breeding of Indian cows with European breeds (including Jersey, Holstein-Friesian, Brown Swiss and Red Dane) using techniques of artificial insemination. The resulting hybrid cows constitute the major part of a national milk herd (comprising also selectively bred Indian (buffaloes)—high yielding animals whose productivity is linked to inputs of concentrates, such as gains and oilcake) as well as high quality green fodder.

2. Capital intensive, centralised facilities and dairy plants for chilling and processing milk collected from dispersed rural centres.

4.30 Milk production figures show a consistent increase after 1971. Both the size and productivity of the national herd are reported to have increased (1973 grams of milk per day per animal in 1981 compared with 729 grams per day in 1971|2). However, it has been pointed out that the sudden increase in milk production recorded in the 1970s may be apparent than actual since the date base is quite unreliable (Dogra, 1982). It is only quite recently that the methodology for assessing milk output has stabilised and milk production in earlier decades may have been substantially underestimated. It has also been shown that increases which have taken place can be attributed to milch buffaloes fed on agricultural residence and not to crossbred cows efficiently converting high quality feed (Nair, 1985).

4.31 The efficient conversion of high quality inputs in the basic rationale for the cross-breeding startagy adopted under Operation Flood. On one projection, it is estimated that a National Milch Herd, comprising just over 11 per cent of the total milch animal population would contribute one third of total milk production, whilst consuming 21 per cent of available concentrates and around 8 per cent of available green and dry fodder (Shah et al., 1980). Comparison of the estimated costs of milk production for different types of animal indicate lower costs of milk production from crossbreeds, despite heavier feeding- -reflecting higher productivity and reduced start-up costs in the form of earlier calving and shorter intervals between lactations.

4.32 There are considerable differences in approach adopted for cost calculations and estimates vary critically depending on the value assumed for the labour component in milk production as well as assumptions made about conditions of animal rearing, calf productivity and the relation between productivity and feed volume and composition. Critics of the Operation Flood strategy argue that agro-ecological as well as infrastructural and economic conditions render crossbreeding technology unsuitable and potentially inefficient in most regions of India.

4.33 Thus, the milk output of cross-bred cows—animals which have evolved in temperate western clims—is severely depressed under typical Indian conditions of heat and|or humidity. These bovines also are easily susceptible to various incapacitating diseases carried by air; water and insects, in a country where most owners cannot insulate their animals from these dangers or afford expensive veterinary aid which in any case is not available in many areas (NDDB, 1978).

4.34 Secondly, the high-yielding potential of cross-breeds depends on a high quality diet of green fodder and concentrates. The cultivation of green fodder envisaged under Operation Flood entails the diversion of prime irrigated land and significant amounts of fertiliser from the production of food crops. If more areas is not sown to fodder crops, the potential of high yielding bovines can only be realised by feeding more concentrates. Studies in Kaira district in Gujarat in the 1960s and Kerala in the 1970s show that increased—and more costly-milk production was achie-

ved entirely by feeding greater amounts of concentrates (mainly oilcake) imported from other states (Desai and Narayana, 1967; Nair, 1979).

4.35 At the level of the dairying household, the introduction of "high tech" bovines is unlikely to result in an improvement of milk yield per animal if, the family does not have money to spare for the purchase of necessary concentrates—the inputs on which higher outputs depend. In the context of the targetting of dairy development to the employment of the rural poor, especially landless families, there is increasing awareness of the need for micro-economic research into the suitability of high-yielding animals as a means of income generation for such households. There is evidence to suggest that especially for these families, use of both green fodder and concentrates is increasingly restricted as common grazing lands disappear and the trade-off between the monetary cost of concentrates and returns from milk production becomes more acute. In this context, local varieties of bovines, whose lower levels of milk output can be maintained by traditional forages, may represent the more economically sustainable technology.

4.36 The shortage of animal feeds is a very significant limiting factor in the livestock economy. The focus of the Operation Flood strategy maximising milk production is likely to entail some diversion of available supplies of concentrate feeds to the feeding of milch animals (Nair and Jackson, 1981). This appears to overlook the requirements of draught animals which are critical to agriculture in India. In general, farmers are more concerned to have adequate draught power than to produce milk. Some 70 per cent of farmers in India are small holders tilling less than 2 hectares of land. Bullocks are their main source of power for farm operations and the energy so derived is enormous. In the 1970s it was estimated that India would have to spend a thousand million dollars annually on fuel if it were to replace the animal power used in agriculture. Mechanisation is not widespread and even where the intensity of tractorisation has been the highest in the country—in Punjab and Haryana—the number of work animals per hectare of operated has not shown any falling trend (Nair and Dhas 1989).

4.37 Questions of employment, workload and access to income from dairying would of course vary significantly between different categories of rural households. Whilst new techniques of dairy production have been promoted as a means of improving income distribution, on the assumption that access to livestock is more equitable and less directly related to landholding, it is clear that dairying remains far from egalitarian. It is certainly true that nearly half the rural households in India own milch animals. About 21 per cent of these are landless and 30 per cent are marginal farmers owning one or two adult animals. However, few of the poorest families own dairy animals. Higher landholding categories (with advantages such as direct access to fodder as well as the capacity to purchase concentrate feeds) own larger herds (averaging well over 6 animals) and usually obtain a higher yield per unit. (op. Mitra, 1987).

COASTAL FISHERIES

4.38 Since the 1950s, the Government has encouraged the mechanisation of the fishing fleet in order to maximise the utilisation of coastal fisheries. The objective was not to disturb or compete directly with the traditional industry but to augment the overall returns. The process of technological modernisation in this sector has thus involved both the motorisation of traditional gears as well as the introduction of new gears—specifically trawling and purse-seining—on large motorised boats. This has been linked to infrastructure development for the provision of diesel and ice as well as for the marketing of increased catches. It is the new gears involving intensive fishing techniques to catch fish for which there is a strong export demand (prawns, shrimps and lobsters), which have attracted huge investment sanctioned by international development agencies as well as big industry concerns involved in fish processing.

4.39 It is estimated that there are about 6.5 million people engaged in fishing and allied activities. In the coastal regions, more than 80 per cent are in the small scale traditional sector. The general trend has been for employment to increase with the new opportunities and increased catches achieved in the initial stages of mechnisation combined with new fishing techniques. However, in all coastal regions, there is evidence that as the intensity of fishing increases beyond a critical point, catches decline, mechanised fishing becomes increasingly uneconomic and employment in both the modern and traditional sectors is affected.

4.40 Along the coasts of Kerala, Tamil Nadu and Goa, declining fish catches have led to a struggle between fishermen of the two sectors, a struggle which in recent years has tended to become increasingly violent as fishing livelihoods become more drastically affected. Whilst motorised boats extend their operations inshore in order to reduce costs, local traditional fishermen warn that : the noise from the trawlers drives away the fish from their traditional fishing grounds ; that the propellers of the mechanised boats tear the nets of the traditional sail boats; and that unlimited bottom trawling operations have led to critical overfishing of small fish and disturbance of breeding grounds leading to ultimate depletion of the fishery resource.

4.41 The limits of the marine resource are reflected in the trends in mechanisation of the fishing fleet. Expansion was particularly marked throughout the 1970s as the number of mechnised boats expanded from the 1960s figure of 2160 up to more than 19,000 1970s as he number of mechanised boas expanded The investment involved in boats and gear has been very substantial. The cost of purchase of purse-seiners alone in three States amounted to Rs. 33 crores.

4.42 The impact of overfishing on the traditional fishing economy has been devastating. Artisanal fishermen have always used selective fishing gear (nets and tackle), fabricated by them in accordance with

the nature and the size of the fish to be caught. They are used at the appropriate season when a particular species of fish becomes available at sea. The new fishing techniques—bottom trawling and purse-seining-evolved in and for temperate water fisheries which are marked by fewer species of fish. In such an eco-system, both these techniques have proved to be very efficient from the production stand point and have greatly enhanced marine fish harvests. In tropical waters, which have a totally different eco-system—numerous species, all highly dispersed, each available in small quantities and with more complex inter-species interactions—these new techniques have resulted in initial spurts in the level of fish harvest followed by sharp fallbacks thereafter.

4.43 The primary reason for this is that uncontrolled use of bottom trawling has resulted in an indiscriminate ploughing of the sea bottom, destroying in the process all forms of marine life and upsetting crucial natural processes vital for survival of bottom dwelling fishes. Purse-seine nets have proved to be stunningly over-efficient. Their rather small mesh size and the extensive coverage (length and depth) mean that they catch whole shoals of fish without discriminating between adults, young fish and spawners.

4.44 The ecological degradation resulting from such uncontrolled use of these modern techniques has resulted in an ecological crisis that has effected the livelihood of the artisanal fishermen, as recent studies increasingly document. Between 1974 and 1982, fish harvests off the coast of Kerala dropped from 420,000 tonnes to 325,000 tonnes despite (or because of) increased investments in fishing craft and gear. The artisanal fishermen's share of this dropped from 74 per cent to 54 per cent. Their productivity more than halved, decreasing from 2900 kg. per annum to 1400 kg per annum (Kurien 1988). Similar developments are emerging in the fishery off the Konkan coast of Maharashtra. Technical developments in coastal fishing have had a dramatic impact on patterns of boat ownership and employment in this sector. Traditionally, whilst men worked directly in fishing at sea, women from poorer fisher households were employed in shore-based activities such as net-repair, net-making, fish drying, other processing and marketing. With mechanisation of fishing and the concentration of effort on high value catches—such as prawns—the larger capital requirement has attracted those with the necessary resources, often from outside the industry. According to one estimate, more than one-third of the mechanised fleet is owned by non-fishermen capitalist entrepreneurs who employ crews not necessarily drawn from the numbers of traditional fishermen. For new opportunities on larger boats have often attracted migrant labour from non-coastal areas as well as traditional fishermen. Many of these opportunities, however, are seasonal, often restricted to the peak fishing season during the monsoon months.

4.45 Employment in activities allied to fishing has also shown considerable change. The marketing of fish has shifted from small villages along the coast to places with developed landing facilities. Here, large lots are sold through auction mainly to commission agents and large wholesalers. Women head loaders who traditionally have earned an income from buying small baskets of fish and selling them in local markets or further inland, are unable to compete. Huge landings at one place, moreover, have the effect of driving prices down. This further reduces the returns to the declining landings of artisanal fishermen.

4.46 The introduction of nylon twine for fish net-making initially represented an extension of women's traditional work in this area which was primarily to provide the household itself with fishing nets or to repair them. As the demand for nets for the mechanised sector grew, fisherwomen were increasingly supplied with nylon twine by the village merchant. Netting was made at home, collected at regular intervals and paid for at fixed rates throughout the year (Gulati, 1984). The introduction of net-making machines, however, has removed this source of employment altogether for thousands of women in Tamil Nadu and Kerala (Ambarsan, 1985 ; ISST, 1985). The ISST study reveals that women who have lost their jobs in the Kerala fishing industries have migrated to West Bengal, Maharashtra, Orissa, Tamil Nadu and Gujarat to work in fish processing plants as peelers, graders and packers.

4.47 Ultimately, both employment and efficiency in fisheries and allied industries is critically dependent on the maintenance of the marine resource. Whilst the initial impact of technological modernisation appears to have been positive, the unlimited application of modern techniques in spite of various attempts by the State Governments concerned to regulate both the expansion and the operation of the new techniques—has led to biological and economic overfishing affecting not only the efficiency of intensive and nowadays increasingly costly new technologies, but threatening the existence of the traditional fisheries sector on which the livelihoods of thousands of coastal families depend.

TEXTILES

4.48 Textiles in India have always been recognised as having substantial employment potential, second only to agriculture. There are three distinct activities in the production of cloth: spinning, weaving and finishing (involving a number of processes including printing). The effects of technical developments over the past thirty years on each of these activities are discussed in this section.

Cloth Weaving

4.49 In weaving, a central technological development during the past thirty years has been the introduction of the decentralised, workshed (rather than mill) based powerloom whose production capacity is more than three times that of the handloom. In the 1950s, certain restrictions were imposed by the government on the organised sector of cloth mills (in

terms of expansion and product reservation) whilst the selective expansion of powerlooms was sanctioned in the decentralised sector with the intention that handlooms would be gradually converted to powerlooms in order to improve the productivity and, thereby, the earnings of the weavers. Thus, the Textile Enquiry Committee in 1954 recommended the following .

1. One powerloom for one handloom weaver.
2. The powerloom to be housed in the weaver's cottage.
3. Powerlooms to be set up only in rural areas.
4. Powerlooms to be given to existing handloom industry on a cooperative basis.
5. Powerlooms to be used exclusively for the production of cotton cloth.

The subsequent decades have seen these guidelines 'diluted' beyond recognition. The conversion scheme was dropped following reports that powerloom units were being introduced in urban areas where power, raw material supplies and finishing facilities were more easily available. Ownership was often benami by those in a position to risk substantial investment and obtain institutional credit—a class which rarely included the handloom weaver. (Estimates Committee, 1977-78; Jain, 1983). Since the late 1950s, the growth of the powerloom sector has locked any effective control. Despite a regulation requiring a permit for installation of new powerlooms, large numbers of unauthorised powerloom units have been installed and their existence "regularised" periodically. From 20,000 in 1953, the number of registered owerlooms had risen to over 6 lakhs in 1986-87 with a further 2-2.5 lakhs or more "unauthorised pending registration". Nearly 40 per cent of the total number are concentrated in a few towns in Maharashtra and more than 30 per cent in Tamil Nadu and Gujarat.

What has been the impact of this tremendous growth on employment in the decentralised textiles sector ? A High Powered Committee warned in the 1970s that each new powerloom displaces six handlooms in the country (Sivaraman, 1974). Full-time employment per powerloom of 2.25 persons in weaving and pre-weaving activities compares with 4 persons working part-time per handloom. In terms of full-time employment, this converts to 1.9 persons : 1.0 in weaving and 0.9 in pre-weaving. Handloom employment is largely cottage based absorbing family labour—both male and female Women are almost exclusively responsible for pre-weaving operations and are occasionally also involved in weaving. Women are not employed in the workshed-based powerloom operations.

4.50 Thus, the production of 9000 metres of cloth on one powerloom by 2.25 men in an urban or semi-urban area would fully employ 12 people—six men and almost as many women—working with six handlooms in a rural area. On this basis, the 11.6 lakh men employed to operate the more than 5 lakh cotton powerlooms which have come into existence since the mid-1970s represent a displacement of full-time employment opportunities for 31 lakh handloom weavers and nearly 28 lakh women in pre-weaving activities for handlooms (Sinha F a.nd Sinha S., 1989). In terms of opportunities for part-time employment, the effective displacement is far greater.

4.51 The extent of displacement which has actually taken place can be gauged from the decline in handloom production—not only in relative share to powerloom production, but absolutely. However, the question of the breakup of cloth production within the decentralised sector is a vexed one. Using a series of assumptions based on informed judgment, it has been estimated that cloth production in the handloom sector was around 2,150 million metres in 1987 (Sinha F. and Sinha S., 1989). This is less than two-thirds of the official estimate of 3f,450 million metres in the same year.

4.52 Estimates for the distribution of employment for the textile sector as a whole are presented in including the mills and khadi sector. The revised estimates in the table reflect; the likely extent of retenchment of workers in the mill sector with declining output; increased production in the powerloom sector due to large numbers of unofficial loom and consequent diversion of hank yarn officially reserved for handlooms, and a corresponding reduction in handloom production. On this basis, potential employment in textiles production is critically affected by the growth of the powerloom sector.

4.53 In terms of the costs of production and returns to labour, the productivity differentials between the various textile technologies—large-scale mill, powerloom, handloom and khadi charkhas—appear more favourable for the former. In the mill sector, the lowest paid operative earns a minimum wage of Rs. 30—35 subject to annual increments with regular employment for twentysix day a month (AIFCOSPIN, 1987). Earnings in the decentralised powerloom and powerloom sectors are piece-rated and subject to irregular periods of employment and varying conditions. Available evidence suggests that a powerloom operator earns up to Rs. 15-20 for a 12 hours working day. The returns to handloom weaving average Rs. 8—10 for a day's production, or Rs. 4—6 per person day. Thus, as the table shows, greater productivity of the powerloom, combined with cheaper labour in the decentralised sector compared to organised employment in the mill sector, enables relatively low production costs.

Yarn Spinning

4.54 Spinning is a process very easily mechanised, and by the end of the nineteenth century Indian

cotton textiles had been transformed from an industry using handspun yarn to one using mill-made yarn. Nonetheless, spinning by hand continues as a means of employment for women (for whom spinning is a traditional, usually home-based, activity) in many rural areas under the auspices of the Khadi and Village Industries Commission (KVIC).

4.55 The khadi sector represents a special case of institutionally supported employment in traditional employment activities. A number of different charkhas are in use for spinning and the potential returns to this activity (on a full-time basis of 8 hours) range from Rs. 2.00 on the traditional charkha up to Rs. 12-15 on the more productive New Model Charkha (NMC) developed under the KVIC. A recent report (CWDS. 1988) has criticised the conditions of women's employment in the khadi sector citing daily earnings of 53 paise a day for spinning in 1987 as a particular instance of women's exploitation. In actual fact spinning is usually a part-time activity for women and there are considerable variations in charkha utilisation and the intensity of work—depending partly on constraints on women's time but also on some organisational shortcoming within the khadi sector. Thus, while more than 9 lakh women are reported to be employed in khadi spinning (KVIC 1989) most of these belong to the rural middle class. As their earning opportunitie are otherwise constrained by societal norms they are willing to work for the unremunerative income (around one rupee per day on the traditional charkha and Rs. 3-5 per day on the six-spindle NMC) provided by this activity which is 'approved' by the community(Sinha, F., 1988).

4.56 In limited parts of the country—such as Tamil Nadu and Gujarat—and in the limited conditions of the operations of the twelve spindle NMC, women from the rural working class are able to generate relatively remunerative incomes of Rs. 9-12 per day but their participation is conditional upon foregoing other income earning opportunities As the e opportunities, such as the harvesting of crops, yield a regular income in kind, they form as essential part of the economic security system for the rural poor. The juxtaposition of these as altenative rather than complements to khadi spinning means that most poor rural workers are unable to take advantage of the khadi network subsidised, as it is, ostensibly for their benefit. Thus, despite the introduction of 'improved' NMC technology into the manual spinning activity, it is clear that there have been neither substantial gains in employment, nor in operational efficiency of a kind which would enable rural labour to participate freely and to earn remunerative wages. A more positive impact on rural labour would require the combination of the improved technology with much greater organisational innovation and efficiency than the khadi institutions have exhibited so far.

Textile Printing

4.57 Until the 1950s, the hand printing of textiles was an important source of rural or semi-urban employment. Since then, in spite of government policy to protect the sector, jobs in hand printing have dwindled considerably as it was not technical change has created a new possibilities based on photographic techniques out of which has developed a highly sophisticated, capital intensive, microprocessor controlled printing sector. In India, employment in rural manual block printing has also been directly affected by the intermediate screen printing technology which is now widly practised on a decentralised basis and is similar, in its impact on the textile printing industry as a while, to decentralised powerlooms in the weaving sector.

4.58 The limited evidence available from micro-level studies indicate the extent of the decline in employment in textile hand printing. According to the 1961 Census there were 49,181 textile hand printers in the country whereas there were estimated to be 200,000 people engaged in this activity at the end of the Second World War. In Ahmedabad, between 1953 and 1987, the number of hand printers decreased by 70% from 8,000 to 2,500 with half of the displaced being women. Figures for places like Lucknow and Gwalior indicate similar trends.

4.59 While the machine printing sector failed even to reach a ceiling of 750 million yards in the 1950s, in 1980 it printed a record 2,400 million metres. It has been estimated (Jain and Kapadia, 1984) that as many as 250,000 job opportunities had been lost to the economy. Given an additional demand of 1,600 million metres of printed cloth by 1934-5, the reservation of the entire additional requirement for hand printing would generate 400,000 additional jobs; in machine printing only 27,000 additional jobs would be created.

4.60 The displacement caused by mechanisation is evident from the fact that the labour input in hand printing is 15 times than in machine printing. At the same time, the capital input in machine printing is as much as 22 times that in hand printing. This latter differential is widening since the cost of machines is escalating faster than wages and the cost of the simple equipment required for hand printing; between 1961-2 and 1980-1, the cost of hand printing equipment increased by 300% while printing machinery costs increased by as much 500%.

4.61 According to the available evidence, the returns to the worker as a percentage of value added are highest in hand block printing :

Returns to the worker in	%
Hand block printing	57.1
Screen printing	29.9
Machine printing	32.4

while it requires the lowest capital investment and provide the highest labour absorption. The activity also provides an equal share of the jobs available to women.

4.62 At the same time, the contention that machine printing on an industry-wide basis is necessary for augmenting exports has been shown to be false by the statistics which show that he export of machine printed textiles remained steady at 1,000 million metres per annum betweeen 1969 and 1978. The exports of hand printed Textiles, on the other hand, increased a factor of four between 1975-6 and 1979-80 alone (Jain and Kapadia, 1984).

4.63 Thus it is clear that technical change in the textile printing sector has had an adverse effect on employment, the efficiency of capital utilisation and, at least indirectly by weakening the demand for labour, on wages as well.

AGRO-INDUSTRIES

4.64 Traditionally, the processing of hides and skins and production of leather goods and the processing of foodgrains and oilseeds have been major rural employment generators. In recent years, sericulture and silk textile production has grown substantially and is increasingly regarded as an important part of the national effort to generate employment for the poor and enhance rural incomes. The implications of technical change for employment and incomes in these three sectors are discussed below :

Leather and Leather Goods Productions.

4.65 After textile production, leather and leather goods production has been perhaps the most important source of off-farm employment for the most socio-economically deprived sections of the rural population. As with other off-farm economic activities, leather processing was traditionally based on the principle of the self-sufficing village community which underlay the Hindu jajmani system. Each village had its own workers in leather-strictly delineated by caste and physically segregated because of the unhygienic nature of their work. These workers flayed the dead animals of their jajmans, tanned the hide or skin and made up the leather into shoes, irrigation buckets or drum heads for use by the latter. In the larger villages, a functional specialisation between flaying/tanning, on the one hand, and leather goods production, on the other, occurred amongst leather workers. These local workers supplied the needs of the rural population without the intervention of traders Only when the supply of hides within the village exceeded demand for leather goods were raw hides or locally tanned leather sold for supply to urban-based tanners or goods producers (Watt, 1890).

4.66 Technical improvements in the tanning process originally helped lay the foundations of an organised tanning industry in the mid-nineteenth century. The extention of the railways provided increased access of the tanner to raw hides and skins from the hinterland and substantial quantities of, raw as well as tanned and semi-tanned hides and skins started to be exported. With the resulting monetisation and the introduction of modern technology to tanning, in the early twentieth century, the independent village artisan was steadily replaced by the small capitalist (using the workshop mode of production) as the unit of production increased. A major structural shift of the global tanning industry from the industrialised to the developing countries during the 1970s led to the substantial expansion of organised tanning in India and to almost total decimation of rural tanning. Rural employment in this activity today is virtually negligible and, at best, a part time activity (Sinha, S., 1986)—unfortunately, no estimates for actual employment are available.

4.67 In a country where the slaughter of animals is socially frowned upon, much of the recovery of hides and skins has traditionally been by labour-intensive methods in rural areas. According to the CLRI (Central Leather Research Institute) Survey on Raw Hides and Skins conducted in 1986, only 38—44% of hides are obtained from slaughtered animals though over 80% of skins are recovered in this way. Though village-level recovery from fallen animals combined with vegetable tanning was a major employment generator at one time it is now only and part time activity. This has occurred as more and more traditional flayers have moved out of the activity (at least partly on account of the stigma associated with it). Concurrently, increasing monetisation of the village economy has led to increasing numbers of unproductive bovine animals being sold for slaughter, on the one hand, and increasing sanskritisation of the lower caste communities has led to increasing numbers of animals being buried rather than flayed, on the other. Thus, the proportion of bovine hides recovered at the village level has fallen to just 40% resulting in a concomitant impact on employment in flaying. It is not surprising, therefore, that even active flayers in U.P. were foudn, in 1983-84, to derive less than 50% of their income from the activity (Sinha S., 1986).

4.68 Most rural leather goods have been replaced by substitute items made of other materials; even inexpensive footwear for rural consumption, is increasingly made of plastic and other synthetic materials. Despite the lack of significant economic of scale in footwear production, herefore, considerable displacement of rural labour has taken place. Leather footwear is now substantially produced for the urban and export market and, though much of this takes place in small scale and cottage-scale units, it is located mainly in semi-urban clusters such as Agra and Kanpur districts in U.P. and the North Arcot district in Tamil Nadu. Only a scattering of dispersed village leather goods producers remains. With substantial growth of the leather export market in recent years, however, the overall impact of the improved goods production technology is likely to be roughly neutral. Indeed, a recent study of the leather industry in India suggests that real wages earned by workers in the leather goods industry may, in fact, be increasing on account of the increase in demand for leather working skills.

Oilseed Processing

4.69 Like most agro-based industries in India, the vegetable oil processing industry is characterised

by a dualistic strucure incorporating a range of tecrnologies. In the rural (as well as urban) informal sector this range covers such devices as bullock-driven ghanis, KVIC-promoted improved (or Wardha) ghanis, elecirically operated ghanis, hand presses, hydraulic resses and electrically-powered screw presses (commonly known as expellers). The (predominently urban) organised sector includes solvent extraction plants using, in many cases, the latest modern technology as well as large units with a number of expeller plant (commonly called oil mills).

4.70 Rural units are usually categorised into village ghani and expeller units. Village ghanis are labour intensive, use manual or animal (usually bullock) power and are predominantly single ghani units. Expeller units are all electric or mechanical power operated units, whether ghanis or screw presses. These usually operate in mills of more than one expeller unit. Indeed, as early as the late 1950s it was found that the average oil mill consisted of 8 expeller units (Chandrasekaran and Achaya, 1980).

4.71 Since then the number of oil mills in India is reported to have increased by nearly 90% from 8,000 to around 15,000. Over this period, oilseed production has increased by only 60—70% and will have led to some decline in capacity utilization. Since the technologies employed in the informal sector have not changed much over this period, but capacity utilisation has declined considerably to around 40%, either the average will size has increased or the number of mills has been greatly underestimated.

4.72 Giving the decentralised and scattered nature of the informal sector vegetable oil industry, reliable estimates of its size are almost impossible to come by. Estimates of bullock-driven ghanis have to be made from Livestock Censuses which (since the early 1950s) have shown an exponential decline in numbers as the power operated units have grown in importance. On the basis of figures available from the 1977 Livestock Census—33,000 units in U.P. and 94,000 in India—it is estimated that there are now around 10,000 units operating in U.P. and perhaps 35,000 in the country as a whole (KDA, 1989). While this estimate is double the 5,000 units for U.P. estimated by the Technology Mission, the field study undertaken for this report suggests that even 10,000 may be a conservative estimate for the 74,000 villages in the state. In any case, it is clear that the attrition rate of village ghanis is high and non-mechanical oil processing has virtually been wiped out by oil expellers. The concomitant effects of the expeller technology on rural employment are obvious. In many villages the concept of the village teli is now totally unknown.

4.73 For expellers, the Technology Mission has estimated just 2,000 units in Uttar Pradesh. As this figure is incredibly low and inconsistent with the survey observation of 10-12 units per block even in some of the low oilseed producing areas, it is assumed that it refers to oil mills. On this basis, the number of expellers in U.P. is estimated at 30,000 and in India at 2.30 lakhs.

4.74 The capacity of informal sector units is estimated from a field study around Kanpur and Gorakhpur, supplemented by KVIC data and other public information. The capacity of the average village ghani including Wardha ghanis is estimated at around 10 kg of oilseeds a day or 3 tonnes a year. The capacity of expellers is 400 kg a day or 120 tonnes a year. Total processing capacity in U.P. and India is indicated in the following Table. As the table shows, the toal crushing capacity in the oil expeller units is estimated at 276 lakh tonnes for India and 36 lakh tonnes for U.P. Given that he total availability of oilseeds in U.P. in 1984-85 was only 8.65 lakh tonnes the capacity utilisation was just 25%. This declined further to around 20% during 1985-86 A cross check with the field study shows that this figure is consistent : expellers previously operated upto 20 hours a day in block level processing units are now working only 4-5 hours. It is only around the major Kanpur, Agra and Hapur markets that longer working of 8-9 hours is achieved. Many of these expeller units are obsolete and ill-maintained and lead to substantial losses (leaving as much as 14% of oil in mustard oilcake). Thus, the expeller technology has not only had an adverse effect on employment and returns to rural labour it has also resulted in a significant deterioration in the efficiency of utilisation of a scarce material like edible oilseeds.

Sericulture and Silk Production

4.75 Silk production, including sericulture, is well known as a highly employment oriented labour intensive activity ideally suited to the conditions of a labour abundant, agro-based economy. It has been one of the most dynamic agro-industrial sectors in India in recent years Silk produtcion has grown at more than ten per cent per annum from just over 3,250 tonnes in 1976-77 to 8,500 tonnes in the 1986-87 and is estimated to have reached 10,500 in 1989-90. The high labour intensity of silk production has meant that there have been concomittant increase in employment recently estimated at almost 27 lakh work years of direct employment on a full time basis.

4.76 A calculation of the directly attributable shares of capital and labour in silk production, using the most labour intensive technologies, shows that the overall share of capital in silk production is around 50% while that of labour is under 40%; with relatively capital intensive techniques this share is likely to be higher (Sinha, S. 1990s). However, as much as an additional 20% of final value accrues to the farmer-sericulturist and to the reeler as profit. To the extent that sericulturists and reelers belong to the poorer classs, the returns to capital constitute a net gain to rural labour. With continuous growth and consequent intensification of the activity, it is well known that increasingly, small and marginal farmers involved in active leading to higher incomes, increased demand for labour and, thus, to higher re-

turns to labour. (A recent micro-study of sericulture in West Bengal found that 50% of sericulturists were marginal farmers and another 32% were small farmers—CSSS, 1990).

4.77 Technical change in sericulture, introduced extensively under the Karnataka Sericulture Project in the early 1980s, took the form of the introduction of cross breed (indigenous multivoltine with exotic bivoltine) varieties. This resulted in the quantum jump in Indian silk production indicated above and led to the positive effects on rural labour through increased cultivation, rearing and processing. The current National Sericulture Project (NSP) aims to take this further by bringing about further quantiative increases in silk production as well as a considerable improvement in silk quality particularly through increases in pure bivoltine silk production. Subsumed within this latter aim, however, could lie dangerous portents for rural labour. As a recent paper (Sinha, S. 1990b) has argued, the problem lies in the technology-driven conditions necessary for bivoltine rearing, on the one had, and in th adoption of automated processing technologies made possible by the superior characteristics of the silk produced, on the other.

4.78 The prospect of the increased availability of bivoltine silk has resulted already in the establishment of a number of units using highly automated technologies for the reeling, twisting and weaving of silk—traditionally all labour intensive activities. Further, the bivoltine-oriented goals of the NSP have generated serious suggestions that modern factory farming be introduced for silk production with the farmer's role being reduced to that of supplier of mulberry leaves. In addition to the impact this strategy will have on the employment in silkworm rearing, it will destroy a substantial proportion of the 6 lakh person years of full time employment presently provided by reeling. Much of the employment lost will be that of women who are particularly prominent in both silkworm rearing and reeling under contemporary conditions.

4.79. Outside the rarified world of factory farming, the effect of the new technology on efficiency is also likely to be negative. Bivoltine races have traditionally been reared in the temperate and relatively disease-free conditions of Japan, Korea and parts of China. Rearing them in India requires far more careful husbanding than the Indian sericulturist, familiar with the more hardy cross-breeds, is accustomed to. In the absence of hygienic rearing and feeding of the right type of mulberry leaves under well controlled temperature and humidity conditions, the productivity of bivoltine silk is low and sericulture is unprofitable. It is for this reason that, in the absence of a substantial market premium, bivoltine sericulture has not been more widely adopted in the country so far.

V

A NOTE ON FARM MECHANISATION POLICY

INTRODUCTION

5.1 The labour-saving advantage of farm machines was the main reason for rapid large scale farm mechanisation in the developed countries. These countries did not face the problem of rural unemployment because the labour displaced by farm, machines was easily absorbed by the growing industries. Unfortunately, this is not possible in the developing countries like India and consequently, the labour displacement associated with farm mechanisation has been a matter of concern.

Growth of Farm Mechanisation : Pattern and Consequences

5.2 The policy of liberal mechanisation in India has resulted in rapid mechanisation of agriculture during the last two decades. In particular, there has been a phenomenal growth in the stock of tractors, irrigation machines and threshers (Table-1). Although the firm data on farm machinery are available upto 1982, rough estimates of the population of major machines in 1989 show an accelerating growth of mechanisation. Moreover the available information about the Eighth Five Year Plan indicates substantial addition to maior farm machines during 1990-95, namely 7.8 lakhs tractors, 32.650 power tillers, 12.4 lakh threshers and 3500 combine harvesters.

5.3 Several studies have been carried out to analyse the impact of farm machines, specially tractors on farm productivity and employment. The emperical evidence on the impact of tractors clearly shows that the productivity increasing impact of tractors has been marginal. Hans Binswanger's analysis of large number of studies on tractors in South Asian region concluded that "the tractor surveys fail to provide evidence that tractors are responsible for substantial increase in intensity, yield timeliness & gross return on farms in India, Pakistan & Nepal. At best, such benefits may exist but are so small that they cannot be detected and statistically supported even with very massive survey research efforts." (Binswanger 1978)

5.4 The evidence on the extent of labour displacements points towards only small reduction in labour use due to tractors. The marginal reduction in labour input reported in these studies is explained by the fact that the adverse impact of tractors has been largely neutralised by the large increase in farm productivity as well as labour input generated by the phenomenal increase in area under assured irrigation sources (Tubewells and Pumpsets) and high yielding crops specially wheat. Most of these studies have wrongly attributed the contribution of irrigation to tractors. In fact tractors have significantly reduced the employment impact of irrigation and HYV crops.

5.5 In addition, rapid tractorisation in few regions has created several socio-economic problems. First, concentration of tractors among larger farms in the wheat belt has accentuated regional and interfarm inequalities, concentration of farm power among tractor owning farmers and shifting of cost advantages of farming towards larger farmers. Second, use of capital and commercial energy intensive machines like tractors has led to over capitalisation of agriculture and increasing cost of cultivation. This in turn has led to pressing demand of farmers for increase in procurement prices of farm products and the consequent increase in subsidies on farm inputs, credit and foodgrains. These subsidies have become a heavy burden on the economy.

The Impact of Harvest Combines on labour use, Cropping Intensity and Productivity

5.6 Harvest combine is relatively a new addition to the mechanisation stream in Indian agriculture. Its use is still limited to a few but prosperous pockets in the northern region of the country comprising Punjab, Haryana, Western Uttar Pradesh and Northern part of Rajasthan. It is a highly capital-intensive technique which completely mechanizes harvesting and threshing operations. The traditional technology, on the other hand, uses human labour and bullock labour for these operations, while the intermediate technology employs human labour for harvesting and mechanical threshers for threshing.

5.7 There are two types of harvest combines—the self propelled and the tractor drawn. The self propelled combines are mostly imported whereas the tractor drawn ones are manufactured within the country. The total number of HCs stood at 770 in 1972 which increased to 4060 by 1982.

Impact on Employment

5.8 The use of HC results in a near-total displacement of labour engaged in harvesting and threshing operations. A study done by the Agro-Economic Research Centre, University of Delhi (1981), for instance, has shown that HC Farms use just 0.5 man-days per acre in contrast to 9.2 MDs/A on farms using intermediate technology i.e. human labour for harvesting and mechanical threshers for threshing, in the case of wheat. This would mean nearly 95 per cent reduction in labour days employed for harvesting and threshing (Table 2). The worst affected by this displacement are the casual labourers consisting of both the locals and migrants who account for about 61 per cent of man-days used in harvesting. Since harvesting is the major source of employment for casual

labourers HC would cut down their employment substantially. Family and permanent labour are also reduced drastically.

5.9 The situation is worse with regard to paddy which is more labour intensive crop than wheat and involves use of human labour in both harvesting and threshing. Substitution of HC for manual operations would entail unemployment to the tune of 17.5 MD|A. Again it is casual labour (accounting for as much as 80 per cent of MDs used in manual harvesting and threshing) that gets practically eliminated under HC. This would mean not only sizeable unemployment for labourers in Punjab (unless alternative opportunities are available), but also blocking of an important avenue of employment for the migrants from the backward and low wage areas of north Bihar and eastern U.P.

5.10 The above study has estimated that introduction of each harvest combine in the case of wheat leads to a displacement of about 2500 man-days, 63 per cent of which constitute casual labour (32 per cent locals and 31 migrants), 23 per cent family labour and 14 per cent permanent labour, in the three sample areas of Punjab, Haryana and Rajasthan. The labour displacement by one HC in the case of paddy will be nearly one and half times that of wheat (3700 MDs), more than half of which will consist of migrants.

5.11 The total displacement in Punjab State alone—which had around 190 HCs (SP) during 1977-78—works out to 11.84 lakhs man days in regard to wheat and paddy. This was the situation when hardly 2 per cent of the area under wheat and paddy was covered by HC in Punjab. The number of HCs and the area operated by them has gone up several times by now, with a corresponding increase in the extent of labour displacement. (The number of HCs in the country as a whole has now increased from 770 in 1972 to 4060 in 1982 and to 4750 in 1990 i.e. by about 6 times). If the entire paddy and wheat area is brought under HC, it is likely to result in displacement of about 5.1 crores of the mandays.

5.12 On tractor-thresher farms, the use of HC will displace about 40 per cent of labour days (25|60). Since wage rates for harvest labour are much higher than the rates for the rest of operations, harvest labour may account for more than 40 per cent of the total wage-bill on farms already using tractors and mechanical threshers. In Punjab, Haryana and West Uttar Pradesh, harvesting is done at present mainly by unskiled labour which is known to migrate on a significant scale from the over populated and depressed regions like East Uttar Pradesh and Rajasthan. Mechanized harvesting would thus hit rural labour, particularly those migrating from the depressed regions by significantly reducing their employment and income.

Impact of Harvest Combines on Production

5.13 It is often argued that even though initially HC may displace labour, eventually it will lead to increase in production and cropping intensity which in turn will raise employment levels.

5.14 However, according to some studies, the rise in employment on the farm needed to compensate for the decline in employment because of HC would be as high as two-thirds (66.6 per cent). The rise in output needed to absorb the required labour would be 133 per cent on farms already using tractors and thresners. Even if there is some saving of output on account of greater efficiency (including timeliness) of harvesting and thresning, it is highly unlikely that the use of HCs on farms already using tractors and mechanical threshers would enable a rise in output of .133 per cent through the rise in cropping intensity consequent on the use of HC. HCs would thus result in a net displacemet of labour on a large scale.

5.15 As regards cropping intensity, the survey conducted by the Agro-Economic Research Centre, University of Delhi in Ludhiana, Karnal and Ganganagar shows no significant difference between users and non-users (it is around 1.80 for both). Individual differences in cropping intensity are explained by the size of holding and irrigation expenses per acre and not by the use of HC. Farm size is negatively correlated with cropping intensity i.e. smaller the size of holding, greater is the cropping intensity. Irrigation, on the other hand, is positively related to cropping intensity,signifying higher intensity on farms with better irrigation facility.

5.16 Total farm productivity per acre works out to be about 10 per cent more for users as compared to non-users. The differences are more in the case of Kharif crops than with regard to Rabi crops. On the whole, users get higher yield per acre than non-users in the case of both wheat and paddy. Analysis of the data indicates that the higher yields among combine users are, by and large, explained by higher doses of fertilizers (which can be taken to represent the HYV technology and irrigation) rather than by HC per se. There is no technical complementarity between the of combine, tractor and biological-chemical inputs, for these can be independently used with equal advantage. However, there is complementarity in resource use in the sense that big farmers in general have better access to all these resources than the medium or small farmers.

Conclusions

5.17 The major conclusions that emerge from the above survey of evidence on harvest combines are the following :

1. The bulk of the demand for HCs stems from the large farmers (with size of holding above 15 acres) in the prosperous, high wage pockets of the northern region comprising Punjab, Haryana, Western Uttar Pradesh and Northern Rajasthan. This highly capital intensive technology is used only on a fraction of the area under wheat and paddy in these areas. Even in Punjab, the centre of the Green Revolution belt, the area under HCs is a very small proportion

of the total area. The vast majority of farmers in the country—small, medium and big—still prefer to use either the manual or intermediate technology for their harvesting and threshing operations.

2. Even among the users of HC, the majority employ also the alternative technique on part of their farms, in order to meet the fodder needs of their cattle, among other considerations. The 5 per cent loss in grain under the labour intensive techniques due to exposure to weather, pests etc. is more than compensated by 100 per cent saving of fodder. In fact, the use of mechanical threshers considerably reduce the grain losses also.

3. The use of HC may be cheaper than traditional technology from the private point of view, in certain high wage areas. It has no scope, however, in large parts of the country where wages are lower. The main argument against any extensive use of the combine is that it would render practically the whole of local casual labour and migrants unemployed during the harvesting season which accounts for 40 per cent or more of their employment. In a country where technological progress and the distribution of its benefits have been quite uneven as between different regions as well as various social clases, mobility of labour from backward to prosperous areas in search of employment is one way of helping towards more equitable distribution of the fruits of technical progress. Mechanisation of harvest operations would virtually halt this labour mobility and cut off an important source of their earnings. It would also depress the wage levels in the advanced regions. It is well known that wages in these regions have not kept pace with the rise in rents and profits, after the advent of the green revolution. It is evident that the use of machines like HC would tend to further widen this disparity in incomes and would thus defeat the important plan objectives of reducing income inequalities and removal of poverty.

4. A case for mechanization of harvesting can indeed be made out if there is compensatory increase in employment through increase in cropping intensity and productivity per unit of net sown and/or gross cropped area. Available evidence on this score does not indicate the possibility of any such increase in employment. Differenees in cropping intensity and productivity between users and non-users of combines are accounted for by other inputs like irrigation and bio-chemical inputs rather than by the harvest combines per se. Even if users of tractors and combines may score an advantage over the non-users in speedy completion of their harvesting and ploughing operations, it is highly unlikely that this alone can help them to raise another crop unless supported by other complementary inputs like assured irrigation and suitable varieties. There could be some advantage of yield increase due to early sowing but even this does not appear to be significant.

FUTURE POLICY

5.18 It is quite evident that the farm mechanisation policy followed so far has been essentially oriented towards the interests of the big farmers and the social costs of labour saving farm machines have been largely ignored. In fact liberal official incentives including the writing-off of loans, have helped in increasing the profitability of farm machines. The cost of cultivation data show declining per hectare labour use, increasing neutralisation of labour-absorbing effect of irrigation and HYV technology by labour-saving machinery in several states and declining employment elasticities in agriculture. The World Bank's annual report on India for 1989 has warned about the dangers of premature mechanisation caused by credit and other subsidies. Further, the report predicts "an actual reduction in the demand for agricultural labour in the next decade in states like Punjab, Haryana, U.P. and Madhya Pradesh." There is, thus, a need for a change in the policy.

5.19 The formulation of an appropriate policy on farm mechanisation is a complex task involving many socio-economic factors. On the one hand, big farmers find it economical to use labour-saving machines. And in a few regions the farmers are motivated by the shortage and high cost of human and bullock labour. On the other hand, the country is faced with the serious problem of growing rural unemployment and rural migration to already congested urban areas. There is no doubt that given the expected growth of population and industrial employment during the next few decades, bulk of the additional rural labour force would have to be absorbed in agriculture. Thus, there is a conflict between the private interests of the big farmers and the socio-economic goals of country. The objective of policy on farm machanisation is to reconcile the private and social goals so as to regulate the pace and pattern of farm mechanisation in accordance with the accepted national goals of balanced regional growth with equity, employment generation and self-reliance.

5.20 The first task is to work out a decision criteria after careful consideration of social benefits and costs of farm machines. Since farm machines differ in respect of social benefits, costs policy has to be specific to different machines. Besides, regional variations in these variables have to be taken into account. The formulation of a decision criteria is undoubtedly a difficult task.

5.21 For the purpose of policy, farm machines can be grounded in three broad categories. The first category include irrigation machines (Tubewells and Pumpsets) which significantly increase farm productivity as well as the demand for farm labour. There-

fore, the use of irrigation machines needs to be encouraged. However, there is a need for regulating the pace of irrigation machines according to the availability of ground water so as to minimise ecological problems arising out of over-exploitation of ground water and growing of highly water-intensive crops in the arid regions.

5.22 Combine Harvesters and Threshers fall in the second category. These are highly labour-displacing and have marginal impact on productivity. Since harvesting operations account for about 40 per cent of total labour input in crop production, widespread use of Combine Harvesters would have disasterous impact on rural employment. Therefore, the production and availability of this machine should be pegged at the existing level. In addition, seasonal migration of labourer to labour scarcity areas should be officially arranged.

5.23 Tractors and Power Tillers constitute the third category. These machines are labour-saving but under suitable conditions also add to productivity. However, the availability evidence shows that, by and large, the productivity increasing impact of tractors has been much less than labour displacing impact. Moreover, the rapid tractorisation would have significant impact on the limited supply of diesel oil as well as scarce foreign exchange resources. Therefore, use of tractors need to be restricted to areas facing serious shortage of human and bullock labour.

5.24 Restricted mechanisation implies the need for improvement in the animal-drawn farm equipment to increase the efficiency of animal draught power. All the Plan documents have repeatedly emphasised this point. ".....first priority will be given to the utilisation of manual and bullock power in the context of small farm and small farmer economy of the country" (Fifth Plan). "The role of cattle and buffalo as draught animals has, of late, gained importance in view of the unprecedented hike in the prices of diesel and petrol" (Seventh Plan). In practice, however, very little has been achieved. The main reason, as pointed out by the National Commission on Agriculture, is that "there is a big slant in the thinking of experts and officials alike in favour of tractors drawn machinery." It is high time that concerted measures are taken up to improve the efficiency of draught animals by encouraging use of improved equipment.

5.25 It is essential that effective policy instruments are used to ensure proper implementation of the declared policy on farm mechanisation. Apart from regulatory measures like licensing, effective fiscal measures would have to be used. These include pricing, taxes, subsidies and credit in respect of farm machinery as well as energy used by these machines. The Sixth Plan (1978—83) document emphasised that "in order to put restraints on indiscriminate mechanisation, it would be desirable that the pricing, credit and fiscal policies are not made unduly favourable."

5.26 Data show that the prices of the electric motors which are used by all categories of farmers increased at a faster rate in the eighties, as compared to other major farm machinery like tractors which are mainly used by large farmers (Table-3). Liberal long term credit assistance in the above areas especially for the small farmers would be fully justified. Subsidies should be strictly targetted to the small farmers.

5.27 Regarding tractors, it appears that the rise in their prices has been slower than the rise in agricultural wages in Punjab or prices of food articles (Table-4). This trend in relative prices is, indeed, a factor inducing farmers to go in for labour-displacing mechanisation. It is important to reverse this trend, if we are to achieve employment maximization. This would require a hike in the excise and other duties so that the price of tractors relative to wage does not become cheaper; in fact, it should be costlier so as to reflect relative scarcities of resources.

5.28 The present rates of excise and other taxes (1991) amount to 15.9 per cent of the ex-factory price of medium (35 HP) tractor and nil for a small tractor (27 HP) (Table-5). Earlier, only tractor upto 12 HP were exempted from excise duty. Even to keep the relative prices of tractor vis-a-vis wages constant, if not higher, the excise and other duties would need to be raised accordingly.

5.29 The present policy of subsidized financing of the purchase of tractors does not seem to be justified in view of the arguments advanced above. There is no case for concessional credit since the buyers are farmers.

5.30 The same arguments apply even more strongly to the case of combine-harvesters. The rates of excise and other duties which are at present more or less equal to those for big tractors (around 15 per cent ad valorem) can be pegged at a higher level than for the big tractors in view of the higher social costs associated with the use of combines.

Table 1 : Growth of Agricultural Machinery in India, 1966-1982

(Hundreds)

	1966	1972	1977	1982	1990 (Estimated)
1 2	3	4	5	6	7
1. Tractors	5,40	1,482	2,759	5,185	10,700
2. Power Tillers	166	172	160	797	920
3. Oil Engines (including Electric Pumps)	4,710	15,460	23,587	32,956	109,000

1	2	3	4	5	6	7
4.	Electric pumps	4,150	16,180	24,397	35,811	
5.	Combine Harvester	N.A.	77	43	406	475
6.	Tractor Operated Implements : Mould					
	Board & Disc Plough	N.A.	573	925	1,429	N.A.
	Disc. Harrows	N.A.	556	1,292	1,892	N.A.
	Tillers	N.A.	815	1,766	N.A.	N.A.
	Seed-cum-Fertilizer Drills	N.A.	246	640	515	NA.
	Seed Planter	N.A.	85	244	905	N.A.
	Trailer	N.A.	551	1,450	2,202	N.A.
7.	Power Driven Threshers :					
	Wheat Threshers	N.A.	1,825	4,278	8,319	N.A.
	Paddy Threshers	N.A.	136	375	1,318	N.A.
	Other Threshers	N.A.	97	188	613	N.A.
8.	Sprayers	2,107	4,479	6,333	1,239	N.A.
9.	Sugarcane Crushers (Powered)	451	872	1,089	1,208	N.A

Source : Indian Livestock Census, vol. 1, 1997 and 1982.

Table 2 : Labour Displacement Per Acre by Harvest Combine in Ludhiana, Karnal and Ganganagar

Size-Group in Acres	Man-days Displaced Per Acre				
	Family Labour	Permanent Labour	Casual Labour		Total
			Local	Migrant	
	Wheat 1977-78				
Upto 20.0	2.57	0.70	3.75	2.25	9.27
	(90.2)	(84.3)	(90.8)	(94.9)	(91.1)
20.0 - 40.00	2.14	1.33	3.07	2.51	9.05
	(93.0)	(88.1)	(95.9)	(98.8)	(94.8)
Above 40.0	1.50	1.44	2.94	3.20	9.08
	(92.0)	(87.3)	(97.0)	(99.4)	(95.3)
Total	2.01	1.23	2.83	2.72	8.79
	(93.1)	(86.0)	(95.9)	(98.9)	(94.6)
	Paddy 1978				
Upto 20.0	2.78	1.12	5.64	8.85	18.39
	(91.4)	(83.6)	(97.9)	(99.9)	(94.8)
20.0—40.00	1.78	1.00	2.46	10.81	16.05
	(84.0)	(79.4)	(96.9)	(99.4)	(95.6)
Above 40.0	1.37	1.50	6.44	9.40	18.71
	(79.7)	(75.8)	(98.8)	(99.9)	(95.3)
Total	1.76	1.17	4.74	9.87	17.54
	(83.8)	(74.1)	(98.3)	(99.8)	(95.4)

Figures in brackets are percentages to mandays for intermediate technology (Manual harvesting and Mechanical threshing).

New Delhi, 1981.

Source : Laxminarayan *et. al.* "Impact of Harvest Combine on Labour use, Crop Pattern and Productivity." Agricole Publishing Academy, New Delhi, 1981.

Table 3 : Trends in the Wholesale Prices of Major Farm Machines

	Prices (in Rs.) on		Percent Increase
	3-1-81	24-6-89	
1. TRACTORS (MF-1035)—Diesel	63,819	109,209	71
2. TRUCKS (Ashok Leyland)	148,848	247,741	66
3. ELE. MOTORS (3 HP, 4 Pole)	1,505	3,400	126
4. DIESEL ENGINES 'Ruston IYWA'	12,490	28,400	127

Source : Index Nos. of wholesale prices in India.

Table 4 : Trends in Retail Price of Tractor, and Agricultural Wages in Punjab, 1981-1990.

YEAR	SMALL	MEDIUM	LARGE	Agricultural Wages in Punjab	
	Eicher (25 HP)	Escort (35 HP)	HMT (59 HP)	Ploughing	Harvesting
1981	40,810	69,249	85,245	10.90	13.60
1982	47,000	69,249	85,245	12.97	13.71
1983	47,000	64,399	87,301	13.87	16.04
1984	48,000	64,722	91,809	15.91	18.03
1985	51,135	71,000	101,503	17.33	21.42
1986	55,020	77,954	101,503	20.04	25.57
1987	59,920	82,870	111,841	21.91	26.25
1988	65,670	91,666	1,22165	23.87	27.97
1989	70,070	97,122	14,5892	.	..
1990	77,945	108,652	16,3089	..	..
Percentage Increase in 1990 over 1981	91	57	91	..	..
Percentage increase in 1988 over 1981	61	32	43	119.00	106.00

Sources : Ministry of Agriculture, Govt. of India; Statistical abstracts of Punjab, Economic and Statistical Organisation, Govt. of Punjab.

Table 5 : Ex-factory and Retail Prices of Tractor, January 31, 1991

(In rupees)

Particulars	Small Tractor (E—325, 27 HP)	Medium Tractor (E—335, 35 HP)
Ex-factory Price	97,982	101,351
	(100.00)	(100.0)
Excise (including Special Excise & Cess)	NIL	16,091
		(15.9)
Dealer Margin	4,800	5,690
	(4.9)	(5.6)
Retail Price	102,782	123,132
(Excl. S.T.)	(104.9)	(121.5)

Figures in brackets are percentages to Ex-factory Prices.
Sources : Ministry of Agriculture, Govt. of India.

VI

INFORMAL RESEARCH SYSTEM FOR NEED BASED TECHNOLOGY DEVELOPMENT

BACK GROUND

6.1 Technological progress is crucial to socio-economic development, since improvement in productivity, employment generation and the quality of life in general, directly hinge on S&T inputs with necessary fiscal and policy supports. However, technology alone does not ensure an equitable development since every technology demands a package of inputs as a prerequisite for its adoption, and these are often outside the reach of the weaker sections This has led to the isolation of poorer sections in rural areas from benefits of technological development, widening the gap between the rich and poor, and often adversely affecting the under privileged sections, weakening the social fabric as a whole. It is well-known that artisans, small farmers and women groups generally belonging to the class of rural labour, are the most affected. This major concern has infact been reflected in the technology policy statement of Govt of India, which says "The use and development of Technology must relate to the peoples aspirations. Our own immediate need in India are the attainment of (Contributed by Rural Reconstruction & Research Sources, New Delhi) technological self reliance, a swift and tangible improvement in the conditions of the weaker sections of the population and the steady development of backward regions. India is known for its diversity, technology must suit local needs and to make an impact on the lives of the ordinary citizen, must give constant thought to even small improvements which could make better and more cost effective use of existing materials and methods of work". It is in this context that the technological requirements or the rural labour is being examined. The situation hence demands that technological needs of this section be carefully identified, understanding all the related problems in a holistic manner and efforts made to specifically design and transfer technologies with a view to directly benefit them. The major objective of the present study is to find ways and means for achieving this and the role of an informal research system based on Participatory Technology Development and Diffusion (PTDD).

6.2 Technology development is a dynamic process which must continually react and adjust itself to the community needs. The technology-community interaction is in fact a two way process wherein the technology moulds the economic status of the society, also affecting the traditions, and culture, while the latter in turn influence the demand profile and hence the technology innovation chain. Hence, conscious efforts are needed both through the formal and non-formal channels to make a strong interface between the community and the S&T system, facilitating the following functions :

6.3 Identification of the technological needs of the community :

- Creating communication channels for reaching their needs to the R&D system.
- Creating channels for interaction between the scientific community and the people for a better understanding of the field situation, specially the constraints and assessing traditional technologies and practices prevailing.
- Ensuring support to the R&D system in terms of finances, infrastructure and policy measures for solving the technological problems posed through both formal system and participatory R&D.
- Field testing the technology options and assessing for their effectiveness vis-a-vis needs.
- Technology adoption including infrastructural development for its sustenance.
- Monitoring, evaluation and feed-back for further improvements

6.4 For any production system to thrive a constant interaction between the other sub-systems specially the R&D generating component and the clientele becomes essential. However, when translated to the decentralised unorganised rural sector it is seen that there are many gaps and even where linkages exist, these are weak and dormant. For example, the rural labour which is totally preoccupied with subsistence on a day-to-day basis lacks the drive to identify, concretise and articulate their technological problems. Nor do they have the necessary financial resources and wherewithal to innovate or interact with the external S&T agencies to initiate R&D, even if the problems are identified. On the other hand under the present education system there is insufficient incentive to enthuse the scientists and technologists to interact with the rural communities and solve their problems. Dealing with high technology is considered glamourous and is more rewarding. Further there is a misconception that solving rural technological problems, requires only low level technology, not calling for an intelligent and creative R&D. Hence such efforts are totally left to the individual or voluntary agencies, not necessarily having adequate technical back up and infrastructure, although any one who in spite of such systematic discouragement attempts to deal with rural problems would find that these are much more challenging In addition to technological issues, such an innovator has to contend with constraints based on scarce resources, small scales of operations, lack of skill and a difficult operational environment beset by socio-cultural, geographic, agroclimatic and other problems.

Considerable flexibility is hence demanded of technologies designed for the weaker sections and often these have to be suitably combined and packaged, based on a systems approach applying the principles of "social cyberneics." Clearly this problem has to be tackled both through the formal and non-formal channels. While the formal educational and training schemes in operation with emphasis on vocational guidance are useful for reasons not far to seek these alone will not suffice. Often, the rural groups under consideration cannot fit into the time frame, course constraints and specialisation which is necessarily a part of any formal training. Even access to such programmes could become a problem as in the case of women labour who have to combine their outside work with household chores and hence cannot find time at a stretch to pursue such courses. Further, the technology package has to effectively counter the constraints arising from seasonal variations, cultural practices and other local specific issues, including marketing.

6.5 Hence, looking to all the possible informal channels for linking the technology development process to the rural community in question and providing all the necessary supports for strengthening the same becomes mandatory, if need based technologies are to be developed and adopted by this section of one society. Often this is looked upon as a one way process with the formal S&T system attempting to transfer what is perceived to be an appropriate technology for the rural sector. However, the pivotal issue for success is one of people's participation at all levels, right from the stage of need identification and making R&D participatory. Inadequate attention to this may well be the major underlying cause of many a failures. It is heartening to note that attempts have been made atleast in the field of Agriculture, world-over for understanding and implementing the concept of Participatory technology Development and Diffusion. The Overseas Development Institute (ODI, London) has been experimenting with four networks namely Agriculture Administration (Research & Extension), Pastoral Development. Social forestry and Irrigation management. It has recently brough out a network paper on participatory Technology Development in Ecologically oriented agriculture, summarising some approaches and tools of PTD and listing institutions actively involved in this. Depending on the value given by scientists to the opinions and ideas of the farmers and in the degree of farmer control in planning, implementing and evaluating the research the participatory on farm trials have been differentiated as :

(a) Scientists on farm trials

(b) Collaborative trials

(c) Farmer led trials

6.6. However, the concept of participatory Technology Development through an informal R&D system has been tried to a lesser extent in technology Development outside the cropping system. Only sporadic attempts have been made in the context of rural labour. Thus the task of the informal R&D system is to bring the S&T community which is essentially in the universities|colleges, National research laboratories, and the government sector as well as some non governmental organisations, and industry closer to the rural target groups. The kind of channels currently available for such interactions are reviewed with a view to evaluate their efficacy, identify gaps, and suggest further measures.

Role of Educational System

6.7. Obviously, any educational system is meant to train the minds of the younger generation and also impart specialised training of skills for making them productive elements of the society. Thus such a system has the role of widening their horizon in a general sense, sensitising the students to the national needs, preparatory to good citizenship, while also equipping them to earn their livelihood and find a niche for themselves in the society. Although it has been a common concern that perhaps the present system has not been able to fully meet these challenges, it has certainly made significant strides since independence. However, essentially these have been to the benefit of the organised industrial sector.

6.8. As for the rural areas, especially rural labour, the efforts have not been adequate inspite of the fact that in the last decade agricultural universities and rural universities and more recently community polytechnics have been established with emphasis on agriculture and vocational training. The contributions of the formal system in this direction have been dealt with in detail. But it is difficult to cater to the needs of the informal sector through such formal channels alone and the infrastructure created under this system can and should be used with necessary additional inputs for functioning as extension arms in an informal way. Already efforts have been made to this effect through the following schemes with encouraging results.

1. Extension centres of the Agriculture Universities.
2. Extension Centres of the Community Polytechnics.
3. Functional literacy and other schemes of U. G. C. being implemented by Universities and colleges.
4. NSS scheme of the Ministry of Human Resources Development, Govt. of India.
5. Extension centres created by other Technical Universities and colleges such as centres within IITs, IISs, TTTIs etc.

6.9. Of these the first two belong to a category of institutions whose very objective is to cater to the needs of the rural areas. On the other hand other institutions do not have this as the major focus and hence their efforts are essentially to make some use of the available infrastructure within their institutions, rather than a full-fledged involvement with the rural sector. Some salient features of these schemes having a bearing on cooperation with rural labour and development of need based technologies are stressed in the National Policy on Education 1986. It may be noted that it has proposed setting up of Special Institutes for Rural Technology in each State

6.10 The schemes of Community Polytechnics instituted in 1978-79 and Krishi Vigyan Kendras of ICAR which are closest to the grass root level have much scope for initiating R&D in the informal sector. These schemes thus fall both under the formal and non-formal system of education and it is very much upto the system to take full advantage for making it useful to the informal sector. Further, some of the technical universities have already initiated courses to sensitize the students and encourage them to tackle live problems of the rural sector for action learning.

6.11 However, an examination of the work done so far by various educational institutions indicates that these have concentrated more on vocational training and lab to land technology transfer. Participatory technology development, if any, is confined to scientists led trials only. No efforts seems to be underway to understand, and assess based on scientific principle, the traditional technologies and existing practices so that the scientists can also learn from traditional wisdom and skills which have stood the test of times. In the absence of this, it is difficult for the scientist community to pin point the Science & Technology inputs required to upgrade the existing practices for enhancing productivity. World over, in the context of sustainable development, eco-farming is coming into vogue and renewed interest is being shown in ecologically compatible traditional practices with low energy inputs such as composting, mulching, vermiculture, and integrated pest management, mixed cropping and other old world methods of nutrient recycling. By the same token its important that traditional technologie- outside the cropping system are also be examined and suitably blended with modern methods.

Role of R&D Laboratories

6.12 The National Laboratories.—India is perhaps one of the few countries which has made large invesments in creating a network of National Laboratories for achieving elf-reliance. However, the R&D efforts have been to a large extent directed toward industry with less attention to solving the problems of rural labour. One of the schemes launched by CSIR for the rural sector is the estabishment of polytechnology centres spread all over the country. In a way these may be considered as the extension arms of the various CSIR laboratories Some of the industrial CSIR laboratories have been undertaking R&D on the live problems of the rural areas. A special Technology utilisation cell has been in operation in CSIR with a mandate for, technology diffusion. It has documented the R&D efforts of the laboratories in the context of Rural Technologies also. Further the National Research and Development Corporation whose main objective is to franchise technologies developed in CSIR has a component of Technology Transfer to rural areas through demonstration and production-cum-training centres.

Private Sector.

6.13 As for private sector. when an industry is established in a backward area, some amount of rural labour gets employment basically in unskilled jobs. Adequate efforts have not been made by them either for skill upgradation or towards need based R&D. Also, it was seen that when Income Tax rebates were available on expenditure for R&D in rural development, a large number of private industries reached by establishing extension centres in rural areas. These efforts over the years had declined owing to the change in government policy on Income Tax rebates.

Governmental Efforts

6.14 A number of Departments of Central and State Governments have programmes related to rural labour. However, majority of these programmes are either welfare oriented aimed at technology tansfer through training and demonstration. Even the maintenance|monitoring evaluation and feed back components are weak. R&D for the informal sector has been marginal. Further it has been observed that the job opportunities in the service sector is directly proportional to the infrastructure created in the area, because these are sustained both by a minimum density of demand and maintenance facilities aavilable. A more equitable distribution of physical facilities would mitigate the problems of unemployment of rural labour to a great extent.

Role of voluntory organisation.—Voluntary organisations which by the very nature have a better opportunity for grass root level interaction, have a pivotal role to pay. They can interest with all the other types of organisations, namely, governmental, universities and colleges, and private industries, for not only training and technology transfer but also in need identification, and R&D, ensuring people's participation. Some of the efforts of such NGO's have been encouraging and are suitable for replication. It would be very useful if the successful attempts are documented and disseminated.

SPOT ANALYSIS OF THE PRESENT SYSTEM

6.15 The basic objectives of establishing an informal R&D system are :

(i) to identify the needs of the community by actually interacting with the people.

(ii) it is equally important that even in undertaking R&D on same. people's participation is ensured.

6.16 This would help in identifying practical problems right at the inception and inculcating a feeling of involvement and pride in the target group making it easy for subsequent adoption. Also this would help in 'technology blending taking the best of time tested traditions and giving modern inputs. In fact, in the context of sustainable development, modern science has realised the underlying wisdom in many traditional practices which are more compatible in terms of energy conservation, environmental impact and optimal exploitation of natural resources.

6.17 Unfortunately, the above two major factors have not been given adequate attention in the present system of formal as well as informal interaction of the scientists with the rural communities. More often than not, the scientists are involved only in the

process of technology transfer as an end in itself. This situation needs to be deemed by creating awareness amongst the scientists|technologists on the importance of Participatory Technology Development. From this, it is glaringly evident that the efforts made so far are mainly towards forward linkages between S&T personnel and rural labour. The backward Linkages are practically non-existent or very weak. Evidently unless thi is strengthened there can be no meaningful cooperation between scientists and technologists and rural labour. In view of this following general and specific recommendations are made.

RECOMMENDATIONS

GENERAL

1. Measures may be undertaken or tapping the infrastructure of the existing educational systems for creating an informal R&D network.

1.1 Introduce Courses to create a climate making S&T personnel aware of the special needs of rural labour, and project the challenges.

1 2 Channel should be open for an informal interaction of the students and Faculty with the rural communities. The existing sy tem of NSS must be suitably modified and given a charter for this.

1.3 Special facilities like sabbatical leave, recognition, incentives and awards be given to individual scientists for interacting with the rural labour to identify their technological requirements and working with them towards solutions.

1.4 Special provisions be made for training such interested scientists in methodologies for science-society interfacing, recognising that they need to take a holistic approach combining concepts of S&T with issues related to operation in Social micro-environments.

1.5 The extension arms of the formal educational system must be suitably strengthened for not only technology transfer but also Participatory Technology Development and Diffusion. This would mean establishing field laboratories where equipment can be handled by the people under the guidance of S&T personnel. Also, technologists in the formal system must handle and evaluate traditional machinery working with the artisans under field conditions

1.6 In addition to already existing formal institutions, facilities for distance education in terms of open technical universities and special instituion mu't be established for providing a continuum of education with innovative programmes to suit conditions of the rural labour.

2.0 National Laboratories

2.1 It may be provided in the charter of all the national laboratories to direct a sizeable component of their R&D effort towards rural areas for Participatory Technology Development.

2.2 In evaluating the working of these laboratories special attention be given to their contribution towards the rural labour both through the formal and informal channels.

3.0 Private Sector

3.1 Already encouragement is being given for setting up industries in backward areas. Further incentives and special Programmes may be launched for drafting them as mother units which should exploit local artisanal skills for setting up ancillary units and skill upgradation.

3.2 Policy on Income tax rebate may be made conducive to investments by the industry in activating and sustaining investment on informal R&D through Participative Technology Development.

3.3 Industry may launch special programmes to stimulate local innovativeness in terms of skills for mutual benefits, using the quality circle concept.

4.0 GOVERNMENT PROGRAMMES

4.1 Modifying existing programmes for forging forward and backward linkages for supporting informal R&D system. This could be done through All India Coordinated Projects, placement of young scientists with informal groups working for rural labour on live problems.

4.2 Funding voluntary organisations for organising special participatory workshops for small farmers, rural labour, artisans and women groups with S&T personnel.

4.3 Providing desired inputs (financial and policy supports) to other channels such as the formal education system) private industry &NCO engaged in informal R&D,

4.4 Establishment of Industries, laboratories, Government Offices and other infrastructure should be properly planned for not only enhancing job opportunities in backward areas but encouraging informal R&D also.

5.0 NON-GOVERNMENT ORGANISATIONS

5.1 Special Training programme may be initiated for strengthening S&T capability of NCOs. For this funding may be provided by CAPART, DST, Ministry of Rural Development among others.

5.2 All steps may be taken to envolve NCOs as an important unit in developing forward and backward linkages between the formal R&D system and Rural labour.

5.3 Efforts be made to establish core group with S&T capability within the NCOs (Funds for this should come from Government as in the STRAD scheme of DST).

6.0 SOME SPECIFIC RECOMMENDATIONS

6.1 Funding All India Coordinated Project for creating a network of informal R&D Units for PTOD.

6.2 Funding special projects for instituting and concept of Quality circles amongst rural labour for stimulating their participation in R&D.

6.3 Constituting informal Development forums in institutes of higher learning for encouraging the interaction between S&T personnel and people.

6.4 Formulating suitable leave rules for S&T personnel so that Scientists/Technologists can stay and work with rural labour for specified length of time.

6.5 Funding of specific projects for involving people and voluntary agencies for identifying and compiling technological needs of rural labour on a continuous basis for preparing data base and initiate R&D at different levels.

6.6 Use of mass media and other methodologies for exposing people to technologies relevant to their specific areas and needs.

(i) Video films and slides may be prepared based on practices in different climatic zones.

(ii) Special funds may be provided for exhibition which could be mobile and also technician level workshops for experience sharing (with emphasis on practical skills)

VII

TECHNICAL TRAINING SCHEME IN RURAL AREAS—AN EVALUATION

Training and Skill Development—The Philosophy

7.1 In a fast changing economy, particularly when the technological environment is changing towards automation and sophistication, and to the detriment of the unskilled workforce, it is recognised that physical-capital-bias to economic development cannot be a preferred strategy. Governments even in developed countries have come to realize that employment and training or human capital incentives were as, if not more, important for promoting economic development.

7.2 In our country there has been a deliberate policy of encouraging higher education and promoting technological advancements at the frontier areas. Yet, these Institutions of higher learning have not made the necessary impact on Indian Industry. While the new technologies have a role to play in a large country like India, one also has to take cognizance of the industrial structure prevalent in the country to see whether there really is a demand for such education and skills. The industry structure in reality is still biased towards technologically less sophisticated industries. A bias in the educational system towards rural technologies and increasing the availability of good technicians rather than qualified engineers and technologists may be necessary for optimum utilization of human resources in the country. An equally important issue for the counrty is to enhance the social returns on education and training. Towards this end it is imperative to focus attention on improving the quality of our technicians and skilled workers and to increase the size of this workforce.

Skill Development & Training—The Indian Experience

7.3 It is difficult to talk of technology absorption and skill development in a rural society beset with high level of illiteracy. While there is a distinction between education and training, lack of basic education accentuates the problem of skill development and technical training as it hinders effective communication of technical concepts. It has been argued by some that emphasis on vocationalization at primary school level is detrimental to mental development of the students and that good basic education is a prerequisite for success in skill based occupations. Unfortunately the basic education in India has received far less attention with the result that the levels of literarcy in the rural areas are quite low. Therefore, a large percentage of the rural society, particularly the rural poor, remain outside the domain of the formal system of education and training.

7.4 Skills can also be acquired on the job. In the Community based industries skills are often passed on in the family from generation to generation through a form of apprenticeship. Studies of the Community Based Industries reveal that in such cases there are numerous business upheavals and the continuity of business does not extent beyond a few generations. To provide stability, even in such industries there is a need for providing inputs and support from the outside, to introduce new technologies, new methods of working and to improve their capacity for innovation and adaptation. In the absence of interventions, the products made by the artisan communities lose their markets and these industries decline, which leave; the artisans in a precarious position. The lack of marketable skills acts as a barrier to exit and leaves them with no option but to follow the low price, low quality, low value added strategy which only impoverishes them further.

7.9 The Industry and Business could have been an important institutional mechanism for on-the-job training. The large and medium scale industry, unfortunately, has made marginal efforts towards supportive education, training and skill development. There are a variety of reasons for this attitude of the industry.

(a) Training is costly business and where the educated and the skilled workforce is mobile, industry is reluctant to invest in human Resources Development. The same holds true for inducting the fresh graduates who given our educational system, need reorientation and training before they can be inducted into business. In the absence of any government subsidy for training the industry has been opting for capital intensity.

(b) The industrial policies of the government have tended to promote investments rather than generate employment, the investment subsidy being an example. Similarly, the protection afforded to industry through licensing and import restrictions has created an ethos where quality consciousness and productivity are not the critical issues.

(c) The rise of militant trade unionism has forced industry towards automation and capital intensive programmes even where labour intensive efforts would have been more appropriate and economical otherwise.

(d) The large wage differentials that exist between the workers in organized and the unorganised sector also have a detrimental effect on the employment generation as well as training in the organised sector. The wages in the organised sector are pegged artificially high and at the entry level they are about three times that in the unorganised sector. The

unorganised sector, as well as the small scale industry finds it difficult to retain labour force once it is trained.

7.6 As a consequence, during the recent past, the large and medium industry has had a negative growth in workforce. The major share of the employment generated in the country is from the cottage and small scale sector, During 1984-85, it employed 31.5 million people while the employment in large scale industries, was only 5.2 million people. Since the employment is generated in small scale sector, this sector has had to take on the responsibility of training and skill development as well, a role for which it is not best equipped.

7.8 In the absence of private sector initiative and implementation of on-the-job training programmes, the bulk of the responsibility for education and training has rested with the Government. The Government, in turn, has responded to this need by formalizing an array of schemes for training These schemes range from certificate courses to short-term training programmes which are designed and implemented by various Ministries and the Departments of the Government (Annexure).

7.9 To involve industry in imparting practical training an important legislation enacted by the Government was the Apprenticeship Act, 1961. Through this act, public and private establishments were required to impart apprentice training according to the size of the company and an apprentice-worker ratio ranging from 1 : 1 to 1 : 10 was established. The programme was centrally administered for the Central Government Establishments while for the private and State Government Establishments, the respective State Governments held the administrative responsibility. Initially the act envisaged training of trade apprentices but it was amended in 1973 to include graduate apprentices and the technician apprentices. (i.e., engineering graduates and diploma holders respectively). In 1987. another amendment was made to bring the vocational apprentices (students from 10+2 vocational stream) also in the fold. The apprentices are also paid a stipend during the training period, lasting from 1 to 4 years.

7.10 While industry was expected to bear the bulk of the cost for apprentices most other schemes are partly or fully funded by the Government. Each year separate provisions are made for employment and training in the Central budget. The Ministry of Labour alone made a provision of Rs. 11 Crores (planned) and around Rs. 10 Crores (non-planned) for employment and training purposes in the 1988-89 budget. The largest share (45 per cent) of expenditure was on formal technical education. The second most important programme is the Apprenticeship Training Scheme which received about 9 per cent of the total allocations on training.

7.11 The Ministry of Industries, similarly, undertakes technical training through its various institutions, such as, the Khadi and Village Industries Commission (KVIC), All India Handicrafts Board and the Development Commissioner (Handlooms) and through the small Industries service institutes. Most of these bodies operate through their own network of institutions and adopt various approaches to training including demonstration by master craftsmen, apprenticeship schemes and short term training programmes.

THE TRAINING PROGRAMMES

7.12 A thread of commonality which runs through most of these training programmes is that they are centrally conceived, packaged and delivered in the field. In a sense technical training in rural areas is not very different from what is done in the urban areas, except that in the rural areas the quality of the training suffers from all the rural disadvantages At the same time there is an inherent urban bias in most of the programmes because they are generally directed towards the educated unemployed. Given the low rates of literacy and lower sustaining power of the rural poor, learning and skill acquisition is not their primary concern.

7.13 The training programmes can be categorized in four major groups :

(a) Formalized Educational Programmes—which lead to certification necessary for entry level position in public and private sector.

(b) Skill Development Programmes—short-term courses or apprenticeship schemes.

(c) Training as a Sub-component of Development Programmes.—The institutionalization of training in such cases is programme dependent, and the programmes themselves are target oriented.

(d) Training for Trainers and Supervisors.

REVIEW, ASSESSMENT AND LESSONS

Technical Training Schemes Evaluated

7.14 A review of the technical training schemes suggests that irrespective of the administering Ministry or Department of the Government most of the schemes have not been very successful. The success is being measured in terms of employment generation, including self-employment. An obvious solution is to improve on the schemes, strengthen the implementation process, and invest more resources in these schemes and or devise new schemes or programmes. Literature suggests that recommendatons to this effect have often been made and the government, from time to time, has been reacting to the suggestions by announcing new training initiatives or steps for upgradation of training

7.15 It is often assumed that the major problem in the country is the non-availability of adequate

number of well trained artisans. Industry tends to support this theory. They argue that in the absence of skilled manpower they are unable to diversify operations in rural areas. While the argument about the supply side constraints cannot be brushed aside, there are others who point out that the technically trained manpower in the country are not in great demand. This holds true not only for the highly qualified scientists and engineers who immigrate from India, but for most categories of technically trained personnel carpenters plumbers, nurses, etc., who end up migrating to other countries. While wage differentials may partly explain the reasons for migration, the demand constraint theory does have some merits.

7.16 Why should there be a demand constraints for skilled labour in a growing economy? First, due to its total dependence on technology import and little investment in technology adaptation, an industrial plant in India is as capital inetnsive as the original. Second, the schemes like capital subsidies encourage capital intensiveness in Indian industry. had, the growth of strong trade union movement and numerous labour laws also prompt small and large industry to adopt labour saving approaches. Fourth, in the presence of high job security and high incomes in the organised sector there is little motivation for workers to invest in learning and skill acquisition. Fifth, by reserving a large number of low-priced products, which could otherwise be produced cheaper and better in mass production system, for the small scale sector the entry barriers in some of the skill intensive industries have been reduced, thus changing the character of the labour market For example it was found that in leather footwear industry, the policy of reserving the low-priced shoes for the tiny and small scale sector, forced the skilled craftsman to become traders. In this price segment one competed on price rather than on quality and benefits of the reservation went to the trader rather than to an artisan. Thus, some of the governmental policies which have been formulated for protecting the craftsman have also obliterated the need for skill development and upgrading products and processes The Government policies towards small scale, tiny and cottage industry, have unfortunately paid scant attention to the impact of these policies on the industry structure and its consequent effects on the labour force in these industries.

7.17 Most of the training programmes for self employment have again been in areas which are still neutral. Thus, the need for good training is not felt by the trainees or the trainers The schemes, such as, SEEUY (Scheme for Self Employment for Education Unemployed Youth) are treated as lotteries by the beneficiaries. In the process a great deal is lost between the conceptualization of the scheme and its eventual implementation

7.18 The difficulties faced by the training institutions are compounded by the ideological debate on the efficiency of poverty alleviation programmes There are some who argue that managing assets requires a degree of skill and knowledge which is higher than that needed for performing a job Thus Rath (1985) argues for wage employment for the poorest of poor as the most effective instrument of poverty alleviation. There are others who feel that we cannot wait for the trickle down effects and that the distribution of income generating assets has a role. Should the training institutions in the rural areas be preparing the rural poor for self-employment or wage employmen remains ambiguous. TRYSEM for example, is major training programme designed for the rural poor. Even here it was found that enough rural youth could not be found to fulfill the targets for the training. Similar, the concurrent evaluation of the IRDP and TRYSEM in 14 States, tends to support the view that while endowment of income-generating assets may increase the family incomes of the poor, the crash programmes at training do not enhance their capabilities of managing resources. Many of these training programme have, in effect devalued the usefulness and importance of technical training.

7.19 Among the formalized institutions for imparting technical training, in the rural as well as urban areas, are the ITIs. While these institutions do make a major contribution to the pool of technically trained, a review of their functioning, however, suggests that there are major lacunae. If the privately run ITIs have grown much faster than those managed by the government it would suggest that there is a great demand for this type of training. In our informal interviews with some of the students from ITIs it was found that the major expectation was that the certificate after the training would help them secure Government job and fetch them high incomes. They were neither prepared nor trained for self-employment even though statistics reveal that the majority of them ultimately have to be self-employed. It was also revealed that if properly directed and counselled, rural youth would be interested in acquiring marketable skills. Yet the Government run ITIs continue to offer courses, which have little market potential The distinction between the private and the Government ITIs is highlighted by the fact that private ITIs are demand sensitive. For example, in U P 90 per cent of private institutions specialize only in 10 trades, where in the demand is high. These are : draughtsman (Civil), electrician, steno (Hindi), cutting tailoring, fitter, DPA, wireman, electronics, welder and COPLA.

7.20 The Government ITIs also suffer on account of (a) lack of training materials, (b) dearth of raw materials, and (c) lack of good rainers. While many ITIs have been well endowed with basic infrastructure and facilities, they are totally dependent on the government for operating expenses which are limited. The faciltities are often underutilized because of lack of training materials, raw materials and lack of good trainers. Therefore, while the certificate is useful for getting Government or Public sector jobs, most tainees are ill equipped to start on their own At the same time due to large wage differentials at the entry level in the public sector and the small scale sector the trainees are constantly on a look out for a public sector job. There is, therefore, migration to urban centres and job hopping As such little on-the-job learning takes place.

7.21 The apprenticeship programme was intended to provide on the job training to the unemployed youth. But this programme also has numerous limitations. First, most of the large employers are n the urban areas. Therefore, it encourages migration from rural to urban areas. Once rooted in an urban setting reverse migration is difficult. Second, the training at the employers premises is minimal and there is little incentive for the employer to improve its training programmes. Third, it was found that in reality the ITIs have little interaction with the business community Aprenticeship scheme ends up as a low wage employment scheme for those trained at ITIs. Interviews with apprentices suggest that the ITI graduates who have prior exposure to business and are purposive are able to gain far more from the scheme than the others.

Lesson

7.22 The demand for education and training in the rural sector is influenced not only by the employment potential and wage rates but also by the existing social structures, jobs status and the traditions Accordingly, the training institutions are also evaluated and ranked on the basis of these perceptions. Since the white-collar jobs command respect college education is valued more than vocational or technical education. Because of the colonial mind-set this is found to be true in many of the developing countries (Leonor, 1985).

7.23 In the rural areas one finds, that among the economically better-off technical education leading to work on the shop-floor, has limited appeal. On the other hand education leading to a government job has great allure. This is true even among the upward mobile in the lower castes. Therefore, institutions which award certificates that are recognised as prerequisites entry into government service are in demand. For many admission to ITIs is a way of obtaining a certificate which could help them secure a job with the government or the public sector.

7.24 For the rural artisan and small business, traditions come in the way of knowledge acquisition. In the absence of a culture of formal system of teaching and also due to the poor quality of training that has often been thrust on them, heev are resistant to change and adoption of new techniques and designs (Gupta, 1988 : 18). They do not see lack of skills as a constraint. Instead the tendency is to demand greater Governmental intervention and support.

7.25 The people who are least touched by education and training are those who need it the most, the unskilled, illiterate, mostly landless, rural poor. In the absence of education they are even unable to articulate their needs. Since for the rural middle class and the rural rich, education is available and accessible in towns and cities upgradation of the technological institutions in the rural areas has not received great priority. For similar reasons the vocationalization at the level of secondary education has not generated much enthusiasm. The setting up of the Navodaya Vidyalaya in the rural areas to update the quality of education, has also not been received favourably.

7.26 While training has become a big industry, the target orientation and fulfilment of quotas has ensured the neglect of quality. While some of the programmes are targetted towards specific communities, in general the programmes are designed and packaged around a concept and delivered in the field. There is little interaction with the community that is to be trained. The sense of purposiveness and attention to design is often missing.

7.27 But the major failures of our development process has been the neglect of primary education. It needs no elaboration. Training institutions, particularly those in rural areas, have to live with the fact that they have to operate at various levels, i.e., provide (a) basic education, (b) motivate the trainees, (c) create awareness and a scientific temper, (d) impart knowledge and skills, and (e) develop their capacity and capabilities for self-learning so that they are able to absorb new technologies.

7.28 Imparting training in the rural areas is therefore, a difficult task. It has to be selectively targetted, properely designed and co-ordinated. There is also a need to make training more rigorous by increasing the duration of training and by encouraging private sector initiative and involvement. It has been found that if the trainees see that skill development can enhance their earned capabilities even the poor rural youth is willing to pay for such training (Pati, et.al., 1987).

Rural Friendly Training,

7.29 To motivate the rural poor to participate in education and training it has to be made rural friendly. This involves :

- Creating opportunities for supplementary incomes during the training programmes.
- Community participation in the selection of trainees and the design of training programmes.
- Increasing programme flexibility.
- In Nagpur experiment the rural youth were brought to the city to work as apprentices with the local small business like, tailors, mechanists, etc. The one year apprenticeship supplemented by in class learning has been a success.
- Short courses in the evenings.
- Enlarging the scope of training by introducing science education, adult education and other community service programmes.

— Intergrating the functioning of the various institutions, like the ITIs, DICs (District Industry Centres), youth organisations, local business associations, etc.

RECOMMENDATIONS

7.30 Education in our country has been a victim of neglect. Today we can boast of one of the lowest literacy rates in the world. Yet instead of improving our educational system the concern seems to be on diluting standards and finding quick-fix solutions to employment. In the process over the decades the quality of education and even the value of education has taken a beating. Most educational institutions, which includes some of the prime institutes of higher learning, have lost their credibility. We have reached a stage where most degrees, diplomas or certificates bear no testimony of the ability.

7.31 While the problems of Human Resource Development are well known, so are the solutions. That primary education should receive primacy has been said again and again by educationists, economists and thinkers. It would not be amiss to reiterate that it is futile to talk of technical education and training without providing a good basic education to the people. Keeping this point in view and in the right of earlier observations we list out the issues of immediate concern and offer some suggestions and recommendations.

ISSUE—1 : Intensify primary and basic education in rural areas.

7.32 The technical institutions should be given a major role in education and information dissemination in the rural areas, since they represent a major investment. To achieve wider acceptance in the community such institutions should be made the focal points for the dissemination of information and knowledge and serve the larger community than just a few hundred trainees. It is recommended that :

— Atleast 25 per cent of the time and resources of such institutions should be devoted to running basic courses, conducting adult literacy programmes, disseminating information and providing scientific and technical services for the local community.

ISSUE—2 : Reduce Migration of Technically Trained

7.33 Better job opportunities and a better social infrastructure are two major factors which allure the technically trained to the urban areas. On the other hand for the small scale sector the lack of qualified technicians is a major handicap. It has also been found that to take advantage of backward area subsidies the industry may locate its plants in these areas, but may have little local impact since even the lower level workers are brought in from outside. It is, therefore, recommended that :

— The trade or industry in the small scale sector which hires a technically qualified person from the local training institutes should be given an employment subsidy for three years.

— Co-operatives, particularly, for housing, education, etc., should also be promoted for the employees of the small scale sector in the rural areas. Provision of housing loans and setting up of educational facilities can help to upgrade the quality of life.

— Government policies have to be modified to promote labour intensivity in industry by interest subsidies on loans, even in the small scale sector, should be linked with the employment generation.

ISSUE—3 : Improve quality of Education and Training

7.34 Considering the low quality of basic education in the country as a whole and the rural areas in particular, technical training and skill development is an arduous task. To improve the standard of training it requires : (i) greater investment of time and resources, (ii) improved training facilities and training materials, and (iii) well qualified instructors. It is also recognised that most of the candidates who join the technical training programmes belong to lower income groups and cannot afford the cost of training, if it extends over a number of years. A balanced approach and a creative programme design is therefore necessary.

7.35 The small scale sector is normally the major training ground for most unskilled rural youth. It is, therefore, imperative to involve and assist the small scale sector in technical training. In the urban areas private initiative, particularly in small scale sector, has been the major instrument for education and now it has extended its reach to technical training as well, through typing schools, computer training courses, etc. It is imperative to encourage private initiative and voluntary agencies in technical training. It is therefore suggested that :

Private and voluntary initiative in technical training should be encouraged by providing partial funding and facilities to these organisations.

Training programmes should be made more rigorous by increasing the duration of the programmes and introducing sandwitch courses wherein 50 per cent of the training is imparted on-the-job in the industry or business.

7.36. Industry has to bear direct responsibility in technical training and skill development. Most trades are best learnt on the job. Apprenticeship schemes, therefore, are the best mechanism for imparting skills To encourage better utilisation of the scheme the apprenticeship period should be suitably adjusted depending on the nature of the trade. The industry should not be held responsible for absorbing the apprentices in their regular cadre. One approach is to merge the ITI training and certification with the ap-

prenticeship scheme. Even today majority of apprentices join the programme after completing ITI training. It instead, certification is provided on completion of the apprenticeship it would help in better structuring the programme. In such a situation it would be possible to design a sandwitch programme wherein the trainee receives six months of inputs at an ITI and six months of the job training with an industry every year. Each ITI can make long-term arrangements with the local small and large business and industry who will then be a party to the design of the training programmes.

7.37 Since a majority of these trainees are ultimately self-employed, it would be useful to train them for the same. It is, therefore, recommended that :

> Courses on self-employment and management should be made integral to the technical training programmes.

7.38 Our study on the District Industry Centres revealed that a large percentage of the businesses set up in small scale sector, mostly cater to the local demand which and are thus location specific. Therefore, the training needs also have to be location specific. The technical training institutions should have enough flexibility to change their course structures according to the local demand. The local industry and trade associations should be co-opted and be the major stakeholders in such institutions. The design of the sandwitch programmes is one way of linking the two. Second, the small scale industry should be given a training allowance for every trainee that they adopt. Third, the apprenticeship Act may need to be amended to allow such training to be counted against the requirements mandated by the Act. Hence it is recommended that :

> Introduce flexibility in programme design by involving the local industry and trade associations in the programme design, training and evaluation.

ISSUE—4 : Training in the non-formal sector

7.39 The artisan communities in the rural areas are one of the important groups, who are left out of the formal training programmes due to the high educational requirements for the entrance to the trades. Studies have shown that one way of bringing about an attitudinal change among these communities, towards education and skill upgradation, is by selective targetting of training and by involving them in the process. It is recommended that :

> Community based training programmes, wherein the artisan community participates in the design of the programmes and in the selection of the trainees, should be conducted.

> The training institutes in the rural areas should be expected to devote at least 25 per cent of their time and resources to such non-formal training programmes.

7.40 There is a need to encourage setting up of trade associations. To create exclusivity and give due recognition to those who possess the necessary skills, the Government should constitute State level bodies which would conduct examinations and award diplomas to the craftsmen and technicians who qualify. Such a scheme has been introduced in UK and a National Council for Vocational Qualification" was set up. Conceptually, it is analogous to the Open University concept and is of great relevance in our country where many skilled workers do not get the necessary education. Involving the trade Associations in vocational education and restricting entry into the Association to members who have passed various tests can also bring in quality consciousness in the trades. The Trade Associations would also serve as a forum for dissemination of information and knowledge. It is therefore, suggested that :

> DGE&T should encourage formation of Trade Associations. Some of the training institutions can be provided the necessary financial support to initiate, develop and guide such association.

ISSUE—5 : Institutional Restructuring and Co-ordination

7.41 As pointed out in the report a diverse set of training institutions are operating in the rural areas. However, there seems to be little co-ordination among them, with the result that while physical infrastructure is created the facilities are not fully utilized due to paucity of funds and other resources. It is therefore, suggested that :

> The institutions promoted by various ministries at the district level, such as, ITI's, DIC's and, as well as the research, training and educational institutions of the State Government, should network and adopt a co-ordinated approach to training and Human Resource Development.

7.42 It is also found that many of the problems with the design of the programmes are due to lack of adequate understanding about the nature of rural industry and clear thinking on how to introduce technology and new products and services in the rural sector. Government and voluntary agencies have been promoting various schemes, for production and training. Of late, a number of "technology development, production and training centres" are also being set up in the rural areas. While innovation and experimentation should be encouraged, it is necessary to make a detailed assessment of these programmes. It is recommended that :

> A regular assessment of the skills in demand should be made and released to the training institutions and voluntary agencies.

ISSUE—6 : Financing of Technical Training

7.43 It is noted that training is expensive and most employers are reluctant to pay for training. This has created a great imbalance between the demand for trained personnel and utilization of the technically trained. Therefore, the approach adopted for financ-

ing of the technically training have implications on how the technically qualified are utilized by the industry. To increase—industry responsiveness to Human Resource Development many countries have introduced a turnover tax on companies, which is then used for government initiated industrial training programmes. Singapore, for example, has introduced such a tax. It is recommended that :

A Human Resource Development Tax should be imposed on all medium and large businesses to finance training for craftsmen and artisans. Seventy-five per cent (75%) of the funds, so collected, should be allocated to institutions operating in the rural and backward areas.

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ANNEXURE VI

TRAINING PROGRAMMES—SUMMARY DESCRIPTION

Kind of the Course/ Progr.	Course	Beneficiaries	Institutions Involve	Ministry/Department
A. Certificate Course Forsal)	1. Craftsmen Training 2. Apprenticeship	Youth with Certificate Level of Education	1. Government ITIS 2. Private ITIS	MOL/DGET
B. Skill Development Programme			Factories	MOL/DGET
	1. Rural Community Polytechnics	Rural Youth	Rural Community, Polytechnic Centres	HRD
	2. Advanced Vocational Training	Craftsmen and Technicians from the industries	Advanced Training Institutes of DGET dand ITIs in fifteen States.	MOL/DGET in collaboration with UNDP/ILO
	3. Entrepreneurship Training	Youth with the Technical background	Universities College, Institutes	Department of Science Technology
	4. Small Industries Service Institute (SISI)	Workers of Small Industries	At Institute workshop workshop	MOI
C. Training as sub-component of development programmes	1. TRYSEM 2. KVIC 3. Handlooms Board	Rural Population	At place and sometimes in some ITIS	MDA/Dept of Rural De MOI
	4. Handicraft Board 5. DIC	Entrepreneur	At centres itself and some time by demonstration in the fiel , also.	MOI
	6. Vocational Training programme (For Adult Women.	Women	Central Social Welfare Board	MOW & Child Welfare
	7. Occasional Courses			
	1. Entrepren urs in the Districts including rural areas	DIC	Department of Industry	
	2. Small and Medium sector Entrepreneurs	State Industrial Consultants	IDBI	
	3. Various Targets Groups including Rural Entrepren ures	Different banking and and Financial Institutions		
	4. Various Target Groups Including rural artisans and entrepreneurs	Voluntary organisation		
9. Training for Trainers/ Supervisors/Research Staff	1. Craft Instructors Training Scheme	Craft Instructors	Advance Training Institutes	MOL
	2. Supervisory/Foreman Training	Existing Supervisors and Foremen	Advance Training Institute	MOL
	3. Research Staff Training and Department of Training, Material in the filed of vocational Training	Executive Staff of the training Dept. of Industrial establishments, ITI, for instructors and officers of central and State Govts. engaged in planning and execution of Industrial Training programmes.	Advance Training Institutes	MOL

NATIONAL COMMISSION ON RURAL LABOUR
TERMS OF REFERENCE OF THE STUDY GROUP ON "TECHNOLOGY AND DEVELOPMENT STRATEGY FOR RURAL LABOUR"

1. To make a detailed assessment of the science and technology development strategy being followed in rural and the extent to which the programmes|schemes implemented thereunder have reached the bulk of rural population and contributed to their welfare and growth in sufficient measure.

2. To study the capabilities in different fields and the infrastructure already created for scientific and technological development in rural areas and recommend measures and policies for optimal utilisation of the potential created for the benefit of the larger section of rural population particularly the weaker sections.

3. To identify the main areas in which technological innovations could directly improve the living conditions of rural labour such as drinking water, sanitation, medical and health facilities, housing, energy education, transport and communication and entertainment and suggest quick result yielding schemes|programmes for improving the quality of life in rural areas.

4. To recommend such technological improvements and innovations as may enable rural labour (especially small and marginal farmers) to raise productivity, income and employment in farming and non-farming occupations including traditional and new crafts and other agro based industries.

5. To critically examine the contention that technological upgradation and modernisation adversely affect efficiency, wages, employment position and labour absorption in rural areas with special reference to women and to that extent it is counter-productive.

6. To make recommendations for programmes for informal research system under which a need based technology development strategy could be evolved with the cooperation between farmers and scientists.

7. To evaluate the current educational and technical training schemes being implemented in rural areas and make recommendations for appropriate manpower and vocational guidance programmes so that labour is fully trained and equipped to utilise the scientific and technological development in different sections of rural economy particularly in the diversification of agrobased industries.

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