NATIONAL PRODUCTIVITY COUNCIL

Productivity

Vol. 37 January–March 1997 No. 4

Focus : Green Productivity/Sustainable Development

Tradeable Emission Certificates

International Trade in Non-hazardous Waste

Green Sourcing

Sustainable Agriculture

Corporate Environmental Reporting

Fertilizer Subsidies

Women Entrepreneurs

Changing Structure of Draught Power

Capital Productivity in Indian Manufacturing

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Sustainable Development

M.S. Swaminathan

With the growing awareness and concern about the depletion of the ozone layer and the resultant green house effect, efforts are being increasingly directed toward development which is in harmony with the delicate ecological balance. In this context, the author presents the guidelines for pursuing 'ecotechnology' to ensure equity in terms of ecology, social and gender factors as well as economics.

M.S. Swaminathan is UNESCO Chair in Ecotechnology and Chairman, M.S. Swaminathan Research Foundation, Chennai. Paper presented at the APO World Conference on Green Productivity, Development Academy of the Philippines Manila, 4-6, Dec., 1996.

Since the advent of the industrial and technological revolutions, economic indicators have been used as the principal criteria for measuring sustainability. Population expansion, rapid industrialisation, commercialisation of agriculture and quantum jumps in economic activity have been some of the results of the development paradigm adopted after World War II. Technological progress in several areas such as space, information, biotechnology, energy and new materials has been impressive. During the last 30 years, there has been a growing understanding of and concern regarding the ecological and social costs of such progress. The UN Conference on the Human Environment held at Stockholm in 1972 and the UN Conference on Environment and Development held at Rio de Janerio in 1992 helped to articulate the serious environmental repercussions of contemporary development pathways. The UN Conference on Social Development held at Copenhagen in March, 1995 warned that development which is not socially equitable will lead to social disintegration and conflicts. Jobless economic growth and feminisation of poverty are the other consequences of the current pattern of development. Thus, the concept of sustainable development has now to be viewed in terms of ecology, social and gender equity, employment and economics. How to achieve such a synthesis in developmental thinking, planning and implementation is the task facing the decision makers.

The concept of sustainable development has now to be viewed in terms of ecology, social and gender equity, employment and economics.

As the International Business Council pointed out in its report, where there is a will there is a way (Schmidheiny, 1992). If technology has so far been a major cause of ecological damage, it can be a leader in finding methods to ensure that development is sustainable. In a recent study, Repetto et al. (1996) of

the World Resources Institute, USA have shown that environmental protection not only need not reduce productivity growth but can in fact stimulate growth without accompanying ecological damage.

Ecotechnology & Sustainable Livelihoods

Twentieth century: a balance sheet

As we approach a new century we can look back and draw a balance sheet of our achievements and failures. Spectacular progress in science and technology ranks first among our major accomplishments. Recent advances in biotechnology and genetic engineering, space technology, information technology and new materials have opened up uncommon opportunities for a world where every individual can lead a healthy and productive life. The spread of democratic systems of governance, the breakdown of apartheid and the advent of the information age have created the socio-political substrate essential for integrating the principles of intra- and inter-generational equity in public policy. The power of a right blend of technology and public policy is strikingly evident from the progress made in recent decades to keep the growth rate in food production above the rate of growth in population, thereby ensuring that the Malthusian prediction of population overtaking our ability to produce adequate food does not come true.

While the positive achievements are many and make us proud of the power of the human intellect, we will be entering the new millenium with some of the greatest social and scientific challenges humankind has ever faced. Several of these challenges have been articulated with great clarity in the Human Development Reports of the United Nations Development Programme (UNDP) of recent years.

Environment degradation and increasing economic and gender inequality are among the most serious problems we face today. The rich-poor divide is increasing at an alarming rate. The pattern of development adopted by rich societies is leading to jobless economic growth, pollution and potential changes in climate. Unsustainable lifestyles on the part of the rich billion and unacceptable poverty on the part of another billion coexist. The absence of an educational and health environment, which is conducive to every child achieving his-her innate genetic potential for physical and mental development, leads to the spread of poverty in capability. UNDP has proposed indicators for measuring both human development and human capability.

The U.S. National Academy of Sciences, the Royal Society of London, the Indian National Science Academy and 55 other scientific bodies in a statement made in 1993 pointed out "stress on the environment is the product of four interacting factors: population growth, consumption habits, technology and social organisation." Concurrent attention is needed on all these four factors to promote sustainable development and sustainable societies. The report "Sustainable America" indicates what an affluent society should do. In poor nations, the social sustainability of the development process is as important as ecological and economic sustainability. Also, if the current pace of damage to the ecological foundations, essential for sustainable advances in biological productivity, namely land, water, flora, fauna, forests, oceans and the atmosphere continues, sustainable food and nutrition security cannot be achieved. Therefore, as we approach the new millenium, we need a broader concept of sustainability which encompasses environmental, economic and social parameters. Among social factors, gross economic and gender inequity need priority attention. If such a paradigm shift in developmental thinking does not occur, the successes achieved in the twentieth century in abolishing skin colour based apartheid, in conquering space and in splicing genes will be overshadowed by the spread of technological and economic apartheid. If these forms of apartheid are allowed to grow and spread, social disintegration and ecological genocide will be the result.

"Stress on the environment is the product of four interacting factors: population growth, consumption habits, technology and social organisation."

Ecotechnology: the emerging solution

Technologies rooted in the principles of ecology, economics and equity are now referred to as ecotechnologies. UNESCO and the Cousteau Foundation established by Commandant Jacques Cousteau are promoting ecotechnology networks in different parts of the world. The M.S. Swaminathan Research Foundation at Madras is the co-ordinating centre for the Asian Ecotechnology Network. A major purpose of this Network is creation of *ecojobs*, which are economically viable, environmentally benign and socially equitable. A multimedia database on opportunities for ecojobs is being developed, since the dissemination of information on ecojobs is essential for creating opportunities for sustainable livelihoods in rural and urban areas.

The most serious manifestation of poverty is hunger. It is recognised that endemic hunger is largely the result

of inadequate livelihood opportunities which in turn leads to inadequate purchasing power. Hidden hunger results from both micro-nutrient deficiencies and poor environmental hygiene which impair the biological absorption and retention of food.

A Science Academies Summit on uncommon opportunities for a food secure world held at MSSRF in July 1996 stressed that national policies for sustainable food and nutrition security should ensure:

* That every individual has the *physical, economic, social and environmental access* to a balanced diet that includes the necessary macro- and micro-nutrients, safe drinking water, sanitation, environmental hygiene, primary health care and education so as to lead a healthy and productive life.
* That food originates from efficient and *environmentally benign production technologies* that conserve and enhance the natural resource base of crops, animal husbandry, forestry, inland and marine fisheries.

During the next three decades, population is expected to increase by another 2.5 billion people. Food requirements will grow both due to increases in population and per capita purchasing power. World grain production has grown from 631 million tonnes in 1950 to nearly 1900 million tonnes in 1995. Such a phenomenal growth has had its environmental cost in terms of soil degradation, aquifer depletion, genetic erosion and pesticide pollution. This is why we have to produce more in the coming decades but produce it differently. To achieve such a shift, the following basic ground rules must be followed in technology development and dissemination as well in public policy.

First, production advances must be based on linking the ecological security of an area with livelihood security of the people in a symbiotic manner.

Second, steps must be taken to create widespread awareness of the human and animal population supporting capacity of different ecosystems. Sustainable systems of management of soil, water, biodiversity and forests should be internalised in rural societies.

Third, since the poor remain poor, because they have no productive assets and there is no value to their time; asset creation and value addition to time should receive high priority in poverty alleviation programmes. Women belonging to the economically underprivileged sections of the society, in particular, are often over-worked and under-paid. What they need is a reduction in the number of hours of work and an increase in the economic value of each hour of work. This will call for massive efforts in information and skill empowerment of the poor, particularly women. The emerging technologies are largely knowledge intensive and hence the transfer of knowledge and market-driven skills can become the most powerful instrument of fighting poverty and deprivation. Modern information technology affords opportunities for reaching the unreached and thereby achieving a learning revolution within a short span of time.

Transfer of knowledge and market-driven skills can become the most powerful instrument of fighting poverty and deprivation.

Four, equal attention is needed to the problems of the rural and urban poor. Lack of livelihood opportunities in rural areas leads to the proliferation of urban slums. Damage to common property resources in villages results in the growth of environmental refugees. Since in many developing countries agriculture, including crop and animal husbandry, forestry, fisheries and agro-processing, provides most of the jobs and income in rural areas, the triple challenge of producing more food, income and jobs from diminishing per capita land, water and non-renewable energy sources can be met only through agricultural intensification, diversification and value addition. Integrated, intensive farming systems, which are ecologically sustainable, are needed for this purpose.

Finally, an evergreen revolution of the kind described above can be imparted a self-propelling and self-replicating momentum only if it is based on the self-mobilisation of the people. In all externally funded and introduced development projects, there should be a built-in withdrawal strategy, so that the programme does not collapse when the external inputs are withdrawn.

Meeting the multi-dimensional challenges

The responses being developed and field tested by M.S. Swaminathan Research Foundation to identify implementable approaches at the micro and policy levels to meet the challenges outlined earlier and now briefly described.

Linking the ecological security of an area with the livelihood security of the local community: creating an economic stake in conservation

The community biodiversity programme of MSSRF illustrates how such mutually beneficial linkages can be

fostered in biodiversity rich areas. It is a sad fact that the tribal and rural families who have conserved and enhanced biodiversity remain poor, while those who are utilising the products of their efforts become rich. When the conservers have no social or economic stake in conservation, denudation of natural ecosystems becomes more rapid. MSSRF has adopted a three-pronged strategy for creating an economic stake in biodiversity conservation.

First, a transparent and implementable methodology has been developed for incorporating in *sui generis* systems of plant variety protection procedures for recognising and rewarding informal innovations in genetic resources conservation and enhancement.

Second, a symbiotic social contract between commercial companies and tribal and rural families is being fostered for the purpose of promoting the cultivation by local communities of genetic material of interest to the companies on the basis of buy-back arrangements. Such a linkage will prevent the primary material being unsustainably exploited.

Third, local women and men are trained in the compilation of biodiversity inventories and in bio-monitoring, so that they themselves become custodians of their intellectual property. Such trained women and men constitute an Agrobiodiversity Conservation Corps and will be able to help their respective communities to deal with issues as "prior informed consent" in the use of genetic resources.

For assisting the community biodiversity movement, MSSRF has established a Technical Resource Centre for the implementation of the equity provisions of the Convention on Biological Diversity. This is the first Technical Resource Centre of its kind in the world and the six major components of the Centre are as follows:

* Chronicling the contributions of tribal and rural families to the conservation and enhancement of agrobiodiversity through primary data collection in the states of Tamil Nadu, Kerala, Andhra Pradesh and Orissa as well as in the Lakshadweep and Great Nicobar group of islands.

* Organisation of an Agrobiodiversity Conservation Corps of young tribal and rural women and men, who have a social stake in living in their respective villages and who, with appropriate training, can undertake tasks such as compilation of local biodiversity inventories, revitalisation of the *in situ* genetic conservation traditions of their respective communities, monitoring of ecosystem health with the help of appropriate bio-indicators and restoration of degraded sacred groves. The members of the corps will be able to assist their respective communities in dealing with "the prior informed consent" provision of the Convention on Biological Diversity in the use of genetic resources.

* Development of multi-media databases documenting the contributions of tribal and rural families in the conservation and improvement of agrobiodiversity, for the purpose of enabling them to secure their entitlements from National and Global Community Gene Funds.

* Maintenance of a Community Gene Bank and Herbarium. A Community Gene Bank with facilities for medium term storage has been established to conserve farmer preserved and developed seeds from the tribal areas of South India. The material will be catalogued and linked to the Technical Resource Centre database. The Herbarium serves as a reference centre for the identification of landraces, traditional cultivars and medicinal plants conserved by tribal and rural families.

* Revitalisation of genetic conservation traditions of tribal and rural families through social recognition of their contributions and the creation of an economic stake in conservation. For this purpose, replicable models of private sector engagement in contract cultivation by tribal and rural families of plants of commercial value are being developed.

* Legal Advice Cell. This cell will make available to tribal and rural families appropriate legal advice in matters relating to intellectual property rights and plant variety protection.

Population supporting capacity of ecosystems: local level socio-demographic charter.

In order to help internalise an understanding of the vital need to restrict population growth within the supporting capacity of land, water, forests and the other components of the ecosystem, training modules have been developed to enable the women and men members of village level democratic institutions to prepare socio-demographic charters for their respective villages. A gender code is an important component of the charter. Such socio-demographic charters will help local communities to view population issues in the context of social development and

to ensure that children are born for happiness and not just for existence.

Information and skill empowerment

For this purpose, the concept of *Information Villages* has been developed. Trained rural women and men will operate Information Shops where generic information on the meteorological, management and marketing factors relevant to rural livelihoods will be converted into location specific information. Trained farm women and men themselves become trainers. The computerised extension system adopted in the Information Shops also helps to sensitise local families on their entitlements from government and other programmes. Information technologies provide considerable opportunities for value-added jobs in rural areas. While new technologies are important, folk media are often even more effective in reaching the unreached. Hence, folk plays and folk arts and theatre are fully mobilized for achieving information empowerment. For ensuring the success of information empowerment programmes, the information disseminated should be demand driven and also locale-specific.

Agricultural intensification, diversification and value-addition

This is achieved through participatory research with farm families. Ecotechnologies like integrated pest management and integrated nutrient supply are used. Eco-technology development involves the blending of the best in frontier technologies with traditional wisdom and practices. Modern science and the ecological prudence of the past can thus be combined.

Eco-technologies are also practised in aquaculture. Integrated agriculture and aquaculture techniques enhance both farm income and the nutrition security of the household. Whole villages are being enabled to adopt such integrated, intensive farming systems (IIFS). This approach is essential for meeting the triple goals of more food, income and jobs from the available land and water resources and the seven basic principles guiding the IIFS movement are as follows:

Soil health care: IIFS fosters the inclusion of stem nodulating legumes like *Sesbania rostrata*, incorporation of *Azolla*, blue green algae and other sources of symbiotic and non-symbiotic nitrogen fixation and promotion of cereal-legume rotation in the farming system. In addition, vermiculture composting and organic recycling constitute essential components of IIFS. IIFS farmers are trained to maintain a Soil Health Card to monitor the impact of farming systems on the physical, chemical and microbiological components of soil fertility.

Water harvesting and management: IIFS farm families include in their agronomic practices measures to harvest and conserve rain water, so that it can be used in a conjuctive manner with other sources of water. Where water is the major constraint, technologies which can help to optimise every litre of water are chosen and adopted. Maximum emphasis is placed on on-farm water use efficiency and on the use of techniques such as drip irrigation, which optimise the benefits from the available water.

Crop and pest management: Integrated Nutrient Supply (INS) and Integrated Pest Management (IPM) systems form important components of IIFS. The precise composition of the INS and IPM systems will depend on the components of the farming system as well as on the agro-ecological and soil conditions of the area. Computer aided extension systems will provide farm families with timely and precise information on all aspects of land, water pest and post-harvest management.

Energy management: Energy is an important and essential input. Besides the energy efficient systems of land, water and pest management described earlier, every effort will be made to harness biogas, biomass, solar and wind energies to the maximum extent possible. Solar and wind energy will be used in hydrid combinations with biogas for farm activities like pumping water and drying grains and other agricultural produce.

Post harvest management: IIFS farmers will not only adopt the best available threshing, storage and processing measures, but will also try to produce value-added products from every part of the plant or animal. Post harvest technology assumes particular importance in the case of perishable commodities like fruits, vegetables, milk, meat, egg, fish and other animal products and processed food. A mismatch between production and post-harvest technologies adversely affects both the producers and the consumers. Growing urbanisation has led to a diversification to food habits. Therefore there will be increasing demand for animal products like milk, cheese, ages and processed food Agro-processing industries can be promoted on the basis of an assessment of consumer demand. Such food processing industries should be promoted in villages in order to increase employment opportunities for rural youth. In addition, they can help to mitigate micronutrient deficiencies in the diet.

Investment in sanitary measures is important for providing quality food both for domestic consumers and for export. To assist the spread of IIFS, Government should make a major investment in storage, roads, transportation and on sanitary measures.

Choice of the Crop and animal components of farming systems: In IIFS, it is important to give very careful consideration to the composition of the farming system. Soil conditions, water availability, agro-climatic features, home needs and above all, marketing opportunities will have to determine the choice of crops, farm animals and aquaculture systems. Small and large ruminants will have a particular advantage among farm animals since they can live largely on crop biomass. Backyard poultry farming can help to provide supplementary income and nutrition.

Information, skill, organisation and management empowerment: IIFS is based on the principle of precision farming. Hence, for its success, it needs a meaningful and effective information and skill empowerment system. Decentralised production systems will have to be supported by a few key centralised services, such as the supply of credit, seeds, biopesticides, and animal disease diagnostics. Ideally, an Information Shop will have to be set up by trained local youth in order to give farm families timely information on their entitlements as well as on meteorological, management and marketing factors. Organisation and Management are key elements and depending on the area and farming system, steps will have to be taken to provide to small producers the advantages of scale in processing and marketing.

IIFS is best developed through participatory research between scientists and farm families. This will help ensure economic viability, environmental sustainability and social and gender equity in IIFS villages. The starting point is to learn from families who have already developed successful IIFS procedures.

IIFS will succeed only if it is human-centered rather than being a mere technology-driven programme. The essence of IIFS is the symbiotic partnership between farming families and their natural resource endowments of land, water, forests, flora, fauna and sunlight. Without appropriate public policy support in areas like land reform, security of tenure, credit supply, rural infrastructure, input and output pricing and marketing, small farm families will find it difficult to adopt IIFS.

Increasing farm and non-farm employment: The biovillage programme addresses three key areas—preventing resource degradation, improvement of crop and animal productivity and alleviation of poverty. The biovillage programme in progress in villages in the Pondicherry area of India places equal emphasis on off-farm livelihood opportunities and on-farm jobs. This programme avoids a patronage approach to poverty alleviation. It regards the poor as producers and innovators and helps build their assets through value addition to time and labour. The basic approach is on asset building and sustainable human development leading to the growth of entrepreneurship. The programmes are designed on a pro-nature, pro-poor and pro-women foundation. By placing emphasis on the strengthening of the livelihood security of the poor, the biovillage model of sustainable development revolves around the welfare of the economically and socially underprivileged.

It is thus a human-centered pattern of development. The enterprises chosen are based on marketing opportunities. The technological and skill empowerment of the poor is the major approach. Because of the market-driven nature of the enterprises, the economic viability of the biovillage approach is assured. Production and post-harvest technologies and farm and non-farm occupations are brought together in a manner that both producers and consumers benefit.

It is a human-centered pattern of development. The technological and skill empowerment of the poor is the major approach.

Biovillages around biosphere reserves would provide alternative sources of meeting the day to day needs for food, fodder and other commodities of the families living near such biodiversity rich areas. Also, biovillages near urban areas link the rural producer and the urban consumer in a mutually beneficial partnership. Producing the processed and semi-processed food products needed in urban areas in the villages around towns and cities minimises the need for the rural poor to migrate to urban centres for livelihood opportunities. Also, food processing can be used as a method of providing the needed micronutrients by including millets and grain legumes in the food.

Towards an Ever-green Revolution in Agriculture: A Case Study of India

The term Green Revolution was coined by Dr. William Gadd of USA in 1968, when our farmers brought about a quantum jump in wheat production by taking to semi-dwarf, non-lodging varieties with great enthusiasm and when similar progress appeared feasible in rich. Punjab took the lead because of the scientific and educational backstopping given by the Punjab Agricultural University on the one hand and on the other, by the presence of the essential pre-requisites for progress such as land consolidation and leveling, rural com-

munication, rural electrification and above all, owner cultivation.

Twenty eight years after the term "Green Revolution" was coined, we are in a position to draw a balance sheet and chalk out a strategy for the future. Apart from erasing the "begging bowl" image of India, the most important gain has been the saving of forests and land, thanks to the productivity improvement associated with high yielding varieties. This year, Indian farmers harvested over 60 million tonnes of wheat, as compared to 6 million tonnes at the time of our independence in 1947. Punjab farmers have raised the average yield of wheat to over 40 quintals per hectare. Likewise, Tamil Nadu farmers have raised the average yield of rice to over 50 quintals per hectare. If the yield improvement associated with the Green Revolution in wheat and rice had not taken place, we will need another 70 million hectares to produce the wheat and rice we now harvest. Thus, the productivity improvement associated with the Green Revolution is best described as forest and land saving agriculture.

The productivity improvement associated with the Green Revolution is best described as forest and land saving agriculture.

The population of India is growing at a rate of 1.8 per cent per year. If this trend continues, our population will double itself in less than 40 years. Only Kerala, Tamil Nadu, Goa and Mizoram have so far achieved a demographic transition to low birth and death rates. Besides population increase, improved purchasing power among the poor will enhance the demand for food, since undernutrition and poverty go together. In contrast, per capita availability of arable land is shrinking. Water use efficiency is still low and water disputes are growing. In addition to the gradual decline in per capita availability of land and water, various forms of biotic and abiotic stresses are spreading. There is still a widespread mismatch between production and post-harvest technologies. In perishable commodities like fruits, vegetables, flowers, meat and other animal products, this mismatch is often severe, affecting the interests of both producers and consumers. This is why foreign experts frequently refer to the setting in of a fatigue of the Green Revolution. Lester Brown and Hal Kane in their book "Full House" released last year predict that at the current rate of population growth and environmental degradation coupled with an improvement in the consumption capacity of the poor, India will have to import annually over 40 million tonnes of food grains by the year 2030. This is four times the quantity we imported in 1966 i.e. before the onset of the Green Revolution. We should examine this issue seriously and should not allow complacency overtake the farm sector, just because we now have over 30 million tonnes of food grains available with Government.

Industrial countries are responsible for much of the global environmental problems such as potential charges in temperature, precipitation, sea level and incidence of ultraviolet-B radiation. While further agricultural intensification in industrialised countries will be ecologically disastrous, the failure to achieve agricultural intensification and diversification in our country will be socially disastrous. This is because, agriculture including crop and animal husbandry, forestry and agroforestry, fisheries and agro-industries provide livelihood to over 70 per cent of our population. The smaller the farm, the greater is the need for higher marketable surplus for increasing income. Even a million new livelihoods will have to be created every year in our country and these have to come largely from the farm and rural industries sectors. Importing food and other agricultural commodities will hence have the same impact as importing unemployment. Thus, what we need now is an environmentally sustainable and socially equitable green revolution or what may be termed an evergreen revolution.

While further agricultural intensification in industrialised countries will be ecologically disastrous, the failure to achieve agricultural intensification and diversification in our country will be socially disastrous.

Those who advocate going back to the old methods of farming ignore the fact that just a century ago when the population of undivided India was 281 million, famines claimed 30 million lives between 1870 and 1900. The famine eradication strategy of India comprising the following steps is perhaps the most important achievement of independent India:

- enhanced production and productivity
- better distribution through the public distribution system
- adequate grain reserves
- purchasing power enhancement through various employment generation and guarantee schemes,

- special intervention programmes for children, pregnant and nursing mothers and old and infirm persons.

While famines have been prevented, widespread under-nutrition prevails among the economically underprivileged. Since non-food factors like health care, environmental hygiene and literacy play an important role in promoting sustainable food security of the level of the individual, we should redefine security as follows:

National policy for sustainable food security should ensure:

- That every individual has physical, economic and environmental access to balanced diets, including the needed micronutrients and safe drinking water and to primary health care and education so as to lead a healthy and productive life.
- That food originates from efficient, effective and environmentally benign production technologies that conserve and enhance the natural resource base of crop and animal husbandry, forestry and inland and marine fisheries.

The principal operational implications of the above mission statement are the following:

First sustained physical access to food will involve a transition from chemical and machinery intensive to ecological farming technologies.

Second, the emphasis on economic access underlines the need for promoting sustainable livelihoods through multiple income-earning opportunities.

Third, environmental access involves on the one hand attention to soil health care, water harvesting management and the conservation of forests and biodiversity, and on the other to sanitation, environmental hygiene, primary health care and primary education.

If the political vision to implement this mission is forthcoming, population stabilisation can be more readily achieved. The prediction of Margins de Condorcet made in 1795 that population will stabilise itself, if children are born for happiness and not just for existence, will then come true.

The emphasis on the individual is important, since the household is not often a homogenous unit. Women and girl children tend to suffer more from under-nutrition than men and boys. UNDP's 1995 Human Development Report contains distressing data on the growing feminisation of poverty. To give operational content to such a concept of food security, we should initiate a Hunger-Free Area Programme (HFAP) consisting of the following components:

- Ensuring sustainable availability of food by maintaining the growth in food production over population growth through the development and dissemination of ecotechnologies, supported by appropriate packages of services and public policies. Ecotechnology involves the blending of the ecological prudence and technologies of the past, with the best in frontier technologies, particularly biotechnology, information technology, space technology, renewable energy technology and management technology. Without ecotechnological empowerment, farm men and women will not be able to produce more food and other agricultural commodities on an environmentally sustainable basis from less land, water and energy resources.
- Sustain the productivity of the natural resource base, by conserving and improving the ecological foundations essential for continuous advances in crop and animal productivity.
- Ensure adequacy of household incomes through promotional social security, such as assessing assets, employment and organisational and marketing empowerment. Agricultural programmes should concurrently aim at more food, more jobs and more income. Integrated attention to farm and non-farm employment and value-addition to primary agricultural commodities will be necessary to enhance income and rural livelihood security.

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- Provide entitlement to food through protective social security measures to the vulnerable groups, such as employment guarantee and food for nutrition programmes.

- Introduce a National Food and livelihood Security Act with the concurrence of the National Development Council for the purpose of paying integrated attention to:
  - Conservation of land, water, forests, biodiversity and the protection of the atmosphere
  - Enhancing productivity through ecotechnologies
  - Improving distribution in order to eliminate endemic hunger
  - Maintenance of adequate food security reserves
  - Strengthening the techno-infrastructure for better post-harvest technology and expanding the coverage of sanitary and phytosanitary measures, and
  - Efficient research, education, extension, marketing systems both to take full advantage of emerging opportunities in international trade and to ensure that research and extension designed to promote public good receive adequate support.

1995 marks the beginning of a new era in global research due to the onset of Trade-related Intellectual Property Rights (TRIPS). How do we promote research for public good under a fast spreading Intellectual Property Rights Environment (IPR)? In order to ensure that our national effort for achieving the ecotechnological empowerment of resource poor farm and rural families does not suffer under an economic environment where profit gets precedence over public good, the Government of India may set up a National Trust Fund and Ecotechnology with an initial outlay of atleast Rs. 1000 crores to foster research designed to promote sustainable public good in the farm sector.

The Final Milestone: A Hunger-Free World

The above represent some of the approaches adopted at MSSRF to overcome the challenges of jobless growth, feminisation of poverty and environmental degradation. The Tamil Nadu Government has recently decided to introduce a Hunger-free area programme to end poverty-induced hunger in association with MSSRF.

Studies at MSSRF have shown that by adding a horizontal dimension to numerous vertically structured programmes and by promoting a coalition of all concerned with ending hunger and deprivation, it is now possible to provide opportunities for a healthy and productive life for all.

The problem of food and nutrition security at the level of the individual has to be viewed in 3 dimensions. First, inadequate purchasing power leads to calorie-protein under-nutrition. Second, lack of the needed quantity and variety of micronutrients and vitamins in the diet leads to several nutritional disorders including blindness caused by Vitamin A deficiency. This kind of problem is referred to as "hidden hunger", a problem which affects today more than 2 billion people in the world. Third, lack of environmental hygiene and sanitation leads to a low biological absorption and retention of food, due to intestinal infection and diaorrhea. Thus, both food and non-food factors assume importance in determining the nutrition security of an individual. Concurrent action at all these levels is necessary in a Hunger-free Area Programme.

Designing a Hunger-free Area Programme (HFAP)

- Identify the basic underlying reasons for chronic under and malnutrition.
- Collate information on available programmes and opportunities for the sustainable end of hunger.
- Articulate the steps needed to provide the 'missing elements' in achieving the end of hunger.
- Mobilise local level community action and commitment for achieving the end of endemic hunger by the end of the Ninth Five Year Plan and enlist mass media support for this purpose.
- Assess the extent of:
  - Financial resources required
  - Technical resources for technological empowerment necessary
  - Managerial and Organisational resources needed
- Foster the organisation of a *Grassroot level Coalition of Ending Hunger* in each HEAP area comprising representatives of:
  - Elected representatives of the people
  - Government agencies
  - Civil Society – Non-governmental organisations, voluntary agencies, service organisations like Rotary clubs, Lions clubs, etc.

- Academia-Research, Training Institutions and Universities
- Corporate Sector
- Financial Institutions and
- Mass Media

The Coalition for Ending Hunger will be responsible for designing, implementing and monitoring the Hunger Free Area Programme. In 1981-82, the Planning Commission set up a Group under my Chairmanship to promote the development of Wardha District on the principles of self-reliance and peoples participation outlined by Gandhiji in the concept of Gram Swaraj. The idea was to develop Wardha into Gandhi Jilla. The Wardha District Plan on Gandhian lines prepared by the Group and published by the Planning Commission in April 1982 shows how the 80,000 thousand families who were then living below the poverty line in the district can have better and more secure livelihoods through an integrated 'health, education and work for all' programme.

From Concept to Grassroot Level Action

The challenge lies in converting HFAP from a concept into an operational programme. In such a programme, during the remaining years of this century, emphasis will have to be placed on generating additional livelihood opportunities for those living below the poverty line in villages and towns. The increasing feminisation of poverty demands that priority attention be given to women and girl children. Based on these considerations, the following operational framework is suggested for a National Hunger-Free Area Programme.

Phase I – Gap and Constraints Analysis

This phase will relate to the analysis of gaps and constraints. Under the GAP Analysis Programme, an inventory will be made of all the entitlements currently available to those living below the poverty line both through the Central and State Government programmes. The inventory will be suitably classified so as to differentiate social security and nutrition intervention programmes from those relating to employment generation.

Once the Entitlements Inventory is compiled, a detailed study based on random sampling techniques will be conducted in about 100 villages of a district to assess the extent to which the entitlements have actually reached the intended families. Within families, special studies will be conducted to ascertain the extent of male-female differences in access to entitlements. The gap between what the poor are entitled to and what they are actually receiving will be grouped according to gender and economic status (i.e., those having assets like land or livestock or fish pond or trees and those who do not own any productive asset).

Once the GAP Analysis is completed, a careful identification of the reasons for the gap and the constraints faced by the poor in getting their entitlements will be made. Such an analysis will be the starting point for understanding how direct and indirect poverty elimination programmes can be made to reach the unreached. An inventory of the voluntary organisations functioning in the villages included under the GAP Analysis would be made together with an assessment of their effectiveness in serving as bridges between Government agencies and the poor. Discussions will be held with both voluntary organisations and men and women members of elected Panchayats and Nagarpalikas on how the gap can be ended and how the delivery systems of poverty alleviation programmes can be improved in their efficiency and impact.

Phase II – Spreading the Message and Strategic Planning

This will be a strategic planning phase giving particular attention to the following:

- Steps needed to fill the gap between entitlements and actual delivery
- Opportunities for mobilising human, financial and technical resources in the concerned areas for improving the efficiency of delivery of ongoing programmes and for initiating new programmes to meet the unfulfilled minimum needs of the population
- Identification of methods of achieving synergy and convergence among all the programmes, whether governmental or non-governmental.
- Articulation of new livelihood opportunities based on both farm and non-farm occupations
- Introduction of organisational and management methods which will ensure the oversight and effective participation of the primary stakeholders in the implementation of programmes designed to strengthen the security of their livelihoods
- Identification of young women and men in the concerned villages for forming a *Corps of Hunger Fighters*. The young hunger fighters would undertake responsibilities such as creating awareness of entitlements, improving delivery systems and promoting environmental hygiene and garbage and sewage recycling. They would be given a small honorarium for

meeting their travel and other expenses and for compensating them for their time. The members of the *Corps of Hunger Fighters* will be drawn from those who have a social or economic stake in living in their respective villages. There will be equal number of women and men in such a corps.

Phase III – Finalising the Action Plan

As a result of the work done during phases i and ii, awareness of the possibilities for ending hunger and deprivation, analysis of methods of achieving the desired goals and an implementable action plan would have emerged. The Action Programme, to be effective, must emerge from discussions with the poor families and on the basis of their suggestions. It is now therefore opportune to establish a broad based local level Coalition for Ending Hunger and Deprivation. Such a Coalition for Ending Hunger could consist of representatives of local self-government institutions, government agencies responsible for fighting poverty and hunger, academic community, the civil society, corporate sector, women's and youth organisations, financial institutions and the mass media. Such a coalition will assign specific tasks to each member of the coalition in the areas of awareness generation, resource mobilisation, task implementation, monitoring and evaluation. The Coalition will aim to add a horizontal dimension to vertically structured government programmes. Coalition members will also help to develop methods of achieving gender equality and eliminating social evils like dowry and alcoholism. By the end of March 1997, the grassroot level coalition for ending hunger would be ready to launch a well-planned programme for eliminating hunger and deprivation from the pilot areas by the year 2000. Financial, technical and managerial resources needed for this purpose will have to be quantified and classified into those already available and the new and additional resources needed.

Phase IV – Towards a Sustainable Food and Nutrition Secure India

During this period, HFAP will be converted from a desirable concept to an implementable local level action plan. Intensive efforts will be made to sensitise all sections of the community to the uncommon opportunities now available for achieving a sustainable end to hunger. The poor themselves will play an active role in both the planning and implementation phase. Many of the members of the grassroot level Corps of Hunger Fighters will come from landless labour families. The Corps of Hunger Fighters will include elected members of Panchayats and Nagarpalikas, so that they are able to serve as links between the elected bodies and the people. There should be a minimum of two members of the corps drawn from every village/town, so that they are able to play a role in improving environmental hygiene and sanitation as well as the health and nutrition security of the families living in their village/town.

Conservation of Agro-Biodiversity

The commitment of the international community to ensure food and nutrition security to every child, woman and man on our planet has been reiterated at several international conferences held during this decade. Some of them are:

1990 World Summit for Children, New York

1992 International Conference on Nutrition (ICN, 1992), Rome

1992 UN Conference on Environment & Development (UNCED, 1992), Rio de Janeiro

1993 World Conference on Human Rights (WCHR, 1993), Vienna

1994 International Conference on Population & Development, Cairo

1995 UN Conference on Social Development, Copenhagen

1995 Fourth World Conference on Women, Beijing.

Despite such high level political reaffirmation of the need to achieve speedily the goal of "Food for All", over 800 million human beings now suffer from hunger and malnutrition. Hidden hunger, arising from the deficiency of the essential micronutrients is widespread. Endemic hunger is now more due to the lack of adequate purchasing power at the household level than due to the lack of availability of food in the market. Both poverty as well as non-food factors such as environmental hygiene, sanitation and lack of safe drinking water are becoming major contributors of food insecurity at the level of communities and individuals. A majority of the food insecure live in Asia.

There is also increasing concern about the earth's capacity to produce adequate food for the growing population. The increase in human population, now mostly confined to the developing countries, coupled with enhanced purchasing power leading to greater capability to buy food and increasing urbanisation will lead to a higher growth rate in demand for food as well as more diversified food products in the coming millen-

nium. Thus, on the one hand, there will be need for intensification and diversification of agriculture, particularly in the developing countries. On the other hand, ecological foundations essential for sustainable advances in crop and animal productivity are getting eroded. This situation has led to the ringing of alarm bells by experts concerning the earth's capacity to produce adequate food to meet growing needs. Constraints imposed by the earth's natural systems, the environmental degradation of land and water resources and the diminishing backlog of yield-raising agricultural technologies are slowing the growth in world food production, raising questions about the earth's population carrying capacity. The earth's capacity to produce enough food to satisfy expanding demand is now emerging as the overriding environmental issue as the world approaches the 21st Century.

Constraints imposed by the earth's natural systems, the environmental degradation of land and water resources and the diminishing backlog of yield-raising agricultural technologies are slowing the growth in world food production.

The year 1998 will mark the bicentenary of Malthus's essay on population. The onward march of science and technology, supported by appropriate public policies, has so far helped humankind to keep Malthusian forebodings on the population-food supply equation at bay. It is, however, becoming increasingly clear that without concerted national and global action to arrest environmental degradation, promote economic and gender equity and check population growth. The Malthusian spectre may still come true in the next century. The Food and Agriculture Organisation of the United Nations (FAO) therefore, organised a World Food Summit in Rome from November 13 to 17, 1996.

We are facing a battle against time in safeguarding our natural resources. In his book, "The Diversity of Life", E.O. Wilson has warned that Homosapiens is in imminent danger of precipitating a biological disaster of a greater magnitude than anything we have witnessed so far in our evolutionary history, There is hence no time to relax, if we are to ensure that the Malthusian prophecy of famine and pestilence do not come true in the coming millennium. Legal, educational and participatory measures of programme implementation and benefit sharing will all be needed for promoting a peoples' movement for conservation.

Facing the Challenge of Potential Changes in Climate

The Second Assessment of Climate Change and its impact made by the Inter-governmental Panel on Climate Change (IPCC) in 1995, confirmed the potential for Climate Change because of injection of various greenhouse gases such as CO_2, methane, nitrous oxide and others. A further refinement of general circulation Models (GCMs) and coupling them with ocean models and the negative feed back by aerosols led IPPCC to project an increase in global mean surface temperature of 2° C which is lower than than projected in 1990. The low estimation of climate change projects a change of 1° C by 2100. However, changes at the regional level continue to remain difficult and uncertain for projections. A mean change of 2° C which is the 'best estimate' could have changes from less than 0 to more than 4É C in different regions. It is these changes which are important for biota particularly the biodiversity and agriculture production system. The projected changes for this part of the world show a change of 1° C but increased cloudiness and about 5% change in rainfall.

Sinha and Swaminathan (1990) showed that in India a change of 1.7° C in temperature in a large grid caused a change from –0.4° to 4.5° C from coastal to interior areas. Recent studies in US also show that an increase in 0.4° C has resulted changes from 0 to 2° C or more.

These changes would have an effect on major crops, particularly grain crops. An increase of 1° to 2° C in combination with reduced radiation causes enhanced sterility of spikelets in rice. Fortunately there is already evidence of genetic variability in rice for tolerance to both a higher temperature and the reduced radiation. Crops such as pigeonpea promote vegetative growth with enhanced humidity and reduced radiation. However, we do not know the response of most of the vegetable and fruit crops.

Generally a view has been taken that the enhanced CO_2 concentration would benefit crops through improved photosynthesis rate. Firstly, at the doubling of CO_2 equilibrium, the actual concentration of CO_2 could be only around 450 ppm in the atmosphere. Therefore, we should be cautious in extrapolating data from 600 ppm or more concentration of CO_2. We need more studies on the interaction of CO_2 temperature and radiation for projecting impacts of climate change on any individual crop or agricultural system.

The projected changes in climate, particularly temperature, humidity and radiation could have a profound effect on diseases, pests and micro-organisms. Incorporation of disease and pest resistance

at higher levels of temperature should be an important objective in crop improvement programmes. A change of 1° C changes the virulence of some races of rush infecting wheat. The whole lifecycle of insects can be affected by a small change in temperature.

The impact of change in precipitation and temperature in relation to crops has received much less attention than it deserves. There are records to show that the rainfall pattern has changed during the last 75 to 80 years. In some areas there is either overall decrease in rainfall or the total number of rainy days have decreased while maintaining the some total rainfall. This causes increased intensity of rain resulting in greater soil erosion and run off. Thus the new crops and varieties will have to adapt to a greater degree soil and water stress. It is in this respect that traditional agricultural systems such as mixed cropping may prove advantageous. Consequently crop improvement for intercropping/mixed cropping should receive a greater emphasis.

Conclusions

The concept of sustainable development should be broad based so as to incorporate considerations of ecology, equity, employment and energy, in addition to those of economics. This will call for a systems approach in project design and implementation. Both unsustainable lifestyles and poverty have to be eliminated. Factors which influence climate and sea level, have to be addressed with the seriousness they deserve. Sustainable development will become a reality if we keep in mind that the greatest responsibility of our generation, to quote Dr. Jonas Salk, is to be good ancestors.

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Internationally Tradeable Emission Certificates

Udo E. Simonis

The urgency of the need to address the problem of rising environmental degradation is an issue which brooks no argument. What form should a future policy instrument to reduce greenhouse gas emissions take, if it is to be biased in favour of developing countries; i.e. enabling global environment protection and global development while satisfying the criteria of both efficiency and equity? The answer, is: by creating a market where no market exists, by introducing internationally tradeable emission certificates. The author presents the approach and issues involved in the implementation of this policy.

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"In some cases creativity requires the use of conventional policy instruments in unconventional ways, but in others it requires the use of unconventional instruments in conventional ways."

Thomas H. Tietenberg

The "Berlin Mandate", the most important concluding document of the first Conference of the Parties to the Framework Convention on Climate Change, passed on 7 April 1995, has the following to say with respect to the formulation and implementation of a global climate policy:

"The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities". It continues: "the global nature of climate change calls for the widest possible cooperation by all countries [...] developed countries [should] set quantified target limitation and reduction objectives within specified time frames, such as 2005, 2010 and 2020". Finally, it states that "the process should begin without delay" (Berlin Mandate, 1995).

The global nature of climate change calls for the widest possible cooperation by all countries. Developed countries should set quantified target limitation and reduction objectives within specified time frames.

As regards "joint implementation", an instrument which affects both industrialized and developing countries, the Conference of the Parties decided "to establish a pilot phase for activities implemented jointly among Annex I Parties and, on a voluntary basis, with

non-Annex I Parties that so request". During this pilot phase, a framework should be established "for reporting in a transparent, well-defined and credible fashion on the possible global benefits and the national economic, social and environmental impacts as well as any practical experience or technical difficulties encountered" (Berlin Mandate, 1995).

Three main topics dominate the formulation of an international greenhouse-gas regime, in the form of a "climate protocol" attached to the framework convention that came into force in 1994: efficiency, equity and decision-making under uncertainty. Three policy instruments dominate the question of the practical implementation of this protocol: the introduction of an international carbon tax or CO_2 charge, joint implementation and tradeable emission entitlements (emissions trading). The following discussion will concentrate on the second-named topic and the last-named policy instrument.

International Emission Charges

Pearce has summed up the arguments in favour of introducing a carbon dioxide charge or carbon tax as an instrument of a global climate policy (Pearce, 1991).[1] As his central argument, he cites Baumol and Oates, who pointed out that a tax allows total emissions to be reduced at minimum cost (Baumol & Oates, 1975). A given tax will induce emitters with low marginal avoidance costs to reduce emissions, while those with high marginal costs will find it more appropriate to pay the tax. In general terms, taxes use the market mechanism to adapt in an optimum way to the greenhouse problem, while direct government regulation can, in the individual case, be extremely expensive. In a comparative study on the USA, the average ratio of "command-and control costs" to "least-cost measures" was 4:1 (Tietenberg, 1990).

Pearce adds four further advantages of a carbon tax. First, the revenue gained allows other taxes to be replaced (neutrality of effect). Second, the potential revenue opens up possibilities of substantial resource transfers from North to South. Third, it involves a constant inducement for industry to undergo structural change towards environment-friendly production and, fourth if new (scientific) information about the climate problem becomes available, the tax can be modified

1. The following concrete examples of greenhouse gas emissions refer to carbon dioxide (CO_2) emissions or the equivalent amount of carbon (C) – calculated at a ratio of 3.67 : 1. If other greenhouse gases such as methane (CH_4) and nitrous oxide (N_2O) are included in the climate regime or discussion about climate policy, it is recommended that they be expressed as equivalents of CO_2, in order to introduce and maintain a common "currency unit" on the emission certificates market.

1: Emission reduction effect of a carbon tax on fossil fuels – two examples

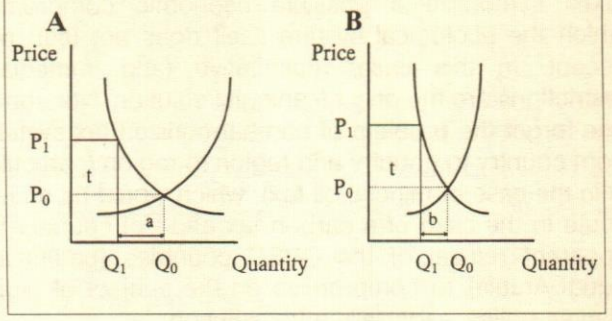

Fig. 1. Emission reduction effect of a carbon tax on fossil fuels – to examples

relatively easily. However, there are also several disadvantages of an international carbon tax, which should not be ignored. As we have only an approximate idea of the price elasticity of the supply of and demand for fuel, particularly as concerns the dimensions we would be dealing with in practice, there is considerable uncertainty as to how great a reduction in emissions would be (two simple propositions are shown in Fig. 1). Furthermore, it is widely held that the final incidence of a carbon tax is regressive. In addition, the real distribution effect of a tax solution is usually concealed, while that of a quantitative solution – as will be shown – is, at least in the initial stage, transparent.

Probably the weightiest argument against an international carbon tax is not concerned with economics but with organisational and institutional factors: the tax volume needed to initiate an appreciable global reduction in emissions would be so huge (the literature speaks in terms of several hundred billion dollars) that centralized administration would be unacceptable, yet an acceptable decentralized redistribution would probably be very difficult to organize (see Hoel, 1991 and his comments on reimbursement parameters).

The weightiest argument against an international carbon tax is not concerned with economics but with organisational and institutional factors: the tax volume needed to initiate an appreciable global reduction in emissions would be so huge that centralized administration would be unacceptable, yet an acceptable decentralized redistribution would probably be very difficult to organise.

There is also, however, an important ecological argument against an international carbon tax: in situations with rapidly increasing marginal environmental damage, taxes symbolize a possible economic compromise which the ecological system itself does not (can not) accept. In this case, quantitative (and immediate) restrictions are the only meaningful solution. Nor should one forget the problem of non-harmonized tax systems from country to country and region to region (particularly in the case of mineral oil tax), which would be no less acute in the case of a carbon tax and – of course – the apparent refusal of the OPEC countries (particularly Saudi Arabia) to compromise on the subject of global climate policy, especially a tax solution.

It should also be mentioned that a tax on carbon (or carbon equivalents) is necessary as a strategy of response to the climate problem, not a tax on energy in general. This has to do with the fact that the main task lies in extensively replacing fossil fuels by renewable sources of energy; this substitution effect would not occur if solar energy, for example, were also to be taxed on a global scale.

While efficiency and equity are central criteria of the Framework Convention on Climate Change and the "Berlin Mandate", it is surprising that no mention is made of a desired international tax solution. This is different in the case of the two other policy instruments, which are referred to explicitly and implicitly.

Joint Implementation

As concerns the choice and structure of the policy instruments of global climate policy, Article 3, section 3 of the framework convention is especially relevant. This calls on the Parties to implement the measures agreed on in a cost-effective way: the desired reductions in emissions are to be achieved at minimum cost. In view of the ecological and economic context of a global climate policy, this efficiency clause is particularly significant: ecologically speaking – i.e. as regards the effect of greenhouse gases on the climate – it is completely irrelevant where in the world, action is taken to reduce emissions, but if the cost of those reductions is to be kept to a minimum, then account will have to be taken of the fact that the marginal costs of reducing emissions (marginal avoidance costs) vary hugely across the globe. In other words, strong economic arguments enter the arena. It was with this in mind that the policy instrument of "joint implementation" found its way into the framework convention (especially Article 4, sections 2a and 2b). At the first Conference of the Parties in Berlin in 1995, it was resolved to introduce a pilot phase in order to try it out.

Basically, joint implementation is an offset version of a quantitative policy with tradeable certificates: a country (branch of industry, company) can fulfill its reduction obligations through a combination of national (internal) reductions and international (external) offsets (offsets here means emission reduction credits which, once they have formally been certified, could be traded internationally). Up to now, this has usually been interpreted as meaning that an Annex I party to the Framework Convention on Climate Change (i.e., OECD countries and countries with economies in transition) can fulfill its emissions target not only by reducing volumes domestically, but also by investing in avoidance activities in another Annex I country. The Berlin Conference resolved a first amendment, whereby non-Annex I states can also be included on a voluntary basis. Joint implementation has thus become a policy instrument in the North-South context, and this provision can be seen as a first step towards a global climate policy of quantitative control and a system of tradeable emission certificates.

A series of questions will have to be answered before it can be said how significant this policy instrument is or can become (Jepma, 1995) :

The Framework Convention on Climate Change does not contain any definite target for the reduction of global emissions. Article 4, section 2b merely formulates the following target for the Annex I states : "individually or jointly to reduce anthropogenic emissions of carbon dioxide and other greenhouse gases to their 1990 level." So far, then, there neither exists a binding global reduction target nor any country-specific targets. Certain countries and associations of countries have, however, unilaterally committed themselves to definite reductions in emissions, including Germany, which, at the Berlin Conference, confirmed its assertion that "by the year 2005", it would "reduce its emissions of CO_2 to a level 25% lower that that of 1990" (speech by by Federal Chancellor, 5 April 1995). In this respect, joint implementation is, for the time being, only a policy instrument to make unilateral targets more flexible. However, in view of the varying marginal avoidance costs for greenhouse gases from country to country and between North and South, a clear reduction in the cost of reducing emissions can be achieved. Or, to put it differently, an additional reduction in emissions can be achieved at no extra cost.

Joint implementation can also unlock positive economic effects via the transfer of low-emission technologies to developing countries. The tremendous increase in emissions that is to be expected, for example, when China and India become ever more motorized and industrialized might be diminished,

especially as no targets for the reduction of emissions have hitherto been set in these and (almost all) other developing countries.

One further important argument in favour of this policy instrument is that it can be applied without further delay, even if there is no global agreement on reduction obligations, or if no such agreement can be reached in due time.

Joint implementation, then, is a potentially powerful policy instrument, both for the ecologically necessary reduction of emissions and for the economically desirable transfor of technology. However, its implementation is faced with equally potent obstacles, which can be summed up under the concepts search costs, transaction costs and control costs. The German Advisory Council on Global Change pointed this out in detail in its 1994 Annual Report; therefore it will not be necessary to go into this matter in further detail here (see WBGU, 1995, pp. 21 ff.).

Joint implementation, is a potentially powerful policy instrument, both for the ecologically necessary reduction of emissions and for the economically desirable transfer of technology.

The success of the joint implementation instrument will depend crucially on the institutional arrangements that are agreed upon. Several models are conceivable:

- A simple bilateral system of negotiation and information—the participating states report the reductions in emissions they have achieved to the other Parties in the Convention
- Inclusion of a supra-national institution (such as the secretariat of the framework convention); this would act as a clearing house promoting the emergence of a joint implementation market
- In addition to that, a supra-national institution (the secretariat) monitors and verifies the reductions in emissions achieved as a result of joint implementation.

One important component of these arrangements consists in ascertaining the reduction in emissions effected by joint implementation in the form of "emission credits" for the investing country (company). These credits are essential for two reasons. First, they provide the necessary incentive for investing capital abroad and, second, they must not run counter to the reduction of emissions in the home country (allegation of "modern sale of indulgences"). The Berlin Mandate stipulates that "no credits shall accrue to any Party as a result of greenhous gas emissions reduced or sequestered during the pilot phase from activities implemented jointly". In order to avoid the possible failure of the joint implementation policy instrument inherent in this restrictive condition, the following compromise can be suggested:

Emission credits should not be credited in full to the national emissions account, but only in part—50%, for example (as suggested by the French), or 75-80% (as suggested by WBGU, 1995). In this case, if the reductions in emissions that have been achieved were used to increase national reduction targets (for the EU, OECD or Annex I states as a whole), then joint implementation would indirectly lead to more stringent climate protection effects.

It goes without saying that participation in joint implementation projects should not lead to any reduction in the financial obligations resulting from the Framework Convention on Climate Change or, indeed, in development aid payments (Norway has submitted a proposal to this effect).

Taken together, then, the debate about joint implementation ought to be seen as an opportunity to sound out what political possibilities exist for stabilizing the climate and to couple them with the necessities of development policy. Nevertheless, the quantitative significance of joint implementation in the global context ought not to be overestimated. This policy instrument will only allow the industrialized countries to fulfill the minor part of their obligations to reduce emissions. Even so, in the developing countries a process can get underway which would otherwise only get off late (or even too late)—and in the end, this process could lead to a more comprehensive system of tradeable emission certificates.

Internationally Tradeable Emission Certificates

Internationally tradeable emission certificates differ in various ways from joint implementation (or "external offsets"). Binding global obligations to reduce emissions will (must) result from the pending negotiations. Like the German Bundestag's Enquete Commission on Climate Policy, the Intergovernmental Panel on Climate Change (IPCC) assumes that a reduction of global CO_2 emissions by 50 per cent compared to the 1987 levels (an 80 per cent reduction in the industrialized countries) must be reached by the year 2050 if the target of the framework convention is to be attained (see table 1).

For the present, let us assume that an agreement of this kind (or similar) is reached in the "Climate Protocol" to be negotiated on and resolved at the Third Conference of the Parties in Kyoto in 1997. What could this mean for the choice and structure of a system of internationally tradeable emission certificates?

Table 1: CO_2 Emission Plan, Enquete Commission on Climate Policy (benchmark 1987, in %)

Year	Industrialized countries	Developing countries	Whole world
1990	+5	+11	+ 6
1995	+6	+24	+10
2000	- 4	+37	+ 4
2005	-20	+50	- 5
2020	-40	+60	- 20
2050	-80	+70	- 50

Source: Enquete Commission, 1989.

As part of the system of agreed quantified permissible global emissions, tradeable certificates (or licenses) would be handed out – for the whole duration of the agreement or, better still, for certain time periods – to the participating Parties on the basis of an allocation procedure that would also have to be agreed on (which will probably occur simultaneously). When the agreement came into force, the participants would receive certificates corresponding to the emission quantities they had been allocated. If this initial allocation were insufficient for a participant, the participant would have to acquire additional certificates via trade. For those participating in the system, therefore, an incentive to reduce emissions would be established, be it to minimize payments for the purchase of additional certificates or to maximize earnings from the sale or lease of surplus certificates. If the initial allocation to developing countries leads to substantial quantities of surplus certificates there, a potent mechanism for the transfer of resources would be created: developing countries could sell or lease their surplus certificates to industrialized countries for money, technologies or patents.

There are, therefore, certain similarities between an international emission charge (*price solution*) and tradeable emission certificates (*quantity solution*): the issue of the initial allocation of certificates is similar to the issue of allocating revenue from a charge. However, there are also considerable differences.

The most important of these is that emission certificates exactly meet the emission reduction target in terms of quantity; financial expenditure would be the result of the costs connected with achieving this target. This contrasts with an emission charge, which regulates financial expenditure but does not directly regulate the volume of emissions. A further difference is that a charge necessarily means monetary transfers, while certificates could be traded for gratuities other than money (such as technologies or patents). Generally speaking, therefore, a system of tradeable emission certificates increases the scope of negotiations between North and South – and might therefore meet with broad (sufficient) political approval for precisely that reason.

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Unlike in joint implementation projects (external offsets), monitoring a system of tradeable emission certificates would be concerned with the (relatively simple) measurement of total emissions from a contracting state rather than the (more difficult) measurement of emission reduction in the specific projects. The question of responsibility for adhering to the rules of procedure (compliance) is also easier, as one is not dealing with direct investments but with the sale or lease of a tradeable good (certificates).

As the Draft for IPCC Working Group III (Response Strategies, Chap. 10) states :

> "The consequences of climate change policy will be determined by the choice of policy instruments [...] For a global treaty, a tradeable quota system is the only potentially efficient arrangement where an agreed level of emissions is attained with certainty (subject to enforcement) [...] A choice of tradeable quotas at the international level would (at the same time) provide maximum flexibility for instrument choice at the domestic level."

From Theory to Practice

A practicable agreement on policy instruments to limit or reduce greenhouse gas emissions has to satisfy several criteria, in particular those of efficiency, equity and decision-making under uncertainty. The weight given to these individual criteria will determine which of the possible policy instruments or combinations of instruments is recommended. If, unlike on the national level, the criteria of equity and uncertainty (particularly because of irreversible ecological processes) play a

special role on the international level, then there is a lot to be said in favour of tradeable emission certificates. Yet, their practical organisation entails many potential snares which can be decisive for their acceptance. There are many theoretical and practical issues connected with a system of emission certificates[2] (Victor, 1991).

Market organisation

Creating a market for internationally tradeable emission certificates is no easy undertaking. Monitoring, certification, market access and market extension require careful management – what is more, in a highly complex area of policy. A debate about these implementation issues has at least begun, and this means that one may expect the system to become established in the foreseeable future. An UNCTAD study (1992) has looked specifically into the institutional issues of market organisation.

One such issue is the number of actors on this market. There is a lot to be said for a "mixed" trading system in which both governments and companies participate. Governments would remain subject to their international obligation to ensure that the certificates tally with actual emissions. Trade at the company level would increase the technical options of emission reduction. Yet, this could also mean that the volume of trade becomes too large. However, the major worry is that cartels could be formed. Whether or not this threat can be conquered will in the first place depend on the number of market participants, which speaks in favour of a more substantial number. If one were, for example, to start with the producers and importers of raw materials containing carbon, then, according to Maier-Rigaud, there would be about 500 actors on an EU certificates market. As in other markets, there is much to be said for the principle: "The more market participants the better", and this implies including the developing countries and private trading in certificates.

There are, however, other ways of avoiding cartellization on the emerging certificates market. Regular rounds of talks to re-allocate or replace certificates could ensure a liquid and flexible market, and rules against hoarding and price rigging could be agreed on. And the final, drastic sanction against improper conduct would be "exit", although this would have an adverse effect on all the market participants.

2. The questions of market organisation, flexibility and the initial allocation of emission certificates, are addressed here. For an analysis of other less problematic issues, see Epstein & Gupta, 1990.

Flexibility

Emission certificates should not be endlessly valid. Although any such "perpetual certificates" would not necessarily prevent the revision (and especially the tightening) of the global emission reduction target – some of them could be withdrawn from the market or devalued regularly – much speaks in favour of certificates with only limited validity. For one thing, not all Parties to the Framework Convention will participate in the system from the start and, for another, this would counter (more or less justified) fears of certificates being bought up by industrialized countries or multinational corporations. The other extreme version, whereby certificates would be *leased but never sold*, would only lead to more flexibility if a (more) frequent new issue was agreed on. However, the question of an *optimum* term for emission certificates is still an open one. In the literature, ideas range from two to 20 years.

In this context, Bertram (1992) has proposed an overlapping procedure, under which ten-year certificates would be issued and 10 per cent withdrawn from the market every year. This proposal could be summed up by the following formula:

> "If certificates are valid for L years and a certain proportion P/L is withdrawn from the market every year P, then a new tranche of certificates valid for L years can be issued."

At any given time, therefore, the market would consist of a mix of certificates, some long-term, some short-term; countries (companies) could accordingly maintain a mixed portfolio and a futures market (comparable with existing other futures markets) could come into being.

The benefit of a flexibilization of the system is obvious: it would be possible, on the basis of the most recent natural scientific evidence about pollution and the adaptability of the ecosystem and of social scientific evidence as regards the limits to adaptability of the economic system, to hold subsequent negotiations on permissible emission limits, to include new sources and sinks of greenhouse gas emissions, and to allow additional countries to participate. Whatever happens, this benefit should not turn into a disadvantage as a result of excessive complexity or bureaucracy. Grubb and Sebenius (1992) have shown that revision periods in an overlapping system of between two and four years might be the best possible solution. Given the probable workings of the global climate regime that is to be established (such as annual conferences of the Parties, two-thirds majorities, gradual tightening of the climate protocol), this may well be a realistic assumption.

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Allocation of certificates

The crucial factor for the political acceptance of tradeable emission certificates will probably be that their design be ethically based and their initial allocation be perceived as fair. Indeed, for most authors, the system hinges on the "equity factor". While the initial allocation of certificates does not finally predetermine the distribution effect, which ultimately is the result of market decisions (certificate price and quantity), it does predetermine the direction and possible volume of transnational resource transfer that the system will involve. A distribution effect will result from all conceivable instruments of climate policy, especially where the dimensions are globally significant, but also in national solutions, be they price or quantity solutions.

There are different ways of effecting the initial allocation of emission certificates. One distinction is that between burden-based and responsibility-based criteria, the former laying emphasis on the burden of adjustment involved in the desired reduction in emissions, while the latter stresses the polluter-pays principle, either in terms of current emissions or of historical and accumulated emissions.

To a certain extent, the search for an acceptable allocation formula in global climate policy reflects the old debate between "realists" and "idealists" in development policy (Sterner, 1994).

* "Realists" would argue that certificates (and the rights to pollute they entail) must be allocated on the basis either current emissions or of Gross Domestic Product, since any other formula would be unacceptable (see, for example, Pearce, 1991). Ethically, this position is extremely weak and completely fails to satisfy any criterion of equity (at all events, neither current emissions nor historical and accumulated emissions can be defined as "fair"). Furthermore, this position ignores one (if not the) crucial advantage of an international system of certificates, which is that an additional transfer of resources can be set in motion. The "realistic" position is also unrealistic because it (almost) completely ignores the developing countries, which are beginning to take an interest in global climate policy precisely because ecological necessity may turn out to be their economic blessing.

* On the opposing side we have the "idealists", who insist, explicitly or implicitly, on the inclusion of historical and accumulated emissions (as a sign of "ecological guilt" – indeed, some of them even argue that developing countries should not be integrated into the global climate regime for the time being (see, for example Hayes & Smith, 1993). Various allocation proposals have been put forward, with globally uniform per capita allocation presenting the strongest ethical claim. In this case, the initial allocation of emission certificates would be directly proportional to national population. It can be said that the practical consequences of this proposal would be considerable, if not revolutionary. Any industrialized country with above-average per capita emissions would have to purchase certificates from developing countries, not only in respect of fossil fuel consumption but also of all other sources and sinks of greenhouse gases, possibly with the exception of deforestation (slash-and-burn, clear-felling). Even under moderate projections as to the certificates prices that would ensue, there would then be a complete reversal of present net South-North transfers. Grubb and Sebenius (1992) assume that it would be at least as much as current official development assistance (ODA), which is about US$ 60 billion per annum.

Any industrialized country with above-average per capita emissions would have to purchase certificates from developing countries, not only in respect of fossil fuel consumption but also of all other sources and sinks of greenhouse gases.

Of course, the alternative to any extreme position is to find a mixed formula – a formula which will at least guarantee that there is a net transfer from the industrialized to the developing countries in implementing a global climate policy.

It is difficult to come to a conclusion about this issue, especially as its practicability will greatly depend

on the further progress of negotiations within the climate convention itself. However, the mixed formula developed by Cline (1992) is extremely appealing:

$$Q_{i'} = Q_g \left[wh\Phi^{y}_{o,i} + wy\Phi^{y}_{o,f} + wp\Phi^{p}_{o,f} \right]$$

where Q_g is the global emission target; Q_i is the emission target of country i; w the weight of the criterion in question (sum of $w = 1$); h is historical emissions, y is GDP is purchasing power parity, and p is population, Φ is the share of country i in the global total; O is the benchmark year.

This allocation formula includes the most important alternative criteria under discussion and weights them, a practice that has also been applied by the IMF (definition of country quotas), the Committee for Development Planning (definition of Least Less Developed Countries), and others (Levi, 1991). The formula could be described as the necessary mixture of efficiency, equity and realism.

Cline also provides as illustrative example of this formula in action: the USA currently (1992) accounts for 25.7 per cent of global GDP, 17.5 per cent of global greenhouse gas emissions (including deforestation), and 4.8 per cent of the world's total population. The simple average of these three figures comes to 16 per cent. Were a global emissions target of 4 billion tons of carbon to be agreed on, the USA's initial share would amount to 640 million tons. Current emissions, however, total 1.2 billion tons. Accordingly, the USA would either have to reduce its emissions by 50 per cent, or purchase almost 100 per cent more than its initial share of emission certificates.

By contrast, India's share would come to 8 per cent of global emissions or 320 million tons of carbon, which would correspond to a surplus of some 50 million tons (or 17 per cent more than current emissions), which India could then sell or lease on the international emission certificates market...

As befits the logic of a mixed formula, the weighting of the three components could be modified over the course of time. For example, the weighting of the first criterion (historical, accumulated emissions) could be reduced from one-third to zero over a period of, say, 20 years ("phasing out") and that of the second criterion (GDP) from one-third to zero over a period of 40 or 50 years, the final result being globally uniform per capita emission rights (i.e., the population criterion).

A less formal, more political solution of the allocation problem might lie in a compromise that could be described as follows:

> "The allocation of emission certificates changes over time, from a position based (more or less) on current emissions to a position of (more or less) equal per capita emissions."

A strategic compromise of this nature might be acceptable both for the industrialized countries and the developing countries, since it offers a strong incentive for a fair (fairer) future emissions situation for the whole world in general, and for the linking of environmental protection and development in particular—even though this perspective was not aimed for at either the 1992 Rio Summit on Environment and Development or at the 1995 Berlin Climate Conference.

Conclusion

As far as national climate (and environmental) policy is concerned, and in view of the high degree of institutionalization and the specific historical and cultural background of policy formulation and implementation in the industrialised countries, there is much to be said in favour of a balanced instrumental mix in environment policy which includes market-oriented and regulatory, price-based and quantity-based policy instruments. As regards the state of the international system and the emerging contours of the structure and function of the global climate regime, on the other hand, at this level market-oriented quantity solutions are favourable especially for joint implementation (external offsets) in the regime's initial phase and tradeable emission certificates in its final phase. If their form is prepared with the necessary care, then Peter Bohm's succinct judgement is justified:

> "Making emission quotas tradeable among countries simplies not only that a globally efficient limit to total emissions is attained with certainty,... but also that the initial emission quota distribution of the treaty is shifted in favour of the poorer countries" (Bohm, 1992, p. 112 [emphasis added]).

However, this does not exclude regulatory solutions or taxation. In particular, if the institutionalization of the *Global Environment Facility* (GEF) is to be pushed forward, then it will (to a certain extent) have to be financed by taxes, as conventional multilateral development assistance would otherwise be affected negatively. In this case, other forms of taxes and bases of assessment (again) appear on the agenda, such as a tax on arms exports (Brandt Report 1983), on long-distance tourism (Mishan, 1970), or on international financial transactions (Brundtland Report, 1987; Qureshi & von Weizsäcker Report, 1995).

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Impact of Waste Paper Imports on Indian Paper Recycling Sector

Pieter van Beukering & Anantha Duraiappah

The huge quantum of waste generated the worldover has made recycling mandatory as disposal options are few. Hence trade in recyclable waste between the developed and developing countries is increasing day by day. There are various issues involved here and the impact has to be analysed in terms of the economic as well as environmental repercussions. The article is an outcome of a joint study between the Institute for Environmental Studies (IVM) Amsterdam, the Indira Gandhi Institute of Development Research (IGIDR) Mumbai and Intervention (India) Ltd., Bangalore, focusing on the inevitable trade-offs between social, economic and environmental impacts of trade in recyclables.

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The contribution of international trade to the global economy is expanding. In the last decade the growth rate of internationally traded materials and products exceeded the growth rate of global production. This implies that mutual interdepencies between the trading partners' production and consumption patterns is increasing. This trend applies not only to primary materials and products, but also to recyclable waste. More and more, recovered materials are traded abroad to be recycled in another country.

The attitude of international organisations, national governments and NGOs towards international trade in recyclable waste is far from uniform. Two contrasting ideologies underlie the disagreement. First, trade in recyclable waste is recognised as desirable because it facilitates a more efficient global allocation of materials, goods and services. The counter argument to this ideology is that secondary materials can not be considered as normal intermediary goods but as a waste which requires appropriate processing. Waste should be taken care of by the polluters themselves, which in this context are the countries or states which generate the waste.

Trade in recyclable waste is recognised as desirable because it facilitates a more efficient global allocation of materials, goods and services.

Both ideologies tend to oversimplify the issue by generalising across a broad spectrum of secondary materials. It may very well be true that for certain secondary materials, trade liberalisation can produce a more efficient global allocation of resources but it could also be true for other secondary materials that international trade only facilitates waste dumping by

the developed countries. To address the issues raised by the two ideologies, a study was carried out which focused on the waste paper sector in India.

International Patterns

International trade allows countries to use more waste paper than is recovered or to recover more than is needed. In other words, the paper cycle extends far beyond the national borders. During the last two decades, the volume of internationally traded waste paper increased substantially, from as little as 2.2 million tonnes in 1973 to 16.8 million tonnes in 1994. This is mainly driven by an overall rapid growth in both, recovery rates and utilisation rates.

Table 1: Direction of Trade Flows in the Paper Cycle (1991)

Direction	Percentage of World Trade			
	Wood Fibre	Wood Pulp	Paper	Waste Paper
North-North	82.5	77.0	73.9	51.1
North-South	2.4	14.3	16.7	39.8
South-North	12.8	6.6	2.6	0.3
South-South	2.3	2.1	6.8	8.8

Source: Pulp and Paper International 1994, International Fact and Price Book.

Table 1 shows the direction of the trade flows in the paper cycle for 1991. While international trade of wood fibre, pulp and paper products mainly takes place between Northern countries, waste paper trade is largely imported by developing countries. This distinct global trade pattern in waste paper was explained by the desire of the paper sector in developing countries to upgrade the quality of their material input.

Impact on Local Waste Paper Recovery

International trade and local recovery of waste paper seem to be two separate issues, yet both the activities are closely linked through the price of waste paper. Changes in the recovery rate of waste paper in one country can have a significant impact on the recovery of waste paper in another country. A typical example of this relation was demonstrated in the late eighties and early nineties when the German Government introduced various policy measures to increase the recovery of waste paper in Germany. From 1989 to 1993, the collection in Germany increased by almost 50 per cent. This sudden increase in supply on the international market led to negative prices for low grade waste paper causing significant problems for waste paper collectors in the neighbouring countries. Subsidies had to be provided by some governments to collectors to prevent bankruptcy. Obviously, developing countries face much more difficulties in handling such external shocks.

Both in terms of unemployment among the poor and solid waste management, distortions in the recovery sector in developing cities can have severe impacts. To determine the vulnerability of the Indian recovery sector to price changes in waste paper, a field survey in and around Bombay was conducted among waste paper collectors and paper mills. Waste traders appeared to have sufficient margin in their trade to survive short recessions. The waste pickers turned out to be the most vulnerable. Since they operate at subsistence level they will look for alternative occupations to earn their income as soon as waste prices become too low. Given the importance of these actors in the current system, this might lead to significant damage in the recovery rate of recyclable waste. Not only can this result in a shortage of raw materials for the recycling industry, it also increases the solid waste burden in developing cities.

The main question is, however, whether the import of waste paper will have an effect on the price of local waste paper. This mainly depends on the substitution behaviour of Indian paper mills between local and imported waste paper. By estimating a production function it was found that the substitutability between these two raw materials was very low. Local waste paper which is generally of a low quality was found to be better applicable in the production process if it was mixed with imported waste paper which typically used to upgrade the quality of the end-product. This complementary relation indicates that it is unlikely that local waste paper supply is fiercely threatened by increased imports of waste paper in India.

It is unlikely that local waste paper supply is threatened by increased imports of waste paper.

Impact on Indian Economy & Environment

This question is closely related to the increasing pressures by governments and NGOs to restrict international trade in waste on the conviction that each nation has to take care of its own waste. A material balance flow model was developed to investigate if free trade in waste paper to India can support economic development and simultaneously reduce environmental degradation. The model describes the various stages of paper production starting from logging to pulping and paper production, transport of inputs and outputs, and waste disposal. At each stage,

the environmental impacts are tabulated and the cumulative impact is transferred into monetary values. Three strategies are analysed: the economic strategy in which economic costs are minimised, the environmental strategy in which environmental costs are minimised simultaneously. These strategies are analysed for a situation in which waste paper trade is banned and in a situation where this trade is allowed.

The results which are depicted in figure 1 suggest that the answer to the above question depends on the objective of the decision maker. If environmental criterion is the prime objective, then trade in waste paper is not the best solution. However, if economic criterion is the sole objective, then trade in waste paper is beneficial but is only part of the solution. However, if the reduction of both environmental and economic costs is the prime objective, waste in trade paper is crucial in the sector design process. In other words, if the paper sector is forced to internalise its environmental externalities, then trade in waste paper becomes a crucial variable in the industrial and environmental policy making.

The last point highlighted in the simulations is the pulp mix and the degree of substitutability between domestic waste paper and imported waste paper. The results show that there is no competition between domestic and imported waste paper and that no crowding out effect takes place. The substitution occurs with agro and wood based pulp which is advantageous in many ways. A reduction in the demand for wood based pulp reduces the pressure on forest reserves. The reduction in demand for agro-residue highlights an area for future technological development. At present, agro-residue is cheap but is environmentally a disaster. The option is to find methods and technologies for reducing the environmental impact of this resource. In the long run, advances in technology in this area will further reduce the pressure on forests and would create an environment in which the use of waste, paper as well as agro, can be maximised.

There is no competition between domestic and imported waste paper. The substitution occurs with agro and wood based pulp which is advantageous in many ways. A reduction in demand for wood based pulp reduces the pressure on forest reserves.

Policy Approach

The study suggested several policy options and many of them are independent of each other because of the differences of operational levels of waste paper and the socio-economic structure and environmental conditions in exporting and importing countries. For example, the issue of general appropriateness of trade of secondary materials is international while the analyses of effects of this trade on paper industry in the importing country is predominantly a national issue. Yet, it was also shown that the impact of national policies in industrialised countries may have various implications on the recovery and utilisation of secondary materials in developing countries. As a result, it seems difficult to formulate consistent policy recommendations which involve international, national

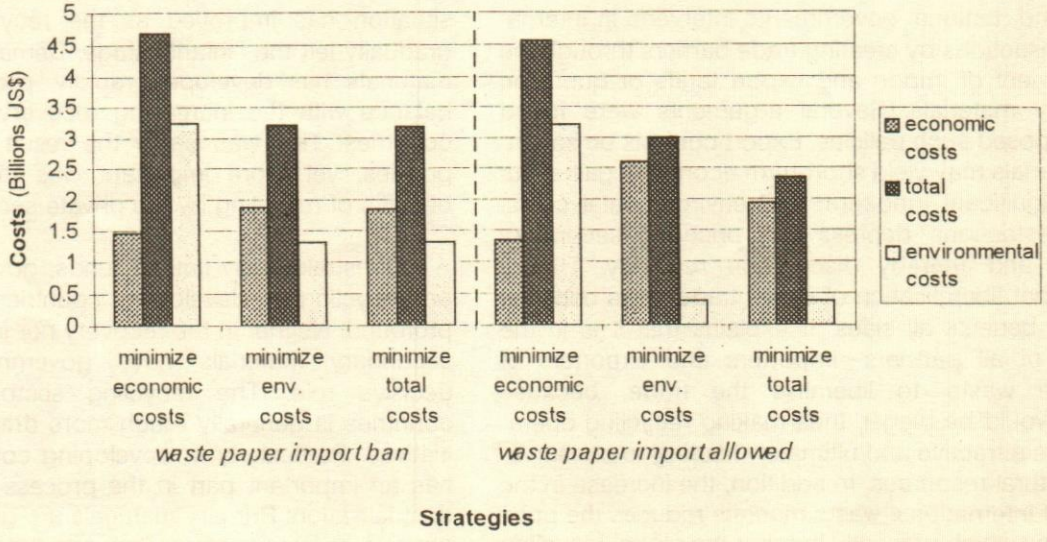

Fig. 1. Costs Comparisons across all strategies

and local scales. In view of this, policy recommendations at different levels have been suggested.

At the international level, policy interventions affect trade and recycling of secondary materials in two principal ways. First, international agreements such as the Basel Convention have a significant impact on trade of recyclables by developing international laws. Since the study deals with waste paper which is considered a relatively "green" material, it does not come under the preview of the Basel Convention. Yet, for many other waste materials, a tendency can be recognised in which international trade of waste is increasingly rejected. This trend is initiated by incidents of illegal exports of hazardous and unrecyclable wastes under the disguise of recyclable wastes. Thus, international agreements are required to find a workable solution to prevent such undesirable dumping practices. At the same time these should avoid restrictions on the beneficial transfers of intermediary goods between countries. The core-issue in this matter is to develop an appropriate definition for "hazardous waste" and "secondary materials". Another option which can increase the transparency of the international market of recyclables and thereby alleviate the uncertainty of supplies and prices, is the introduction of an electronic trading system. The first steps towards such a trading system have been initiated by the Recycling Advisory Coalition and the Chicago Board of Trade.

International agreements are required to find a workable solution to prevent undesirable dumping practices.

Second, national governments intervene in international transactions by creating trade barriers through the establishment of import and export tariffs or quota on secondary materials. Several arguments were found which opposed such policies. Export controls on secondary materials may yield short-term economic gains, but only at significant long-term and environmental costs. Export restrictions depress the price of secondary materials and thereby discourage recovery. Theory teaches that liberalisation of waste trade flows between countries benefits all sides. It explains that it is in the interests of all partners – importers and exporters of recyclable waste – to liberalise the trade, because markets would be bigger, thus making recycling operations more attractive and ultimately leading to conservation of natural resources. In addition, the increase in the volume of international waste markets reduces the price fluctuations which presently hamper the global recycling industry. Instability particularly harms the importing countries, because of the considerable downstream effects caused by the lack of raw materials. It should be realised that increased imports of secondary materials can very well have positive net effects on the balance of trade in developing countries as it may offset the import of virgin materials which are generally more expensive. These theoretical arguments were generally confirmed in the study on waste paper trade to India. Yet, as always, caution is required in generalising these conclusions over other recyclable waste materials. Each material has different environmental and economic effects.

It is in the interests of all partners – importers and exporters of recyclable waste – to liberalise the trade, because markets would be bigger, thus making recycling operations more attractive and ultimately leading to conservation of natural resources.

On the national levels, a distinction is made between policies in industrialised and developing countries. In the industrialised countries, the following policy related issues need to be addressed: In the late 1970's, it was concluded that markets without government's interventions fail to recycle waste materials consistent with the maximisation of social welfare. A number of countries in the North have chosen to set recycling targets, usually without attempting to determine the economically "optimal" recycling level. This is the level where the marginal costs of recycling equal the marginal benefits. Until recently, increasing recyclable waste collection levels led to increased instability on the markets for secondary materials. This situation has improved as the recycling sector has gradually left the "infant" stage. Demand for secondary materials has developed rapidly, providing a mature balance with the increasing recovery in industrialised countries. This was partly the result of demand side policies, yet more important was the recognition of benefits of recycling by the private sector.

Constrained by limited funds, government policies on recycling in developing countries are much less profound. Neither in the recovery nor in the utilisation of secondary materials have governments played a decisive role. The recycling sector in developing countries is generally much more driven by private initiatives. Particularly in developing countries, recycling has an important part in the process of increasing industrialisation. Primary materials are generally more expensive, require more energy and are more polluting in the production process than secondary materials. Also

the technologies used in recycling processes are often less sophisticated. The major constraint for recycling in developing countries is the lack of a stable supply of raw materials. As consumption levels are low, so is the recovery rate of recyclable waste. The gap between domestic supply and demand of secondary materials can very well be met by foreign sources. Not only can waste imports stabilise domestic fluctuations, it can also upgrade the low quality of secondary materials generated by the local market. All these arguments support the elimination of trade barriers on recyclable wastes. Increasing dependency on foreign inputs does not form a significant threat to industrial development because, due to the increasing volume of the international market of recyclable waste, instabilities are bound to reduce in the future.

Besides adapting trade policies, governments in developing countries should also directly promote the recycling industry. An important aspect which has not been discussed very extensively is the technological performance of the recycling industry. For paper production, technological limitations to recycling have largely been overcome in the last decade. As a result, cost-competitiveness between virgin and secondary paper making improved. Due to innovations in deinking technologies, the quality of recycled paper is almost similar to virgin paper. Also, technologies for chemical recovery in the paper production process have improved. As a result of the high capital costs and the relatively less strict enforcement of environmental regulations in developing countries, these "best available technologies" are not yet widely implemented in developing countries. Therefore, recycling policies should receive more attention in developing collaborative projects dealing with technology transfer from the North to the South. Also policies which are not specifically directed to recycling such as those affecting the pricing of virgin materials can have important influences on waste recovery.

Recycling policies should receive more attention in developing collaborative projects dealing with technology transfer from the North to the South.

Similar to the polices at national level, the local policies are different for the North and the South. For industrialised countries, international trade of secondary materials may lead to increase, or at least maintain, their recovery rates. Such policy targets have been under threat recently. The glut in waste paper markets in the North America and Europe dramatically increased the cost of recycling programs. Alternative management options, such as waste paper incineration, were considered by a number of municipalities in the North. This caused considerable distrust among consumers about the usefulness of their voluntary support in separating their waste. Globalisation of the market for secondary materials may cause an additional demand for the separated waste in the North.

In developing cities, solid waste is a significant and growing problem. The current system of waste management in most developing cities is very inefficient. Only part of the solid waste is collected by the municipalities. Uncontrolled landfill disposal and illegal waste burning are pervasive problems that cause a range of external costs, such as cost of human health hazards. Most developing cities are serviced by an informal sector which operates parallel with the formal waste authorities. This sector, which is fully driven by market forces, prevents significant quantities of municipal waste going to the dumpsite or lying idle. Still, developing countries are not able to recover at a similar rate as industrialised countries. For waste paper, partly, this can be attributed to the relatively high re-use rate of secondary materials. This is a very common practice in India to use waste paper for loose and cheaper consumer packaging. However, major reason for the low recovery rate is inefficiencies in the waste recovery system which can be overcome by developing policies which build on the existing informal recovery sector. One way of doing this is to have residents pay for the disposed waste collection. Yet, the administrative burden of such an urban-wide system should not be underestimated. Alternatively, public campaigns for waste separation at the source could support increased recovery. In doing this, policy makers should be aware that campaigns are particularly successful if the economic advantages of separation are highlighted by stressing the existence of the waste networks in most cities. Adoption of the Western recovery system does not seem to be a feasible option in developing countries as this would require tremendous voluntarism of the urban population, which, given the high levels of poverty and illiteracy is unlikely to occur.

The advantages of separation at the source are a reduction of the volume of municipal solid waste and the increase in volume of uncontaminated secondary materials of a relatively high quality. The only drawback of this separation at the source is that the waste pickers, who are dependent on the recyclable waste which is disposed by households and institutions, may be affected seriously as they will have either no waste or less waste to pick. However, the increased unemployment among waste pickers can be compensated for by the growth in labour demand by the expanding waste trading network and recycling industries.

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Role of Green Sourcing in Green Productivity

C. Visvanathan & Anna Marie M. Hufemia

This paper focusses on the role of green sourcing in the process of GP. Raw materials or catalysts which are inputs to processes in industries contribute significantly in deciding the quantity and nature of wastes produced in the production processes. Green sourcing looks at the identification and selection of those input materials which bring about a substantial reduction in the pollution load, maintaining or improving the process efficiency. The examples and case studies presented in this paper indicate how, appropriate selection of the input materials have resulted in reducing waste generation potential, achieved energy or material conservation, eliminated hazard to the waste receiving bodies. Various issues on implementation of green sourcing have also been discussed.

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Green Productivity (GP) is essentially a matter of converting raw materials into products in the most efficient way, thus producing little or no wastes from the production processes. It is the latest integrated approach in handling wastes and pollutants in the industrial world. Before the idea of sustainable development became an integral part of every production system, environmental protection was carried out through the employment of end-of-pipe (EOP) technologies. Pollution control which means applying treatment techniques for generated wastes, was the traditional key to meeting waste-related legislation.

However, this reactive approach to waste management is hardly the best solution because EOP technologies simply transform wastes from one media to another, without really eliminating them. Secondly, more stringent regulations are forcing industries to upgrade treatment facilities, resulting in escalating costs added to production. Hence, environmental management strategies have shifted towards finding ways of preventing generation of wastes, whenever possible, such that a more integrated approach to reducing quantity and toxicity of waste is implemented in all aspects of the production processes.

Green Sourcing

Various techniques in GP have been developed so far and have received a positive response from the industrial sector with enterprises willingly adopting the new processes and consequently reaping the rewards of economic savings and environmental protection. The approaches to GP can take the following strategies as shown in Fig. 1. One is by raw material change. Selecting appropriate raw materials and/or catalysts in each production process so as to reduce the amount of waste or generate more easily biodegradable waste or less toxic waste is termed as green sourcing. Green sourcing can be applied by

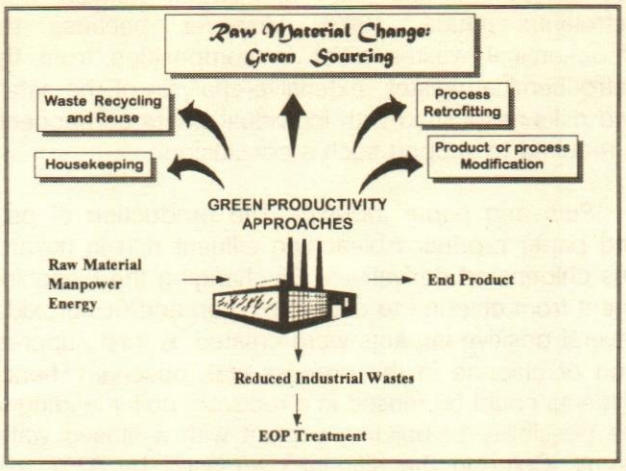

Fig. 1. Approaches to Green Productivity

selecting and substituting one raw material or a combination of two or more of them by more environmentally friendly substitutes in the production process which will result in any of the following:

- Reduction of waste amount in terms of weight, volume, organic content
- Change of hazardous wastes to non or less hazardous waste
- Lowering of capital investment in treatment systems needed to meet pollution discharge limits
- Contribution to the achievement of sustainable development.

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As a result of exploring ways of cleaner production through raw material substitution, many techniques have been discovered that are practically applicable to a number of production processes. Fig. 2 illustrates some general strategies in targeting green sourcing. With a deeper understanding of process chemistry, nature of raw materials used and their possible hazards to humans and the environment alike, an increasing number of environmentally less harmful substances have been found suitable in reducing, if not eliminating, pollution problems.

New catalysts that have been developed greatly improve conversion efficiencies and minimize the production of useless by-products. Impurities in the feed streams may reduce the activity and selectivity of catalysts or may even lead to reactions that yield unwanted by-products.

Some of the other techniques already applied in industry are the following (Schnitzer, 1996):

- Using pure oxygen instead of air, for oxidation reactions
- Using pigments, fluxes, solders, and biocides without heavy metal or other hazardous components
- Switching over to terpine or citric acid-based solvents from chlorinated or flammable ones
- Substituting organic by aqueous compounds; petrochemicals by biochemicals which are less volatile and contain less toxic components
- Utilizing wastes as raw materials, thereby conserving conventional raw materials.

Applications in Industry

Many industries have already benefitted from green sourcing. By reducing the hazardous impact of the whole production process, green sourcing lessens the liability of the industry in terms of occupational health and safety of its workers, possible clean-up costs in the future, and treatment and disposal of toxic wastes. Table 1 lists a number of techniques that have been successfully applied in specific industries.

Bleaching and dyeing industry: It is desirable to use raw materials that will cause less pollution. In this way, treatment of wastes coming from the industry will be less costly. In one bleaching and dyeing industry, material

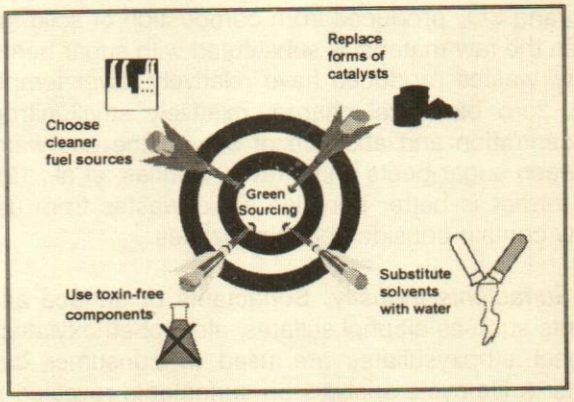

Fig. 2. General Strategies for Green Sourcing

Table 1: Techniques of Green Sourcing applied in Industry

Industry	Technique
Electroplating	Replace $Zn(CN)_2$ with $ZnCl_2$; Cr^{6+} with Cr^{3+}
Communications	Replace copper wires with optical fibers made of glass
Cleaning	Substitute halogenated hydrocarbons with water supported by detergents or ultrasonic
Textile and Dyeing	Replace starch with CMC as sizing agent Replace soaps with detergents as cleaning agent Replace coal tar dyes, azo dyes with triazine-based dyes
Wood processing	Replace creosol by pentachlorophenol, chromated copper arsenate and copper napthenate for impregnation of wood
Printing, Paints and Coatings	Replace solvent based ink by water based ink
Power generation	Replace coal by low-sulfur product; Use gas instead of oil or coal
Automobile	Replace coal by LPG, alcohol, low-olefinic gasoline
Chemical	Replace $AlCl_3$ by "Clayzic" or monmorillonites and zeolites-based as catalysts in Friedel Craft synthesis
Steel	Replace acid pickling of steel with peroxide treatment

substitution came in the form of carboxymethylcellulose (CMC) instead of starch as sizing agent, and soap instead of detergent as cleaning agent. Significant pollution reductions occurred as a result. Wastewater BOD was lowered by 48% and alkalinity by 65% (Tsang, 1987).

Fuel-grade ethanol production: A suitable substitute for transportation fuels is ethanol from biomass. In Greece, raisin and molasses are used as traditional raw materials for industrial production of fuel-grade ethanol. However, this process results in environmental problems such as liquid wastes with high biological charge, CO_2 produced from alcoholic fermentation, and CO_2 and SO_2 produced from combustion of solid fuels. When the raw material is substituted with sugar beets or straw, wastes produced have relatively lower temperature, zero biological charge, relatively small nitrogen concentration and absence of SO_2 in the gas wastes. Between sugar beets and straw (Koutinas, et al., 1984), the former is better because liquid wastes from using straw contain considerable pentozanes.

Surfactants industry: Surfactants or surface active agents such as alcohol sulfates, alcohol ethoxylates, or alcohol ethoxysulfates are used in consumer detergents. A life-cycle analysis on surfactants revealed that producing it from oleochemicals (based on palm oil, palm kernel oil, and tallow) resulted in the generation of higher amounts of atmospheric, waterborne, and industrial solid waste than surfactants derived from petroleum (Oude, 1993). However, because the oleochemical wastes differ in composition from the petrochemical wastes, extensive analysis of the safety and risks associated with individual waste components is required to support such a conclusion.

Pulp and paper industry: The production of pulp and paper produces bleaching effluent rich in hazardous chlorinated derivatives. By changing the bleaching agent from chlorine to ozone, oxygen and/or peroxide, several positive impacts were created. A total suppression of chlorine in the process was observed, hence effluents could be reused in a recovery boiler leading to the possibility of building a plant with a closed water circuit. Color in the effluent decreased by 97%, and malodorous discharges into the air from lower sulfide ratio of the pulp was reduced.

Steel Industry: In the treatment of steel, process chemicals such as HNO_3 and HF may be replaced by H_2O_2 and HF (Overcash, 1986). This material substitution reduced input requirements of HF by 36%. It also eliminated emissions of NO_x in the air and NO_3 in the liquid waste. Suspended solids in the effluent were also reduced by 54%.

Issues Faced in Implementing Green Sourcing

Industries and governments must play active cooperative roles: On a wider scale, green sourcing is an effective exercise when industries choose to utilize only renewable materials or those produced in a sustainable manner. For example, one furniture company labored to ensure that the raw materials for their teak-based products (Schmidheiny, 1992) are imported solely from a sustainable forest. By settling for nothing less than the most environmentally preferred materials, industries can create a global impact in protecting the environment and achieving sustainability. Likewise, through effective legislation, national governments can play a greater role in attaining green productivity through green sourcing. If the production of virgin raw materials was taxed instead of being subsidized, people will be more careful in using them more efficiently. Then, more efforts will be put into conserving

Green sourcing is an effective exercise when industries choose to utilize only renewable materials or those produced in a sustainable manner.

or finding suitable substitutes for non-recyclable raw materials such as minerals, another key to attaining sustainability.

Involves high financial input: However, such noble pursuits in the quest for selecting the finest raw materials demand high monetary inputs. In this sense, green sourcing becomes mostly a privilege of rich nations which can afford to demand the best raw materials. Japan, for instance, has the financial capability to import fuel sources that can meet their stringent quality standards and can insist on coal with low sulfur content for their power plants. In contrast, countries like India and China are dependent on their own natural resources and resort to using coal with high sulfur content to provide for their energy needs. The quality of raw material obtained may not be optimum for the production process but because of lack of other options, Indian and Chinese industries are reliant on what their mines can produce. As a result, energy industries in Japan, unlike in India or China, can run more efficiently with minimum environmental hazards.

A dynamic understanding of process chemistry must be coupled with advances in technological research to aid implementation of green productivity opportunities.

Needs accompanying technological change: In many cases, green sourcing entails accompanying change in technology to adopt to the introduction of new raw materials. A dynamic understanding of process chemistry must be coupled with advances in technological research to aid implementation of green productivity opportunities. A case in point is the shift from gasoline-fueled cars to electric cars. The whole design of automobiles will have to be modified if the fuel source is changed. Certainly, such major transformation will have other serious implications on other aspects of the automobile industry.

Case Studies

Change in fuel source for energy production: Table 2 presents the emission factors obtained when different fuel sources are considered for industrial boilers. By changing from coal or wood to gas or oil-fired boilers, emissions of harmful gaseous pollutants have been significantly minimized. Table 3 gives the conversion efficiencies and emissions of air pollutants from various electricity-generating raw materials. Here with a change in raw material and a corresponding change in technology, emissions of environmentally-damaging gases such as NO_x, SO_2 and CO_2 have been reduced to a minimum.

Table 2: Emission Factors from Industrial Boilers

Raw Material	Emission Factors (kg/TJ energy input)		
	CO	CH_4	NO_x
Wood	1,504	15	115
Coal	93	2.4	329
Residual oil	15	2.9	161
Natural gas	17	1.4	67

Table 3: Conversion Efficiencies and Air Pollutants from Electricity Generation

Raw Material	Conversion Efficiency (%)	Emissions (g/k Wh)		
		NO_x	SO_2	CO_2
Pulverized Coal	36	1.29	17.2	884
Fluidized Coal	37	0.42	0.84	884
Phosphoric Acid Fuel Cell	36	0.04	0.00	509
Combined-cycle Gas Turbine	53	0.10	0.00	345

Change in type of refrigerant in chillers: The Montreal Protocol has called for the cessation of

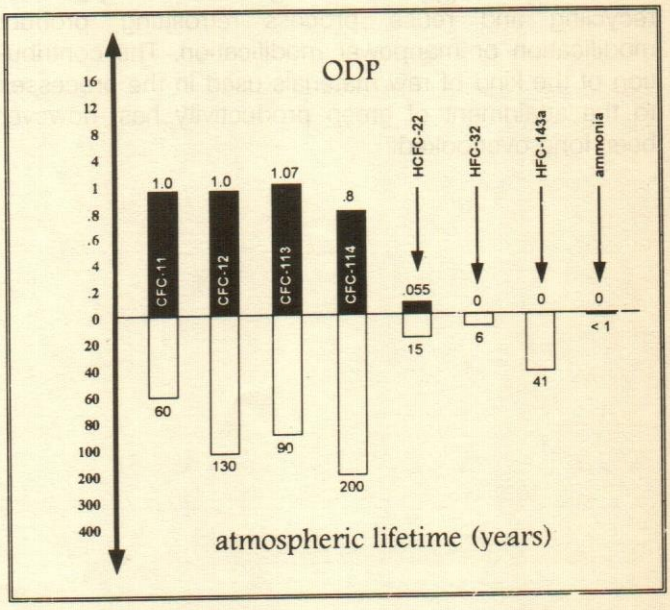

Fig. 3. Ozone Depletion Potential (ODP) and Atmospheric Lifetimes of Common Substances

manufacture of ozone depleting chemicals, including refrigerants, around the world. Some refrigerants, especially chloroflourocarbons (CFCs) contribute to the destruction of the ozone layer which is the protective layer of the earth's atmosphere. Two important factors that must be considered in choosing an alternative refrigerant (such as HFCs) are the refrigerant's atmospheric lifetime and the ozone depletion potential (ODP). Fig. 3 presents the differences in ODP and atmospheric lifetime of several refrigerants. This case shows that green sourcing for chillers has advantages that has worldwide impact.

Change in reducing agent in textile dyeing: The highly polluting Na_2S is the traditional reducing agent used in converting the original dye into its affinity form. This causes an increase in the sulfide content of the mill's effluent to undesirable levels and leads to complications in the conventional effluent treatment processes. A textile company in India found through research that hydrol, a by-product of the maize starch industry, can serve as an alternative reducing agent with corresponding improvement in the quality of the dyed product. The substitution even resulted in the reduction of sulfide concentration in the effluent to levels below the required standards. With less sulfide in the treatment plant, corrosion was minimized and the foul smell of sulfide in the work place was eliminated.

Conclusions

To achieve effective green productivity, conventional wisdom is the approach through waste or by-product recycling and reuse, process retrofitting, product modification or manpower modification. The contribution of the kind of raw materials used in the processes to the attainment of green productivity has, however been long overlooked.

With the successes of green sourcing achieved in various industries, it is obvious that there lies a great potential in exploring strategies in changing raw materials for green productivity. Although this may entail lengthy and expensive in-depth analysis of the process chemistry involved in production processes, experience has shown that these efforts can have tremendous pay-offs.

As the concept of green productivity is integrated into each production process in industry, the role of green sourcing will continue to expand to include more industrial systems, resulting in elimination of toxic substances, improved process safety and efficiency, proper management of raw materials, thereby leading to sustainability of the environment.

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Focus

Corporate Environmental Reporting – Some Empirical Evidence

V.K. Vasal

Considering "Agenda 21' as the single most important event in bringing environmental responsibilities of business and industry to the center-stage, a study was conducted with two-fold objectives. With regard to the first objective of measuring the degree of pro-active periodic reporting on environment in the U.S.A., the U.K. and India, the study has inferred that Indian companies are lagging far behind their counterparts in other countries so far as the issue of supplying environment-related information through the annual reports is concerned. With regard to the second objective of examining the dynamics of corporate environmental reporting in India, the study has concluded that reporting behavior of Indian companies, besides being erratic, has shown definite signs of using inferior forms of reporting with time.

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Currently, at a sectoral level, there is unanimity all over the world on the urgency of addressing environmental pollution, the malady of the industrial age. Accordingly, in recent years, industrial sector, particularly the corporate sector, is being increasingly asked by the bodies that matter, to assume responsibilities/obligations for proper environmental management. These obligations on the part of corporates range from the alleviation of environmental stress through conservation and protection of the environment[1] on the one hand, to the regular contribution of corporates to the restoration and regeneration of the environment on the other. In fact, at the largest international Conference ever convened – the 'Earth Summit' in June 1992 – the United Nations Conference on Environment and Development (UNCED) in its widely quoted publication 'Agenda 21' (an end-product of the deliberations concluded amongst the representatives from 170 countries) has duly recognized the role that business corporates can (and should) play in the overall management of the environment. The said publication, in one of its Chapters, has called upon the business and industry to be "full participants in the implementation and evaluation of activities related to 'Agenda 21' (para 30.1). Further, the document states that 'through more efficient production processes, preventive strategies, cleaner production techniques and procedures throughout the product life cycle, hence minimizing or avoiding wastes, the policies and operations of business and industry.....can play a major role in reducing impact on resource use and the environment....." (para 30.2). Obviously, it follows that the aforesaid environmental accountability of business enterprises needs to be reflected conspicuously on their respective annual reports on a regular basis.

1. The environment can be structured in several ways, including components, scale/space and time. In the present paper, the term 'environment' is taken to mean physical environment, that is all media susceptible to pollution (Glasson et al., 1994).

Obligations on the part of corporates range from the alleviation of environmental stress through conservation and protection of the environment on the one hand, to the regular contribution of corporates to the restoration and regeneration of the environment on the other.

Indian Scene

As elsewhere in the World, public awareness in India towards environment issues like the environmental pollution, environmental preservation, and environmental development, has grown tremendously over the past few years. This is evident from the contemporary regulatory regime that is being enforced for businesses by the Central and State Governments in India. Some major developments concerning periodic reporting by businesses in this regime are:

In the context of requiring environment-related information from businesses on a periodic basis, the first public announcement was made at the level of the Central Government in the year 1991. It was in this year that the then Union Minister of Law, Justice and Company Affairs in reply to a question in Parliament stated that the 'Ministry of Environment and Forests' had proposed as under:

> "every company shall, in the Report of its Board of Directors, disclose briefly the particulars of compliance with environmental laws, steps taken or proposed to be taken towards adoption of clean technologies for prevention of pollution, waste minimization, waste recycling and utilization; pollution control measures; investment on environmental protection and impact of these measures on waste reduction, water and other resource conservation."

In his reply, the Minister had also stated that his Ministry was examining the need for amending the Company Law so that the aforesaid proposal on environmental reporting by the companies could be put into effect. Incidentally, such a proposal did find a place in the Companies Bill, 1993 (since withdrawn).

Beginning 1992, vide a notification, the 'Ministry of Environment and Forests' has already mandated a periodic 'Environmental Audit Report'. According to the notification issued, at the end of every year, the aforesaid Report is to be submitted by every person carrying on an industry, operation or process requiring consent under Section 25 of the Water (Prevention and Control of Pollution) Act 1974 to the concerned State Pollution Control Board. Strangely, however, such information is still not being required by the Government to be publicly disclosed, say, through an annual report. Consequently, as of now, any disclosures on the environmental matters in the annual report of an Indian company are voluntary in nature[2].

The Study

Considering 'Agenda 21' as the single most important event in bringing the environmental responsibilities of business and industry to the center-stage, a study was undertaken to measure, based on an analysis of the annual reports, the degree of pro- active periodic reporting on environmental impacts in select countries. For this purpose, some top manufacturing companies operating in U.S.A. the U.K. and india were selected for the year 1990[3]. For the select countries, those sections of the annual reports were been identified where in the companies have predominantly disclosed information on their environmental accountability. Second, an attempt was made to collect some evidence on the changes, if any, in the environmental reporting behavior of Indian companies in a 'post Agenda-21' era. For this purpose, comparisons were made on the annual reporting behavior of Indian companies for two years. These years are 1990 (a 'para Agenda-21' year) and 1995 (a 'post Agenda-21' year).

A sample for the manufacturing companies operating in the U.S.A. and the U.K. was taken from the list of top GLOBAL-500 manufacturing companies (prepared by the renowned international magazine 'FORTUNE') for the year 1991. Importantly, data in this list relate to the operations of these companies during the calendar year 1990[3] (a year before the adoption of Agenda 21 and hence a better indicator of pro-active managerial attitudes). For India, however, due to non-listing of even a single company in the list of top-100 companies, a sample of companies was

2. As against the Indian environment, the Securities and Exchange Commission (SEC) in the U.S.A.. has mandated some disclosures on the pollution related activities of a firm in the report to be filed with the Commission every year (Jaggi, 1997). Importantly, this report is a document open to public scrutiny.

3. Considering 'Agenda 21' as the single most important event in arousing world-wide awareness to the environmental responsibilities of business and industry, 1990 is considered to be the year appropriate for measuring proactive attitudes of management, subject of course to the statements made at note 2 above.

drawn from the list of Central Public Sector Companies (CPSC) manufacturing goods in the country during the year 1990[4]. Such a list is prepared by the Department of Public Enterprises (DPE), Government of India, on an annual basis.

The list of GLOBAL-500 companies prepared by the 'FORTUNE' for the year 1991 indicated that 34 and 8 companies, respectively, for the U.S.A. and the U.K. are listed in the top 'Global-100' manufacturing companies. Therefore, each of these 42 companies was approached with a request to supply a copy of its annual report for the year 1990. Out of 34 companies in the U.S.A., 27 companies responded favorably. From the U.K., however, the response from 8 companies was 100 per cent. Thus, the sample size for the U.S.A. and the U.K., respectively, was 27 and 8. So far as Indian companies are concerned, as a response to the request letter sent to 160 manufacturing CPSC, annual reports for only 55 companies could be collected for the two years, 1990 and 1995.

Findings – Down the Memory Lane

Based on a sample of 90 companies in three countries, the findings of the study are summarized in table 1. Results show that a large number of sample companies – 24 (88.88%) – are reporting on their environmental matters through their respective annual reports in the U.S.A.[5]. A further analysis into the spatial reporting aspect of these 24 companies shows that 23 (95.83%) companies are using 'Supplementary Statements' for the purpose of disseminating information on the environmental issues[6]. The next most important section of the annual reports that has been used by the companies for the stated purpose is the 'Management Discussion and Analysis (MD&A)'. As many as 15 (62.50%) companies have been found reporting on their environmental performance through MD&A section of the annual reports.

In the U.K., 6 (75.00%) sample companies have been found reporting on the environmental performance and affairs through their annual reports. An analysis into the spatial dimension of reporting revealed that the two most important sections of the annual reports that have been used by 4 (66.67%) of these 6 companies are the 'Directors' Report' and the 'Supplementary Statements'. As against the findings for the U.S.A., the results for the U.K. show the following. First, the percentage of companies reporting on the environmental matters is lower in the U.K. than that in the U.S.A. Second, a comparison of results on the spatial dimension shows that the percentage of companies giving information through their 'Chairman's Speech', 'Annual Accounts', 'Schedules/ Notes to Accounts', and 'Supplementary Statements' sections of the annual reports is higher for the U.S.A. than the U.K. On the other hand, 'Directors' Reports' is a more important section of the annual reports wherein the companies are, comparatively, disclosing more information in the U.K. Last, an interesting finding of the study is that out of the sample companies reporting on the environmental issues, a greater percentage of companies in the U.K. are supplying information through the 'stand-alone environmental reports'. However, much importance cannot be attached to this result as the absolute number of com-

Table 1: Environmental Reporting Practices in Select Countries – 1990 (percentage values in parentheses)

	U.S.A.	U.K.	India
Number of sample companies	27	8	55
Companies not reporting	3 (11.12)	2 (25.00)	31 (56.36)
Companies reporting	24 (88.88)	6 (75.00)	24 (43.64)
Stand-Alone Environmental Report*,**	5 (20.83)	3 (50.00)	–
Section of the Annual Report**			
Chairman's Speech	14 (58.33)	3 (50.00)	5 (20.83)
Directors' Report/MD&A***	15 (62.50)	4 (66.67)	24 (100.00)
Financial Statements/ Annual Accounts	2 (8.33)	–	–
Schedules/Notes to Accounts	10 (41.67)	2 (33.33)	4 (16.67)
Supplementary Statements (Voluntary)	23 (95.83)	4 (66.67)	5 (20.83)

* Only when referred and publicized through the annual reports.

** Percentages for the stand-alone environmental reports as also for different sections of the annual reports have been computed with reference to the number of sample companies reporting on environmental matters.

*** The equivalent of Directors Report in the U.S.A. is the Management Discussion and Analysis (MD&A) section of the annual report.

4. In the Indian context, the ICAI (1985) has observed that it is mainly the companies belonging to the public sector which are supplying information in their annual reports much beyond the statutory requirements of the law.

5. This could possibly be attributed to the SEC requirements (see note 2 above).

6. These findings are in contrast to Jaggi (1997). More specifically, Jaggi (1997) has stated 'President's Message (termed 'Chairman's Speech' in the present study) as an important place of reporting in the U.S.A.

panies preparing 'stand-alone environmental reports' in the U.S.A. is higher at 5[7].

An analysis of results for Indian companies showed that, first, as against 88.88 per cent in the U.S.A. and 75.00 per cent in the U.K., only 43.6 per cent companies are disclosing some information on the environmental impacts in India. Second, a unique finding of the results, unlike those obtained for the U.S.A. and the U.K., is that every Indian company reporting on the environmental matters does so, at least, through the 'Directors' Report' section of its annual report. Third, some Indian companies report on their environmental impacts through the 'Chairman's Speech', 'Schedules/Notes to Accounts' and 'Supplementary Statements' sections of their respective annual reports. However, percentage of companies reporting through these sections are, comparatively, much lower than their respective counterparts in the U.S.A. and the U.K. Last, an important finding of the results on Indian companies is that the practice of preparing 'stand-alone environmental reports' is yet to take roots in India. Surely, this is a virgin area wherein some of the forward-looking Indian companies with a progressive and pro-active managerial outlook may like to come forward and assume the role of a leader.

The practice of preparing 'stand-alone environmental reports' is yet to take roots in India. This is a virgin area wherein some of the forward-looking Indian companies may like to come forward.

Environmental Reporting In India – Then & Now

A secondary objective of the present study is to identify changes, if any, in the environmental reporting behavior of Indian companies in the 'post Agenda-21' year vis-a-vis a 'pre Agenda-21' year. Concerning this objective, findings of the present study have been reported for the two years – 1990 and 1995 – in table 2.

Table 2: Environmental Reporting in India – 1990 and 1995 (percentage values in parentheses)

	1995	1990
Number of sample companies	55	55
Companies not reporting	28 (50.91)	31 (56.36)
Companies reporting	27 (49.09)	24 (43.64)
Stand-Alone Environmental Report	–	–
Section of the Annual Report*		
– Chairman's Speech	4 (14.81)	5 (20.83)
– Directors' Report	27 (100.00)	24 (100.00)
– Financial Statements/Annual Accounts	–	–
– Schedules/Notes to Accounts	4 (14.81)	4 (16.67)
– Supplementary Statements (Voluntary)	3 (11.11)	5 (20.83)

* Percentage for the sections of the annual reports have been computed with reference to the number of sample companies reporting on environmental matters.

A review of the findings reveals that whereas 24 (43.64%) companies were reporting on their environmental impacts through annual reports in 1990, the number of companies reporting in 1995 has gone up to 27 (49.09%). So far as disclosure of information in different sections of the annual reports is concerned, the following inferences can be drawn from the findings reported in table 2. First, like 1990, each and every Indian company reporting on the environmental matters does so, at least, through the 'Directors' Report' section of its annual report. Second, a disturbing finding of the results presented in the table is that the number and percentage of companies disclosing information through the 'Chairman's Speech' and 'Supplementary Statement' sections of the annual reports has gone down in 1995 vis-a-vis 1990. Last, number of companies disclosing information through the 'Schedules/Notes to Accounts' section of the annual reports has remained unchanged over the period of study (though lower in 1995 as a percentage value due to a higher base quantity). However, the composition of the companies reporting through this section of the annual report has been observed to be different in the two years. Specifically, whereas in 1990 the group consisted of such companies as the 'Hindustan Organic Chemicals Ltd.', 'Indian Oil Corporation Ltd.', 'Neyveli Lignite Corporation

7. The companies identified preparing 'stand-alone environmental report' in the U.K. are 'British Petroleum Company', Imperial Chemical Industries', and 'Unilever'. The corresponding companies in the U.S.A.. are 'Amoco Corporation', 'Chevron Corporation', 'Exxon Corporation', 'Georgia Pacific Corporation', and 'Xerox Corporation'.

Notably, two companies in the U.S.A. are supplying stand-alone reports which, inter alia, contain some disclosures relating to environmental matters as well. These companies are 'Digital Equipment Corporation' and 'General Motors Corporation'. However, owing to a predominant discussion on matters other than the environment, these companies have been excluded from the count of companies preparing 'stand-alone environmental report'.

Ltd.', and 'Pyrites, Phosphates and Chemicals Ltd.', the companies forming the group of four in 1995 are 'Eastern Coalfields Ltd.', 'Lubrizol India Ltd.', 'Neyveli Lignite Corporation Ltd.', and 'Pyrites, Phosphates and Chemicals Ltd.',

Results presented in table 2 show that there is a net addition of three companies over the period of five years, 1990 through 1995, which are reporting on their environmental impacts. However, a net addition of three companies does not imply that there has been no change in the behavior of companies reporting on their environmental impacts in the year 1990. In order to find this out, a transition analysis was performed on the sample companies. Accordingly, a transition matrix was prepared for the 24 companies reporting on their environmental matters in the year 1990. This matrix, presented in table 3 helps in two ways in analyzing the dynamics of reporting behavior of Indian companies. First, the matrix helps in identifying the number of companies consistently reporting on the environmental matters both in 1990 and 1995. Second, for companies consistently reporting in both the years, the matrix has measured the movement of the companies in terms of their usage of different 'forms of reporting', alternatively termed as different 'levels of measurement'. In the study, reporting behavior of the companies has been classified into three levels of measurement, namely 'narrative', 'quantitative', and 'monetary (financial)' (Ahmed & Zeghal, 1986).

An analysis of findings presented in table 3 leads to the following inferences: First, out of the 24 companies reporting in 1990, only 18 have continued reporting on their environmental impacts in 1995 as well. Stated alternatively, out of 24 companies reporting in 1990, 6 have 'shelved' reporting on the environmental matters in 1995. An industry-wise examination of companies shelving their reporting in 1995 shows that out of 6, two companies each belonging to the highly polluting industries, namely 'Fertilizer' and 'Chemicals and Pharmaceuticals'. And, one company each belonging to the 'Heavy Engineering', and 'Consumer Goods' industries. Second, 9 companies have been found reporting on the environmental impact in 1995 though with no corresponding information reported in their respective 1990 annual reports. Of the 9 additions in 1995, 7 are from the highly polluting industries. The detailed industry-wise break-up for these 7 companies is as follows – 2 from 'Steel', 1 each form 'Minerals and Metals' and 'Petroleum', and 3 from 'Chemicals and Pharmaceuticals' industries. Last, a net addition of three companies in 1995 is from the industries which have been classified as 'highly polluting' by the Union Ministry of Industry in India. Surely, this is a small step taken forward by the Indian public enterprises towards better accountability of their operations to the public in general.

Table 3: Environmental Reporting in India – 1995 Vs. 1990 (percentage values in brackets)

1995 / 1990	Narrative	Quantitative	Monetary	Deletions From 1990	Total (1990)
Narrative	6	0	1	4	11 (45.84)
Quantitative	2	0	1	2	5 (20.83)
Monetary	4	2	2	0	8 (33.33)
Total (1995) (out of 24)	12	2	4	6	24 (100.00)
Additions in 1995	6	2	1	–N.A.–	–N.A.–
Total (1995) (out of 27)	18 (66.67)	4 (14.81)	5 (18.52)	–N.A.–	–N.A.–

Legend: '–N.A.–' stands for 'Not Applicable'

Table 3 has also presented the results on the levels of measurement used by the companies in India. An examination of these results shows an adverse change in the forms of reporting used by the Indian companies in 1995 vis-a-vis 1990. Specifically, in 1990, 45.84%, 20.83% and 33.33% companies have used, respectively, narrative, quantitative and monetary forms of reporting (base value 24 = 100). On the other hand, the corresponding percentages in 1995 are 66.67%, 14.81% and 18.52% (base value 27 = 100). Simply stated, the results have shown a backward movement from the superior forms of reporting (monetary and quantitative) to an inferior form (narrative)[8]. Needless to say, such a behavioral change on the part of the corporates needs to be reversed at once.

The results have shown a backward movement from the superior forms of reporting (monetary and quantitative) to an inferior form (narrative).

As already discussed, one-fourth of the companies reporting on their environmental impacts in 1990 have

8. It is likely that the forms of reporting used by the public sector companies in India have gone for an adverse change owing to a more competitive economic regime instituted for them since 1991. In this more competitive regime, there are bound to be some incentives for not disclosing or poorly disclosing the information which is legally not mandated.

bid 'good-bye' to the practice in 1995. For the rest 18 companies, results presented in table 3 show the following in terms of their improvements/deterioration in the forms of reporting. First, there is no change in the level of measurements used by 8 (44.44%) companies (base value 18 = 100). Of these 8 companies, 6 (33.33%) and 2 (11.11%) companies are using 'narrative' and 'monetary' forms of reporting both in 1990 and 1995. Second, 10 (55.55%) companies have shown an improvement or deterioration in their forms of reporting. Notably, only 2 (11.11%) companies have improved upon the levels of measurements used by them in 1990. And 8 (44.44%) companies have shown a deterioration in the measurement levels adopted by them in 1990. On a net basis, it a indeed a regressive change and; undoubtedly, needs to be controlled forthwith.

To sum up, the discussion on the environmental reporting practices by the Indian companies has highlighted several adverse changes in the behavior of companies in 1995 over 1990. In short, not only is the behavior of many-a-companies found to be erratic over time but the levels of measurements used by companies reporting on a consistent basis are also seen to have taken a turn for the worse with time. No doubt, the situation at hand is crying for a turnaround.

Conclusions

The objectives of the present study are two-fold. With regard to the first objective of measuring the degree of pro-active periodic reporting on environment in the U.S.A. the U.K. and India, the study has inferred that Indian companies are lagging far behind their counterparts in other countries so far as the issue of supplying environment-related information through the annual reports is concerned. With regard to the other objective of examining the dynamics of corporate environmental reporting in India, the study has concluded that the reporting behavior of Indian companies, besides being erratic, has shown definite sings of using inferior forms of reporting with time.

Acknowledgment

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Focus

Wealth from Waste

L.N. Satapathy

The generation of various kinds of solid wastes poses a serious threat to the environment. On one side the amount of waste generated is increasing due to population explosion, but on the other side, waste disposal options are getting reduced due to non-availability of land. The only method for safe disposal, is converting these solid wastes into value added products. This article presents a compilation of a few such efforts.

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When something is unwanted or no longer serves the purpose, it is regarded as waste. Solid waste is any unwanted material, solid or semi-solid, that is thrown away by individuals, industries or communities. However, what is thought of as waste varies from person to person and from time to time. One person's waste rags may be another person's recyclable clothes.

Every living thing uses energy to process raw materials invariably creating waste. Disposal options are steadily getting reduced. Open dumping is hazardous. Landfilling and sanitary landfilling have their own problem of non-availability of lands. Incineration creates unsafe gases. So, the only safe option is conversion of waste into value added products. This can be achieved either by recycling or through conversion by the development of improved technology. Integrated waste management techniques like the 5R theory (Refuse, Reduce, Reuse, Repair and Recycle) should be given more importance. The 5R's approach to material use and the waste treatment involves the individual along with local action and thus brings about an atmosphere of universal involvement in the management of change. The details of 5R theory are given elsewhere (Simmons, Undated). Recycling is one of the best options for reducing waste. Fig. 1 depicts the advantages of recycling.

Value-Added Products from Waste

The conversion of solid waste to value added products has been the focus of many scientists, engineers and entrepreneurs. Various reports have also compiled these data. (Kaur, 1996; Thippaiah, 1996). Some of the latest developments in the field of wealth from waste are as follows.

Compost from garbage

This is relatively an old method of converting segregated municipal garbage with the help of either microbes (Appelhof, Undated) or with cowdung slurry (EXNORA, Undated) to convert into compost. The com-

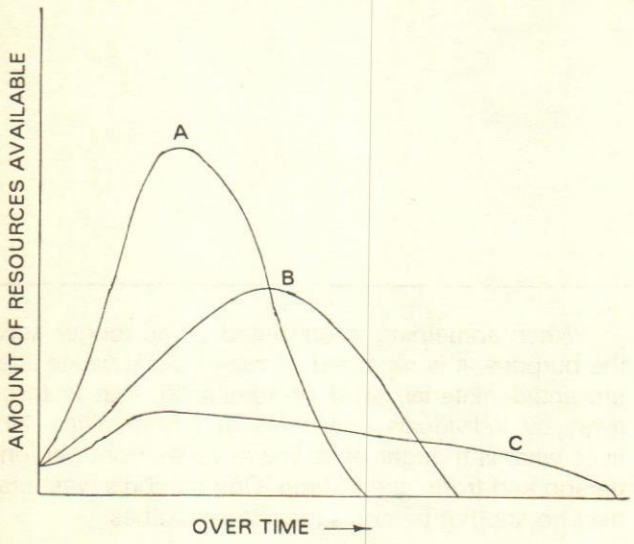

Fig. 1. Depleting Non-renewable Resources

posting is based on the principle that, nothing ever really disappears, but just changes shape and takes new forms. The compost is high in Nitrogen and Carbon and looks just like soil and is an excellent medium for growing plants. In addition to being clean, safe and thrifty, composting can also significantly reduce the amount of garbage a family sends to the garbage bin.

Products from flyash

Flyash generation from the burning of pulverised coal in boilers of thermal power stations poses a serious threat to health by air pollution. The quantum of flyash is set to touch 100 million tons per annum by the turn of the century from the current level of 70 million tons per year. Disposal of such huge quantity of waste is a big challenge. Scientists have succeeded in converting the flyash into value added products like bricks, tiles, cement, concrete blocks, vibrated paving slabs, ceramic articles etc.

Recently a scientist from Canada has formulated a pioneered technique of converting flyash and sewage sludge mixture to soil, which is under study in Orissa in the name of "Flyash Forest" (The Week, 1996).

The disposal of Flyash can be avoided, if we can generate electricity from thermal power stations without generating Flyash. One such technology – Integrated Gasification Combined Cycle Power generation (IGCC) has been developed by scientists at Indian Institute of Chemical Technology (IICT), Hyderabad. This technique is yet to be commercialised in India.

The detailed utilisation of Flyash has been reviewed in two recent reports (Satapathy, 1996; Subba Rao, 1996).

Plastic as wood substitute & fibres

Plastic is a very good recyclable material, yielding various products (Satapathy, 1996). In one of the latest methods, a wood substitute like structural Polystyrene foam, which has been introduced in India, can technically be manufactured using 80% recycled Polystyrene waste. These wastes are obtained from soft drink and ice-cream cups. These are mixed with 20% virgin Polystyrene before processing.

In another method, Poly Ethylene Teriphthalate (PET) waste bottles can be used of form fibres. These fibres are wowen into fabrics such as Eco-spun from Wellmon Inc. Companies like L.L. Bean, Reebok, Nike and others use recycled fibres in shoe lining. Others use it for making soft luggage.

Recycling in ceramic industry

In Ceramic industry, refractories occupy a prominent position. The huge quantities of waste refractories can be recycled in various ways.

In one typical example, Chrome based refractories are considered. These materials are used as liner materials in rotary kilns in cement manufacturing. They become hazardous on use, because of the valence change of Chromium from trivalent to hexavalent carcinogenic counterpart. The used refractories are crushed, sized and used as raw material feed in the manufacture of cement clinkers.

In another method, alumina-silica based refractories used in the flue-walls of Carbon bake furnaces are crushed and mixed with refractory cement. The resulting concrete is used in pot room floors and as flue caps in aluminium production. Details of recycling of refractories are covered in few latest reports (Satapathy, 1996; Bennett et al, 1995; Pervez, 1991).

Countering rubber waste

Microbiologists at the Richland Facility in United States Department of Energy, Pacific North-West Laboratories, are training sulphur loving micro-or-

ganisms to eat up the sulphur used in tyres. The bacteria (generally Rhodocoecus and Thiobacillus) attack the sulphur that bonds together the basic polymers and leave the carbon backbone intact for reuse. Best of all, the particles of rubber left still have the physical properties of rubber and can easily be recycled.

Edible plastics

Scientists at Argonne National Laboratory, USA mixed whey and waste potatoes and converted them into a Glucose syrup using enzyme action. This is fermented to give a lactic acid soup, which is evaporated until it releases all the water in it, leaving behind molecules of Polyactic acid which can be formed into films and coatings. The industrial production is expected to begin with Echo-Chem (a joint venture of Du Pont & ConAgra) and Cargill competing for the market.

Tyred roofs

While trying to help his daughter devise innovative use of old tyres for a school project, Richard Moora saw the light. Now he cuts the side walls of the old tyres and uses them in 50 inches length as roofing.

Diamond from cheap plastics

Plastic is the raw material used to convert to Diamond by a Hongkong Professor Hiro Yuki Hiraoka. It is used because, it is full of Carbon, the only ingredient of pure diamond and it is dirt cheap. A laser sends the shock waves through the plastics inside a vacuum chamber, creating a fire ball that sprays out the the tiny precious crystal. They fling themselves uniformly on to a specially prepared Silicone coated surface and sticks like glue. The rock hard shiny coatings look quite similar to stainless steel.

Oil from plastics

The idea of Yang Yali, a computer scientist of The Beijing Golden river petroleum products factory was "if the plastic comes from oil, why can not plastic turn back to oil?"

Coal furnaces stoked by China's low paid labour force, glow under the tank, heating up the plastic mixture in the presence of Young's catalyst to convert into oil. The temperature is monitored by a panel of machines linked with the computer. When the temperature reaches the catalyst level, oil gushes out of the tank down another tube and into cooling tanks from where it is injected into a small refinery at the end of the production line that converts it into petrol or diesel. The production cost has been estimated as 1300 Yuan ($153) per ton, while the domestic sales price for petrol is 2000-3000 Yuan ($236-271) per ton. Processing one ton of plastic requires 300 kilograms of coal. The above cost estimation excludes capital expenditure. In China, with this technology, a 35 per cent return including interest can be achieved.

Fuel from kitchen waste

Kitchen waste which accounts for more than 30 per cent of the total urban trash (in weight) is considered one of the most serious environment threats in South Korea. As many as 24,000 tons of food residues are generated from urban households across the country everyday. But the food remnants are not properly disposed off at garbage dumps or trash burners as nearly 80 per cent of them are liquids. This causes enormous damage to public hygiene.

The scientists at Korea Institute of Energy Research (KIER) have invented a waste digestion system. This system maximises the energy recovery rate and minimises the possible damages to the environment, by handling liquid and solid wastes separately. It has been observed that, 35 litres of pure Methane gas and 10 kilograms of quality fertilisers can be obtained from 100 kilograms of kitchen waste by using two phase digestion system. The methane gas can be used to provide heating service to households and produce electric power.

Fuel from residual waste

A German company Herhof–Umweltechnik GmbH has developed a novel technique of converting residual waste into solid fuel, that can be used as substitute for fossil fuels in blast furnaces, cement ovens or decentralised power stations.

The technique "Encapsulated Decomposition Process" preserves the maximum amount of organic carbon. The process is carried out in modular computer controlled decomposition boxes known as System Herhof. The final product does not contain any biologically or chemically reactive components and the dry condition make it easier to separate clean metal scrap and the high calorific content that can be used as fuel. This part of the waste is then stored as bales and then can be used as an emissionless fuel.

Cattle feed from waste food & waste paper mixture

Illinois State University in the USA has begun a project to evaluate the feasibility of converting food waste and waste newsprint into cattle feed and as a soil supplement. The technique involves first pulping the food waste from a college cafeteria and then mixing

with ground waste paper. It then must be made appealing to the cows. The pulped food and paper will be composted together in the second part of the project to make a soil amendment. Using the waste in its pulped form, is expected to hasten the composting process and lower production costs.

Door panels from fertiliser & paper waste

Gypsum, a waste product from factories making phosphatic fertilisers can reinforced with glass fibres to form a wood substitute that is 'weather and termite proof. The work in this regard is under evaluation at Central Glass and Ceramic Research Institute (CGCRI), Calcutta. Phosphogypsum with cotton waste is used to make ceiling tiles by a company at Visakhapatanam with German collaboration.

Recycled newspaper can be mixed with plastics to form car door panels, that are harder and stiffer than the existing designs. Scientists at the United States Department of Agricultural Forest Service Products Laboratory are trying to iron out the problem in controlling the viscosity of the composites by varying the plastic to newspaper ratio.

Synthetic granites from waste

A group of scientists at CGCRI, Calcutta succeeded in converting the garnet sand, a by product of Indian rare earth factory at Alwaye, Kerala to synthetic granites. The garnet sand is mixed with some special additives, compressed under a hydraulic press, sintered at 1100° C and then polished. The resulting product is a sparkling granite as good as original granite.

An effort at making synthetic granite from flyash waste is under progress at Ceramic Technological Institute, BHEL, Bangalore.

Brick from marble waste

Marble slurry is a major pollutant, formed during cutting down of marble slabs, when water is sprayed to keep the temperature down. The Indian Environmental Society (IES) has developed a demonstration and training unit at Udaipur to produce bricks from this slurry after several studies and in depth analysis.

Labware from tubelight waste

Huge piles of tubelight waste from industries and other sources are being recycled by a company at Madras. It uses the conventional glass blowing technique to produce laboratory wares.

Conclusions

Waste has become a part of our lives—and since we are so used to seeing it around as—the smoke, pollution and rubbish—we are learning to live with it and die because of it. We are waiting ever so patiently for someone to clean up our mess. This possibility is remote, considering the amount of solid waste generation, the availability of land for disposal and the number of people employed in cleaning such a mess (for example, in Bangalore city, 3000 tons of garbage is generated daily, which 6000 corporation workers are supposed to clean with a 50 per cent absence, which is highly impossible). So, the only solution is to reduce the waste at source. Whatever is still generated, either is recycled or converted into value added products. The latter step should be given top priority. It should be the duty of every citizen to save the environment by taking the above steps of waste management.

The only solution is to reduce the waste at source. Whatever is still generated, is either recycled or converted into value added products.

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Sustainable Agriculture: Issues & Policy Implications

K.K. Kaushik

While sustainable agriculture focuses on a symbiotic relationship between ecology and economics, the development effort pursues exploitation of resources to meet the needs of the society. The direction of investment and institutional change should however, be consistent with the present as well as future needs. To achieve such elusive goals of sustainable agriculture, the efforts have to focus on harmony with ecological system, economic effectiveness, equity and social justice and trade-off between exploitation and conservation. Keeping in mind that sustainability conjures up a kaleidosopic image of many separate issues, the present paper is an attempt to look into those aspects that come in the way of operationalizing the concept of sustainable development in the context of Indian agriculture.

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Sustainable agriculture is an elusive and difficult concept to define precisely. Generally, it encompasses objectives of maintaining soil productivity, environmental quality and economic viability. According to Food and Agriculture Organization, (1989) sustainable agriculture is "the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of environment and conserving natural resources". Crosson and Ostrove (1991) consider sustainable agriculture an economic system that will indefinitely meet rising domestic and foreign demand for food and fibre at constant or declining real economic and environmental costs of production. Conway (1985), views sustainable agriculture as a farming system that can withstand collapse under stress. Sustainable agriculture production not only involves identification and application of improved technologies but also encompasses ecological and social concerns (Pookpakdi, 1993). One of the most important and unquestionable concepts, nevertheless is, maintaining agriculture growth without impairing the resource base. Essentially, sustainable agriculture entails putting nature to work rather than paying to put it out of work.

Growth Vs Equity

One of the basic tenets of sustainable development is the concept of trade-offs. Trade-offs involve policy and individual decisions regarding such factors as current versus future income, private versus public benefits, and future growth versus current consumption. In order to undertake an assessment of potential trade-offs, production systems which are more benign to the environment than the current practices must be identified and appraised.

Sustainable agriculture requires a good knowledge of how things work i.e., who controls the factors of economic activity, what the environmental consequences are likely to be and how social benefits and

safeguards can be equally managed. The basic principles are simple. Their application to production and policy is not. For example, encouraging increase in productivity would seem to be inconsistent with sustainable agriculture. It pits growth and stability/equity against each other, whereas achieving sustainability suggests balance and co-operation between growth, stability and equity.

Achieving sustainability suggests balance and co-operation between growth, stability and equity.

Constraints Encountered

Though new agriculture technology has succeeded in enhancing foodgrain production, some distortions have occurred in the pattern of agriculture development. Firstly, a very large interpersonal inequalities continue to exist in land distribution. Secondly, employment opportunities remain bleak in the rural sector. Thirdly, new agriculture technology has not spread to all regions with the result that regional inequalities have remained quite high and in some cases have tended to increase. Finally, it is seen that new technology has been more concerned with promotional aspects and efficiency in resource use has not been given due importance.

Though green revolution has helped in achieving the goal of enhanced food production, it has led to farm practices which appear non-sustainable. The fact is confirmed by the prevalence of such symptoms as salinization, erosion, soil compaction and waterlogging, fresh water pollution and depletion and desertification. This has led to a degradation in the eco-system causing poor soil health, toxicity, acidity, nutrient deficiencies, lowering of water table, intensive use of energy, to name only a few.

Sustainable practices are not only technological or economic in nature but are a also a part of the mindset to approach economic and social arrangements towards other living things. As long as economic considerations are put before other values, the latter is always at risk. While saying that growth and sustainable development can take place simultaneously if a proper balance between them is not maintained, there is the risk of the former taking precedence over the latter.

New technology has been more concerned with promotional aspects and efficiency in resource use has not been given due importance.

Sustainable agriculture is differently perceived and understood by different people. Sustainable practices are hard to identify because the impact of any given practice is site specific. Farming methods that are sustainable in one setting may not be so in another. The basic flaw in the definition of sustainable agriculture is that they are qualitative, not quantitative. Conventional production techniques, while deserving accolades for increasing productivity, must also account for their shoddy performance on the resource conservation front (Faeth, 1994).

Growth and Instability

For analysing growth/instability question, only major crops/crop groups have been taken up for discussion and analysis. The study is based on secondary data for the last 26 years, i.e. from 1968-69 to 1991-92. The period 1968-69 to 1991-92 has been further divided into two periods 1968-69 to 1979-80 and 1980-81 to 1991-92 to clearly bring out the trends in more recent times. For measuring growth, exponential functions of the form $\log Y_t = a + b_t$ have been computed. The instability measure (1) has been constructed by fitting an exponential time trend to the data and then calculating the following statistic from the residuals.

$$I = \frac{1}{\log \bar{y}} \sqrt{\sum_{i=1}^{n} \frac{(\log Y_t - \log Y_t)^2}{n-2}} \times 100$$

This procedure has two advantages: first, since the data have been pre-normalized with respect to their means, the instability measure is not scale dependent and hence can be used for cross comparisons. These figures are presented in table 1. Though production variability is the outcome of area and yield variability, and their interaction effect, our interest lies primarily in yield instability. Yield rather than area variability has also been the major source of production variability in India (Kaushik, 1993).

Foodgrain production in India dominated by rice and wheat has kept pace with population increases; and presently is marginally below domestic demand. The long-term growth of food grain output has been about 2.31 per cent per annum in the post green revolution period as against 2.2 and about 3.2 per cent for population and domestic demand respectively. One important implication of this concerns the likely surplus available

Table 1: Period wise Compound Growth Rates of Production, Productivity and Instability Index in Crop Output in India

Crops		Period I (1968-69 to 1979-80)		Period II (1980-81 to 1991-92)		Whole period (1968-69 to 1991-92)	
		Production	Productivity	Production	Productivity	Production	Productivity
		(1)	(2)	(3)	(4)	(5)	(6)
Rice	g	1.88	0.95	3.72	3.12	2.88	2.31
	I	(1.26)	(1.90)	(1.58)	(1.21)	(1.18)	(1.60)
Wheat	g	4.74	2.35	3.58	3.13	4.75	3.20
	I	(2.70)	(1.83)	(1.26)	(1.12)	(1.91)	(1.42)
Pulses	g	–0.12	–0.70	1.40	1.10	1.63	6.69
	I	(2.77)	(2.22)	(2.10)	(1.48)	(2.83)	(2.13)
Total foodgrains	g	2.23	1.40	2.87	3.67	2.31	2.56
	I	(1.71)	(1.41)	(1.20)	(1.14)	(2.40)	(1.47)
Groundnut	g	1.68	1.65	3.02	1.09	1.62	0.91
	I	(3.29)	(2.71)	(3.66)	(2.83)	(3.30)	(2.76)
Rapeseed mustard	g	0.63	-0.41	8.98	4.88	5.32	3.09
	I	(3.42)	(3.71)	(2.51)	(1.59)	(4.01)	(3.10)
Total oilseeds	g	1.31	0.98	4.69	3.52	2.62	1.96
	I	(1.87)	(1.65)	(2.31)	(1.75)	(2.37)	(1.88)

Source: Government of India, (1990)
g = growth rate
I = Instability Index

for exports. The estimate of foodgrain requirements suggests that there is already a surplus over production of almost 20 million tonnes, and this will increase over time if production increases faster than population, on the other hand, a deficit of around 3 million tones is predicated by the end of this century, even if foodgrain production grows at the rate of 3 per cent per annum, given an income elasticity of 0.4.

There are indications of some improvement in the growth rate after 1980s. For example, the growth rate in rice production accelerated from about 1.88 per cent per annum during period I to 3.72 per cent per annum during period II. For rice and wheat, yield rather than area has been the major source of output growth in this period.

Magnitude of Instability

Instability is one of the important decision parameters in development dynamics and more so in the context of agriculture production. Despite the impressive growth achieved by Indian agriculture, instability too has shown a tendency to rise, as has been indicated by various studies (Mehra, 1981; Hazell, 1982; Ray, 1983; Parthasarthy, 1984; Mitra, 1990; Kaushik 1993). The latter characteristic, is very widely perceived in both aggregated and disaggregated levels, and has been the dark spot in an otherwise, good agricultural performance. The existence of such uncertainity provides an ethically sustainable basis for the existence of profits. Oddly enough, despite the widespread concern over the instability of agricultural production, there have been very few rigorous attempts at quantifying the phenomenon.

The disturbing feature, however, is that along with growth, the magnitude of instability in the output of rice in the more recent period i.e. (1980-81 to 1991-92) has shown an upward trend and fluctuations in yield of crops turn out to be the dominant force behind this instability. In the post green revolution period, yield fluctuations contributed most in the output fluctuations for all crops. Rice, despite being a largely irrigated crop reported comparatively more instability than wheat indicating the diverse environments and constraints under which it is grown in India. Access to yield enhancing technologies has encouraged rice cultivation to marginal areas also. For all crops fluctuations in yield have been of a higher amplitude than in area.

Encouraged by a favourable price structure, paddy production has taken off in the semi-arid land. Its future is now questionable in North-West India in general and Punjab in particular. With the excessive use of water,

ground water tables are declining at an unsustainable rate of about 1 meter per year.

This positive relationship of growth with instability is also found in the case of south and south-east Asia (Barker et al), though the converse is true for Bangla Desh (Allauddin & Tisdell, 1988). Though the level of relative instability in India is low by international standards, yet absolute variability is large. It has been observed that even small variations in inequitable income distribution with large on-farm retention of crop produce have serious implications (Hazell, 1982).

Consequences of Instability

Instability drives poor people below the lines of minimum subsistence in bad times. This drop reduces their ability to plan for the long-term and leads them (and their animals) to assault the environment for short-term gains in ways they would have avoided had their incomes been stable and above the subsistence level. Agricultural instability causes great problems in areas of excessive poverty and environmental fragility, but the damage also carries into the middle classes.

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Environmental risks arising from technological and development decisions impinge on individuals and areas that have little or no influence. The extension of cultivation to areas with fragile environmental resources has further contributed to higher yield instability. As a result, most of the green revolution regions have reached a plateau in productivity, and profitability of farming has started declining (York, 1988).

Role of Technology

In so far as instability is an attribute of unsustainable growth, this should be a cause of concern. It has been observed that the increased instability is not due to the new technology itself, but rather due to its application in less favorable conditions as it is extended from areas of assured irrigation to rain-fed areas. Further, it has been argued that high input intensive agriculture has been disappointing. So far as the issue of labour absorption is concerned – it has not helped in preventing deforestation as landless labour does not seem to gain much from the new technology. Chemicalization in agriculture has started showing its adverse potential with regard to fertilizers as well as pesticides.

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The need for appropriate technologies for sustainable agricultural development is an issue of importance from two angles. One is the feasibility and the other is regarding the relevance of high productive technologies (Reddy, 1995).

An important issue regarding sustainability is whether the elimination of externalities results in a slow-growth or fast-growth agriculture. Producing fertilizer nutrients with the agriculture production system by the use of rotation or other means may reduce the externalities associated with the use of commercial fertilizer. But it may also result in a slower growth in agricultural output. In this case, technological solutions which make it possible to use commercial fertilizers may have a social pay off. Moreover, the issue again involves the question of the intertemporal allocation of resources and of output, thus putting the interest rate in a key role.

Agricultural operations can be arranged along a continuum ranging from organic agriculture to the intensive production schemes using little biological inputs. Widespread organic cereal production can not be maintained indefinitely in the face of rising demand for international export, especially with little recycling between the consumer and the production system. Similarly the high input agricultural technology can not produce indefinitely without profilgate use of energy, deteriorating land base and contamination problems, unless given extraordinary levels of subsidy.

Between these two extremes is a range of low input agriculture which does not necessarily imply low levels of production. Certainly, the extremely high yields produced by high-input intensive agriculture may not be achieved on a wide scale. This will happen when government subsidy changes occur in favour of low input agriculture. Advances in agricultural production techniques have largely been due to the reductionist approach. The implications and consequences of such approaches are not given importance and are often

regarded as the price society pays for efficiently produced cheap food.

Cost Effectiveness

New agricultural technology definitely deserves accolades for increasing productivity of food grains in general and rice and wheat in particular, but this has been achieved at an ever increasing input-output ratios in the post-green revolution period (Rao 1995; & Nadkarni, 1988). Our analysis further corroborates their findings by using triennium averages for the more recent period i.e. 1984-85/1986-87 that wheat in the green revolution belt is afflicted by the malady of increasing cost of cultivation. The increase in the ratio of paid out cost to total cost for wheat in Punjab and Haryana was 25 per cent and 48 per cent respectively (Govt. of India, 1990).

Thus the high input base growth is not sustainable and is becoming more expensive and less efficient. The increasing input output ratios have serious implications as less and less surplus is available for future investment. In fact studies suggest that real public and private investment in agriculture for India has declined in recent years (Shetty, 1990; Kumar, 1992) and so also agricultural growth rates (Nadkarni, 1988). With the agricultural sector facing fiscal compression under economic reforms, confronted by declining investment and high degree of instability of foodgrains production, it may be difficult to maintain the trend growth rate of 2.5 per cent in respect of foodgrains. However, slowing down agricultural growth would lead to growing income inequalities in rural areas. If the present trend of investments policy are continued, sustained agricultural growth could be impeded (Kumar, 1992).

The Indian experience of technological breakthrough in agriculture has gone against the common belief that an upward shift in production function is associated with lower per unit cost. Further, a strong and a negative correlation between yields and net returns was observed reflecting that in the years to come, the goal will be maximization of yield per hectare irrespective of the cost to cultivators. This shows that the real cost of this agricultural development strategy, inclusive of subsidy, therefore, is higher than what is indicated by private costs to farmers (Nadkarni, 1988).

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There is a growing realization that agricultural development at any cost, with scant regards to long-term implications of such growth is suicidal. However, espousing the diametrically opposite stance of opposing any change is an extreme point of view. A via-media has to be evolved for a critical balance between agricultural development and harmony with the ecological system for attaining growth with equatability.

The ecological consequences of an expanding agriculture are likely to be deleterious. Intense biotic pressure on forests is degrading the land and inadequate investment in soil and water conservation activities is resulting in soil erosion, at 16.35 tonnes per hectare a year (Goel & Prasad, 1993).

The environmental cost of agricultural growth has been quite high; it is a different story that in India these costs have not been internalized. According to the National Commission for agriculture, some 6 million hectares of land suffer from water-logging and another 7 million hectares from salinity and alkalinity (Mohan Rao, 1995). Modern irrigation has adversely affected the quality of land by causing salinization and water logging. Production and use of fertilizers have been damaging the soil, water, air, the flora and fauna. Increases in agricultural production in north-west India have occurred through a nine fold increase in fertilizer consumption, with reducing marginal gains and at the cost of significant soil salinization and pollution (WCED, 1997). In Gujarat which is known as the chemical capital of India, the loss in soil fertility and the subsequent fall in farm output has been in the range of 60 to 80 per cent (Kumar, 1994). Excessive fertilizers can also adversely affect the nitrogen fixing organism in the soil and reduce the natural nitrogen absorption (Nadkarni, 1988). Scientific studies have confirmed the presence of pesticides in ground water which can be traced to agricultural uses.

Making the most efficient use of resources should receive the highest priority in the steps to deal with substainability issues. Pricing policies for the use of water should be rationalized which is definitely a tough task. Dissemination of information on better utilisation of water is top priority. Research is to be directed toward generating new technology for marginal lands. There is also a need to assess the output-input ratios of alternative ways of dealing with sustainability problems.

Equitability, Poverty & Sustainability

Issues of inter-generational and intra-generational equity are closely allied to some aspects of sustainable agriculture and are generally found conflicting with the

development strategies. Inter-generational equity is at the core of the definition of sustainability, whereas intra-generational inequality is the main force driving ecological degradation. Productivity and stability are pitted against each other in order to achieve sustainability and equitability and vice-versa. Green revolution technologies help in enhancing productivity but they are associated with low sustainability and equitability.

Indian agriculture is suffering from some structural deficiencies on the one hand and distortions in agrarian structure on the other. Inequality of asset distribution implies poverty for the deprived. Land distribution in India is heavily skewed. The Gini coefficient is around 0.7. Small farmers constitute about 80 per cent of the farming community and operate upto 30 per cent area. Within the rural sector, outside the irrigated belts, the level of investment is very low.

The equity issue can be resolved only when these structural deficiencies and distortions are taken care of. Nearly 76 per cent of agricultural holdings are less than 2 hectares each and sixty seven per cent of these are less than one hectare each. The average size of these holding has been reduced to 0.39 hectares and fast becoming unviable. Land reforms have failed to bring about equitable distribution of land and consequently very large interpersonal inequalities continue to exist in land distribution in all parts of India. These inequalities have given rise to a great deal of social tension. In fact, according to the 1981 census data, the concentration in agriculture has increased. The increasing pressure on agriculture has resulted in very great increase in the number of marginal and small holdings on the one hand and increasing proportion of landless labour on the other. Therefore, given the present agrarian structure, the high input agriculture also needs external interventions to achieve the objectives of equitability.

The causal factors underlying environmental degradation are due to the quality of the growth process rather than growth per se. Poverty and environmental degradation appear to be closely associated and so are poverty and population growth. The most disturbing feature of Indian economy is the inverted U relationship between per capita income and environmental degradation (Shafik & Bandyopadhyay, 1992). Important environmental trade-offs occur under the pressures of population growth and falling per capita income. The effects of poverty on the environment are endlessly complex. Unable to increase productivity from their limited resources, the poor are driven to practices that amount to ecological suicide; extending cultivation to forested areas that they need for fuel wood and forage; burning dung for fuel instead of using it to build soil fertility; planting annual crops on erosion prone slopes; and grazing more animals than natural range land can support.

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There is a fundamental conflict or trade-off involved not only between environment conservation and economic requirement but also between them vis-a-vis social equity both in inter and intra-generational context. In developing countries, economic and social goals like eliminating poverty and unemployment contradict very strongly with the goals of environmental and resource conservation. So also are attempts to improve distribution which conflict with faster growth.

New Economic Policy and Development in Agriculture

To establish an environment for sustainable development, the government's new economic policy is a bold attempt. Its long run objective was to promote efficiency and enterprise through deregulation, devaluation and deflation. Since agriculture in India continues to be a tradeable sector, many of the structural reform policies are likely to have far reaching effects on agricultural exports, imports investments in new technology, pattern of agricultural growth income and employment in agriculture, agricultural prices and food security.

Deregulation is not always a good policy. Free trade can also introduce new inefficiencies. More than half of all international trade involves the simultaneous import and export of essentially the same goods. Specialization is likely to result in reduction in the range of occupational choices. It is argued that free trade runs afoul of all

economic policies, the efficient allocation of resources and the maintenance of sustainable scale of production (Daly, 1993).

The free-trade scenario simulates a completely undistorted economic environment, which would be possible only if developed nations eliminated producer price subsidies and stopped dumping surplus production in the world market. Unrestricted international trade also raises problems of resource distribution when capital flows from abroad, the opportunity for new domestic employment declines resulting in the fall of domestic labour prices.

Agriculture is presently practised under an economic climate dominated by issue of subsidy, quotas, debt management, and liable commodity prices. Hence, understandably agriculture economics is directed towards short-term high gain strategies. Producing for export to generate foreign exchange, has become a national goal throughout the world, despite the environmental and distributional impact of such policies. Emphasis on increasing exports will most likely be accompanied by a move from share-cropping to contact farming. The adverse effects of such farming have already been felt in a number of developing countries (Nanda, 1995). The structural adjustment policies seem to be more encouraging to capital intensive technology and save on labour. Such policies of export orientation may aggravate the problem of ecological degradation and marginalization of small farmers.

Agricultural development under the new economic policy may benefit large farmers and the multinational corporations who may enter into partnership with local firms for exploiting our natural resources. Modernization and diversification of agriculture for achieving the goal of globalization is unsustainable keeping in view the socio-economic characteristic of our rural population on the one hand and the nature of our agriculture on the other.

Trade reform measures, viz; real devaluation and fiscal compression tend to raise agricultural prices benefitting only surplus farmers. The rise in prices of foodgrains adversely affects the landless agricultural labourers and the rural and urban poor. The rise in input prices may work as tax on small farmers. As they are not in a position to expand input use, production is most likely to suffer. Fiscal compression implied in structural reforms also results in reducing public investment in rural infrastructure, hence decelerating agricultural growth and foodgrain supplies. The net impact of devaluation is not self generating as it depends on price elasticities of exports and imports, share of tradeable and non-tradeable goods in the sector and other policies (Kaushik, 1994).

On the other hand, it is being argued that freeing trade from inefficient restrictions may be the best way to achieve environmental protection while safeguarding prosperity and liberty. Dry land areas, with widespread poverty and low wages may stand to gain significantly from trade, as they have a comparative advantage in horticulture and livestock products, the demand for which is comparatively less inelastic than for foodgrains. Rice, wheat and cotton have a good export potential, under the new economic policy, whereas the imports of edible oil could be increased as they have been heavily protected (Gulati & Sharma, 1991). Further the distortions in international and domestic prices of cereals and oilseeds can be corrected by diversification of resources from assured irrigation crops to semi-arid crops, provided it is backed by cut in input subsidies in India and elsewhere in the developed countries.

Conclusions & Policy Implications

Thus the most obvious cases of environmental degradation and loss of sustainability are associated with the modernization of agriculture as the latter brings with it the use of chemical insecticides and commercial fertilizers. Deregulation in case of agriculture is unlikely to be effective in ensuring sustained agricultural growth. The agenda of policy should accord highest priority to take steps for making the most efficient use of resources to deal with sustainability issues, reduce the discrimination against agriculture by means of trade and exchange rate policies, improve the capital markets that serve agriculture, encourage public and private capital formation in this sector, soil and moisture conservation, better farm infrastructure management and removal of restrictions on trade in agricultural commodities. Further, there is a need for identifying efficient means of dealing with the equity problem.

Education and awareness may be used to make farm producers more sensitive to the environmental impact of their operations. Committed human input is a pre-requisite of any sustainable system rather than just opting for yet more machine power. Therefore, human resource development should be at the top agenda in the development planning.

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Economic Implications of Industrial Pollution Control

M. Ravichandran & S. Dhanaraj

A case study of sugar industry in Pettavaithalai, Tiruchirapalli district, Tamilnadu was conducted for the purpose of analysing the impact of pollution on human health and that of pollution control measures at the factory level. It was found out that the respondents who live in the pollution prone area incurred medical expenditure significantly greater than those in the pollution-free area. The concerned factory had to bear the cost burden of the pollution control equipment, which worked out to be 9 per cent of the total investment of the firm, while the annualised pollution control cost was only 0.67 per cent of the turnover of the factory.

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Any economic activity, industrial or agricultural has a bearing on the environment. As the pace of development is accelerating the world over, production has become more complex with the use of non-renewable resources and energy becoming more intensive. As a result the ravages on environment have assumed alarming proportions. Literature on environmental problems and the deleterious effects thereof is mounting. However, the discussion over environmental issues is more rhetoric in nature. Quantitative information is scanty on environmental aspects, particularly regarding the impact of pollution on human health.

Although the process of industrial pollution control started from the early seventies in the form of environmental legislative protection, the progress leaves much to be desired. Industries are the leading cause of environmental destruction. The Government of India notified way back in the seventies the different categories of polluting industries which are to comply with the pollution control Acts. Sugar Industry is one among the notified categories.

This paper attempts to present the results of a research study carried out during 1994-95, on a sugar factory located in Pettavaithalai of Tiruchirappalli District, Tamil Nadu. The major thrust of the study included the environmental problems generated by the factory, its negative externalities and the cost burden of pollution vis-a-vis its control, on the firm.

Methodology

In order to probe the extent of adverse effect on the health of people, 100 households were chosen as respondents among the inhabitants around the factory. The research design used in the study envisaged two different sets viz, control and experimental groups. The control group lived at least 2 K.M. away from the sugar factory called Zone II and the experimental group lived

Table 1: Medical Expenditure incurred by Experimental Group

Health center	No. of households affected	Diseases reported	Expenditure during 1994-95 (in Rs.)	Average per house expenditure per annum (in Rs.)
Private Hospitals	31	Headache, Chest Pain, T.B., Asthma, Eye diseases, Skin diseases	77,500	2500
Government Hospitals	1	Headache, Chest Pain, Fever, Cough, Stomach Ache, Body Pain	800	800
Private Hospitals (other sources)	9	Headache, Chest Pain, Cold, Asthma, Eye diseases	18000	2000
Both Private and Government Hospitals	6	Headache, Fever, Cough, Burns, Eye diseases	6000	1000
Private, Government, and other sources	2	Headache, Chest Pain, Body Pain	1800	900
Other sources/CSI (P) Sources	1	Body Pain, Chest Pain, Cold	700	700

Table 2: Medical Expenditure incurred by Control Group

Health centre	No. of houses affected	Diseases reported	Expenditure during 1994-95 (in Rs.)	Average per household expenditure per annum (in Rs.)
Private Hospital	17	Headache, Tuberculosis, Eye diseases, Fever & Cough	9020	530
Govt. Hospitals	2	Headache, Fever & Cough	300	150
Private Hospitals/other sources	8	Headache, Chest Pain & Cold	4720	590
Both private and Govt. Hospitals	22	Headache, Fever, Cough, Burns, Eye diseases, Stomach Ache	5580	254
Private, Govt. & other sources	1	Chest Pain, Body Pain, Eye diseases	480	480
Other sources/(CSI (P) Sources	–	–	–	–

in the area within a radial distance of 2 K.M. from the factory called Zone I. By using a simple random sampling method, 50 households for each group were chosen from the voter's list which was treated as sampling frame for the study.

Gathering information regarding the pollution level and the effects thereof is not easy. Infact, the authors obtained prior permission from the Member Secretary, State Pollution Control Board, Madras, to collect the necessary data from the concerned unit. The impact of pollution control cost on the economic indicators of the factory was also analysed.

Results & Discussion

The major findings of the study included the fact that the respondents who live in the pollution-prone area incurred significantly higher medical expenditure than those in the pollution free area. Regarding the cost burden of the pollution control equipment, the concerned factory had to bear the pollution control cost which worked out to be 9 per cent of the total investment of the firm, while the annualised pollution control cost was only 0.67 per cent of the turnover of the factory.

Table 3: Pollution Control Cost in the Select Sugar Factory

(Rs. in Lakhs)

Expenses (cost)	1993	1994	1995*
Installation cost	44.00	44.00	44.00
Power and fuel	1.75	1.98	4.34
Chemical consumed	0.22	2.06	2.06
Labour	2.00	0.29	0.29
Depreciation	4.40	4.40	4.40
Interest	5.20	5.20	5.20
Total maintenance cost	13.57	13.93	16.29

* Cane crushing capacity increased from 1016 tonnes of crush per day (TCD) to 25000 TCD.

Table 4: Cost of Pollution Control (PCC) in relation to Total Cost, Investment and Turnover

Year	Investment (plant etc.) installed for PC as % of Total investment	Annualised PCC as % of Total cost	Annualised PCC as % of Turnover
1992-93	9.9	6.3	0.80
1993-94	9.2	5.5	0.80
1994-95	9.1	5.5	0.67

An attempt was made to test the hypothesis, "Expenditure on health care of the households belonging to the sugar factory area is more in pollution-prone area (experimental group-Zone I) than in the pollution free area (controlled group-Zone II)."

Null Hypothesis: $H_0 : u_1 = u_2$: Categories of the households being affected or not being affected by the Sugar Industrial Pollution and their medical expenditure do not differ.

Research Hypothesis: $H_1 : u_1 > u_2$: Categories of the households being affected or not being affected by the pollution and their medical expenditure differ (greater than the control category).

Categories: Households affected by pollution (more medical expenditure) Category is an experimental group, and households unaffected (less medical expenditure) category is a control category.

Obtained 't' ratio = 2.624, Table 't' ratio = 2.262 degrees of freedom = 9, P = .05.

As the calculated value is higher than the table value, we reject the null hypothesis and accept the research hypothesis. Hence, medical expenditure of the experimental category is significantly greater than the medical expenditure of the control category.

With regard to the cost of pollution control in relation to other economic indicators of the firm, the possible impact of the pollution control cost on the economy of the firm was analysed. This is quite essential because of the fact that industrialists are averse to investing money on pollution control as they feel that the increased investment on pollution control could have an adverse effect on the profitability. Therefore, an attempt was made to analyse the pollution control cost and its possible influence on the concerned firm.

The collected cost data from the sugar factory on pollution control was classified into capital and maintenance cost. The capital cost includes the cost of the treatment plant and the maintenance cost includes power, fuel, labour and chemicals used in the treatment process. The annual pollution control cost is estimated by taking annual depreciation on the value of the plant and machinery installed for this purpose, interest charge on the same and annual maintenance cost of pollution control. The investment in pollution control is then compared with the total investment; similarly annual pollution control cost is compared with the total cost of production and annual turnover.

Table 4 shows the details of the cost of pollution control (PCC) in relation to total cost, investment and turnover. In the year 1992-93, investment (plant etc.) for pollution control as percentage of the total investment was 9.9 pr cent, annualised pollution control cost as percentage of total cost was 6.3 per cent and annualised pollution control cost as percentage of turnover was 0.80 per cent. In 1994-95, investment for pollution control as percentage of total investment was 9.1 per cent, the annualised pollution control cost as percentage of total cost was 5.5 per cent and annualised pollution control cost as percentage of turnover was 0.67 per cent. The analysis of pollution control cost was entirely based on the information obtained from the concerned factory. The authors cross checked with Pollution Control Board officials and feel that the cost information might have been exaggerated over and above the original cost of pollution control.

Recommendations

Although anti-pollution laws are stricter now, by themselves, they are not likely to achieve a significant improvement in pollution abatement particularly air and water pollution. The major weakness of the regulatory system is the large amount of discretion and even laxity that it allows the authorities in charge of monitoring and ensuring the implementation of the law. Its implementation cannot be taken for granted merely because it exists.

It is in this regard that economists argue in favour of pollution tax as against regulatory measures, such that it would be cheaper to adopt anti-pollution measures than to pay the tax. It has to be a tax directly on the pollutants emitted; such a tax permits less laxity and is far more automatic than a regulatory system. A tax on pollutants favours firms adopting anti-pollution measures and heavily discriminates against those not adopting them. Such a tax can also be imposed on institutions like municipalities which do not produce commodities but only release pollutants.

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Assuming increasing marginal costs as the level of abatement increases, the tax is so set as to equal the marginal cost of achieving the level of abatement desired by the community, the region or the country. (M.V. Nadkarni & M. Ravichandran 1987). At present, the standards laid down in the regulatory system are to be taken and the levels of the marginal costs of attaining these standards would be the rate of the pollution tax. The marginal cost is to be interpreted here not only in terms of current inputs, but should also include the annualised cost of additional capital or equipment needed for attaining the desired level of abatement. Then the unit concerned finds it cheaper to achieve this level of abatement than pay the tax, though beyond this level the marginal cost would be higher than the tax. The tax should nevertheless be imposed on the pollutants remaining unabated also, and the revenue realised thus can be used to cover the costs of administering the tax.

Concluding Remarks

The process of pollution control is a continuous endeavour towards environmental protection. It is a question of social responsibility on the part of the industrial entrepreneurs to internalise the negative externalities. The pollution control measures in terms of financial commitment may be burdensome, but on actual analysis pollution control cost constitutes only 5 to 10 per cent of the total investment. Pollution control not only facilitates environmental protection by way of improved health and better yield of crops—in the case of air pollution control devices, it also helps save material inputs which go out otherwise as pollutants.

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Strategic Management of Hazardous Wastes in India

Thomas Mattew & Seema Unnikrishnan

In this paper the importance of an integrated approach to the problem of hazardous waste management has been stressed. The methodology used is TOWS Matrix study which has been done for the critical analysis of the hazardous waste legislation and management in India, with case studies on Bharat Zinc recycling plant and the hazardous chemical units relocated from Delhi. Recommendations have been suggested for modified approaches in improving hazardous waste legislation and management in India.

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Management of hazardous waste has become a very complex problem today. Improperly managed hazardous wastes have led to large scale contamination of water, air and land in many countries including India. Though, India has various programs for the management of hazardous wastes and environmental pollutants, these are far from being effective. Incidents involving an accident of a truck carrying hazardous wastes, toxic waste being discovered in a remote site, or an explosion in some industry resulting in a toxic gas cloud are becoming far too frequent, demanding urgent attention.

Objectives of the Study

A study was undertaken to analyse the weak and positive aspects in the hazardous waste legislation and hazardous waste management. The study unfolds a large canvas to view matters in a total perspective for better appreciation. A critical analysis was carried out by TOWS Matrix Study and two case studies were analysed to identify the strengths and weaknesses in terms of their efficacy to achieve the target.

Hazardous Waste Recycling: Bharat Zinc Case Study

Bharat Zinc, Bhopal is India's largest toxic waste importer. Last year it recycled Zinc and Lead wastes sent from Germany and Netherlands and is one of the few companies in the country authorised/licensed by the Environment Ministry to import and recycle toxic waste. Green Peace Investigators visited and made a video film of the working conditions in this reprocessing facility. They found basic health and environmental safety measures missing at the factory. This is in violation of article, 21, 47 and 48 of the Constitution of India as well as the Environmental Protection Act.

At Bharat Zinc limited, an electroplating process is used to extract zinc from the imported Zinc waste. Sulphuric acid is used to combine with Zinc resulting in Zinc Sulphate. Thereafter, Zinc is extracted from the solution using electrolysis. No other metal is recovered in this process and the toxic residual wastes are dumped in the open land. Shipping documents obtained by Greenpeace in Europe, showed that Bharat Zinc was buying about 450 tonnes annually from these countries. Lab tests carried out in Britain on the samples collected from the Bharat Zinc plant in Bhopal detected large amounts of highly toxic dioxin produced during recycling. Laboratory analysis of such imported waste sample showed the presence of Nickel, Cadmium, Lead, etc., which are deleterious both to the humans and to the environment.

Bharat Zinc factory does not have proper facilities for dealing and processing the wastes from recycling. These are just being dumped in the courtyard of the factory in the open space. Women and children also work in the factory and no protective clothing is given to any worker, Workers are also not aware of the hazards they are exposed to.

On 18 September, 1995, a writ petition was filed by Ms. Vandana Shiva, Director of Research Foundation for Science and Technology and Natural Resource Policy. This writ petition challenged the decision of the Ministry of Environment and Forests permitting import of toxic wastes in India. It stated that these decisions are against article 47, which enjoins a duty on the state to raise the standard of living and to improve public health. This is also a case of flouting the International Treaties particularly Basel Convention of which India is a party. As per the Basel Convention, all exports for recycling of hazardous wastes from OECD to non-OECD countries will be banned.

The Ministry of Environment and Forests argued that the metals which have been given license to be imported are essential for India. There is a shortage of these metals here as there is a shortage of quality non-ferrous ores. The final products smelted as metals can

Table 1: TOWS Matrix Application: Bharat Zinc Case Study

	Strengths	Weaknesses
	1. Judicial Activism 2. Increasing environmental consciousness	1. Lack of proper disposal measures in waste recycling units 2. Worker's Safety and Health aspects are completely overlcoked 3. Lack of integration between the Government, Public and the industries in tackling the problem.
Opportunities 1. Industries can be made aware of the importance of cleaner production and disposal measures. 2. Taxes can be introduced for industries dumping hazardous wastes	Strategies SO 1. Cleaner Production in industries should be encouraged by the Government [O1, S2] 2. ISO 14000 and Life cycle analysis should be encouraged [O1, S2] 3. Taxes for hazardous waste dumping industries will lead to voluntary waste reduction measures [O1, O2, W2]	WO 1. Incentives can be given to industries to minimising hazardous wastes [O1, W1] 2. If after source reduction and minimisation wastes are produced, it must be properly incinerated or stored in a lined landfill [T1, W1].
Threats 1. Large scale dumping of hazardous chemicals by developed countries going against Basel convention 2. Large scale pollution of land, ground water and air due to widespread dumping of hazardous wastes without treatment after recycling. 3. Deteriorating Health of workers	ST 1. All the conditions in the Basel Convention of which India is a signatory should be followed strictly [T1, T2, S1].	WT 1. Safety measures while handling hazardous wastes should be improved [T3, W2]. 2. Education should be given to workers about the ill effects of improper handling of hazardous wastes [T3, W1, W2]. 3. An integrated approach by the Government, Judiciary, industries and the Public is a necessity [T2, T3, W3].

be imported, but the imports will be very expensive and can have a deleterious effect on Indian economy. Moreover processing of metallic ores here to extract the smelted pure metal would also create large scale pollution. The Ministry also argued that procedures are followed to ensure that appropriate quality and quantity of wastes are imported. The State Pollution Control Board has to certify that the industry has valid consent to operate under the relevant pollution control acts. It also has to certify that any waste which is generated from such processing is disposed of in an environmentally safe manner.

This case study shows the politics of trade. Gross negligence is aided by policy loopholes and the bureaucratic maze is chaotic enough to shield erring importers (Uniyal, 1996). Table 1 presents TOWS matrix application of this case study.

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Hazardous Units In Delhi: Non-Integrated Approach

The Supreme Court ordered 1200 hazardous units located in the capital, Delhi to be shifted out in response to the petition filed by environmental lawyer Mr. M.C. Mehta in 1985 highlighting the problems caused by these industries.

The lack of integration between the Judiciary and the various Government agencies is seen from the fact that the Union and Delhi Governments tried to persuade the Supreme Court to extend the deadline for shifting polluting industries from November 30th, 1996 [Raj, 1996]. Both the Governments were concerned that atleast 50,000 workers will be rendered jobless. It was not made mandatory for the units to pay the workers compensation in the event of closure, instead of shifting to the place allotted to them. Many units who were asked to move, chose to shut down as the land they possessed would fetch them very high prices. About 50% per cent of the units had chosen this short cut to become rich.

Many units who were asked to move had chosen to shut down as the land they possessed would fetch them very high prices.

In reply to the application by the Central Government to clarify the status of workers in the units being closed, the Supreme Court gave its verdict in the first week of December 1996. The Supreme Court has asked all the hazardous industries which chose to close down instead of shifting out of Delhi to pay six years' wages to their workers. The compensation can be paid either in lumpsum or in installments by April 30th 1997 to the retrenched workers. The Court also added that like the industries being relocated, those which are planning to shut down will be entitled to retain only 32 per cent of land occupied by them. The rest of the land will have to be surrendered to the state.

As per the earlier order of the Supreme Court given on July 8th, 1996, the Court had asked the industries to give the workers retrenchment benefits under the Industrial Disputes Act. Accordingly, only one year's salary had to be given to those who were losing their jobs due to closure. This has now been enhanced to six times, i.e., they have been asked to pay wages for six years. Those workers who do not want to move to the new sites in the case of shifting industries will be paid only one year's salary as in the earlier order.

Under the new verdict of the Supreme Court, industries opting to close down will have to pay more than Rs. 600 crores as labour compensation. Many of the Industries like Siddharth Shriram's Siel Foods Ltd., which had decided to windup and open a new division in a land not allotted by the Government but in Punjab will have to rethink. Under the earlier order it had to pay only Rs. 9 crores to the workers but now it will have to pay Rs. 54 crores.

This whole confusion could have been avoided if there was an integrated approach in the planning stage itself. These industries should not have been permitted to start their operations in the Capital Region.

Environmental protection and hazardous waste management needs coordinated action by Government Departments, Public Enterprises, Research Organisations, Universities, Private Industries and Non Governmental Organisations (NGOs) to be effective. Such harmony will avoid needless duplication and conflicts [Rajasekharan 1992].

TOWS Matrix: A Tool for Analysis

TOWS Matrix is a conceptual framework for systematic analysis. The strengths and weaknesses are studied in relation to the threats and opportunities. Matching them in a systematic manner helps in formulating better strategies [Dyson, 1990]. This conceptual model

Table 2: TOWS Matrix: Hazardous Chemical Units in Delhi

	Strengths	Weakness
	1. Judicial Activism 2. People like M.C. Mehta, Environmental Lawyer whose Public Interest Litigation is responsible for this situation 3. Benefits to Workers and the Environment	1. Lack of Co-ordination between Government, Judiciary and Industries 2. Nothing mentioned about source reduction of Hazardous Pollutants at the relocated site
Opportunities	SO	WO
1. Environmental Planning can be done on the lines of Eco- Industrial Philosophy with the help of the Government 2. ISO 14000 and Life Cycle Analysis can be encouraged in all the relocated Industries. 3. Public and worker participation can be improved.	1. Integrated approach between industries and the Government in the relocated site can give rise to a Eco Industrial park [O1, O2, S3]. 2. 60 days notice period in the EPA can be removed [O3, S1, S2].	1. Integrated approach to environmental protection [01, 02, W1, W2]. 2. ISO 14000 and Life Cycle Analysis should be encouraged in the relocated industries [02, W2].
Threats	ST	WT
1. If Industries are put up in the relocated site without giving priority to waste minimisation and cleaner technologies, the same problems of widespread pollution will be there. 2. There is a threat of residences being built very close to the industries in the relocated site also.	1. Special Green courts with Environmental experts to weigh technical matters in every city in India [T1, T2, S1]. 2. Workers should be given training in the handling of hazardous chemicals and wastes [T1, T2, S3].	1. Cleaner technologies should be provided to the relocated industries by the Government [T1, W1, W2]. 2. Incentives should be given to the industries going in for source reduction of hazardous chemicals [T1, W2].

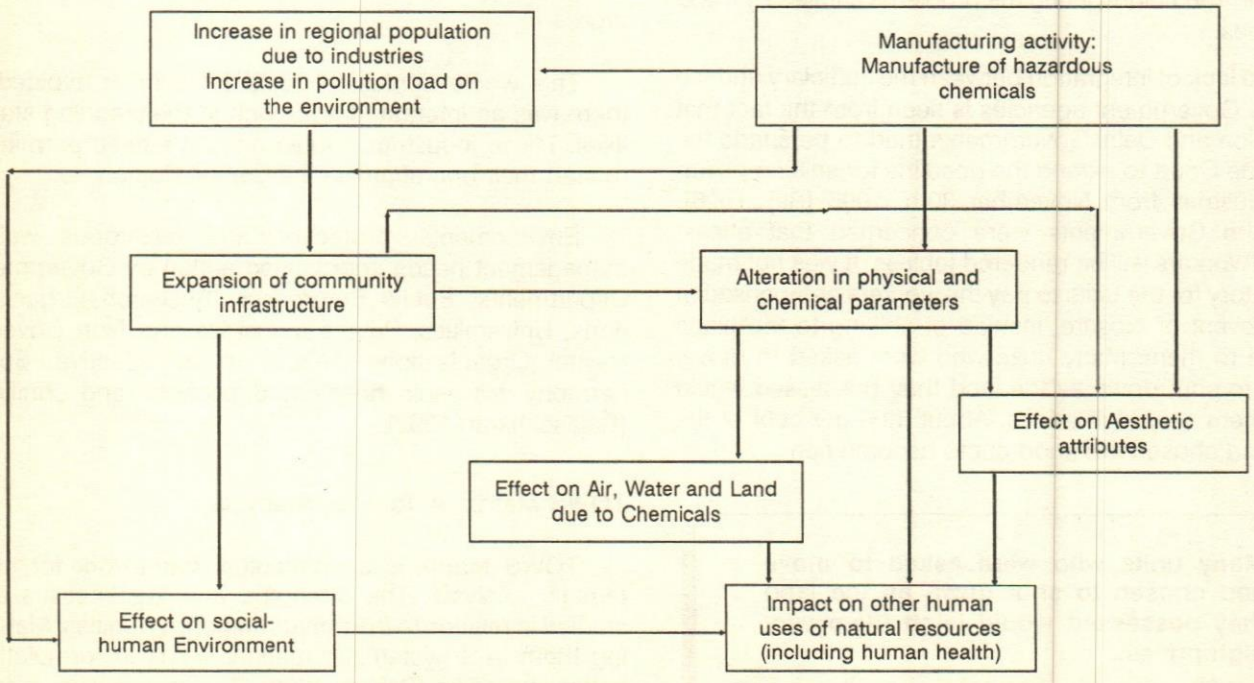

Fig. 1. Schematic Representation of Manufacturing Impact of Hazardous Units in the Relocated Sites

provides a good framework for identifying relationships between the various factors; the combination of relationships can give rise to a choice of strategies.

- In the TOWS matrix,
- SO Stands for strengths versus opportunities
- WO stands for weaknesses versus opportunities
- ST stands for strengths versus threats
- WT stands for weaknesses versus threats

TOWS Matrix was applied to the case study, involving the Supreme Courts verdict of shifting of hazardous waste units away from Delhi, the capital city of India due to the problem of hazardous chemicals (Table 2) to get better strategies to deal with the problem.

Impact Analysis: Moore Impact Matrix was developed by Moore et al. for describing the relationship between manufacturing activities and their potential impact on the environment. The basic philosophy of the Moore method is that a meaningful analysis of the manufacturing environmental impacts must ultimately be based on the determination of the direct and indirect impacts on human uses [Canter, 1977].

This matrix has been used on the hazardous chemical units in Delhi to predict the impact of the industries in the relocated site if importance is not given to environmental aspects. The inter-relationship between various primary and secondary activities involved in the case study is given in Fig. 1. TOWS Matrix can also be used to formulate alternate strategies to improve hazardous Waste Management in India (Table 3).

Recommended Strategies

The following strategies can be adopted for improving hazardous waste management in India:

An Integrated approach is what is lacking most in managing hazardous wastes. There should be cooperation between various regulatory agencies and departments in the Government, Industry, Public and the Judiciary; such an integrated approach will be more productive and more functional.

A new institutional mechanism by dissolving the present Boards and putting up a central National Protection Authority just as the EPA in US will improve implementation to a great extent. This Authority should be run by persons having a high level of knowledge and maturity, who will be able to achieve sustainable development by balancing economic growth with preservation of ecology.

There is huge backlog of cases pending in the lower courts. The high courts and the Supreme Court are also overburdened with pending cases (Desai 1996). Specialized Courts are required because many of the cases have to be dealt with urgently as the repurcussions on the environment are deadly; these courts also require people with technical expertise on the Jury. The mandate of the tribunal under the National Tribunal Act has to be broadened. It will also be advisable to constitute special benches in Calcutta and Madras in all the high courts to exclusively deal with environmental cases.

Institutional impetus should be provided for the adoption of "clean process technologies" and "waste minimization" techniques. A change to a cleaner technology will have a positive impact on the environment. As the amount of hazardous wastes produced reduce, they also have economic returns that mitigate the need for extensive regulatory interference (Sakurai, 1995). Developing environmentally conscious designs will become more important as consumers and governments demand lower impact products (Cattanach, et al., 1995). Batneec Principle, that is Best Available Technique Not Entailing Excessive Cost concept, used successfully in UK, can be tried in India. This concept weighs the economic aspects also.

Batneec Principle, that is Best Available Technique Not Entailing Excessive Cost concept, used successfully in UK, can be tried in India.

Government should enact take-back legislation to reduce the production of hazardous packaging wastes. This requires that a company take back specified components of a product after the consumer is finished with it.

Education should be given free atleast till 10th standard so that illiteracy and poverty can be reduced. All aspects of environmental protection should be taught in schools including dangers involved in handling hazardous chemicals in the wrong way.

Eco-Industrial Parks should be encouraged in India with the help of Government. One of the major goals of industrial ecology is making one industry's

Table 3: TOWS Matrix for Hazardous Waste Management in India

	Strengths	Weakness
	1. Comprehensive and less complicated legislation 2. Judicial activism very high 3. Some schemes for financial assistance to industry brought out by Ministry of Environment and Forests	1. No integrated approach to waste management 2. Authorities (CPCB/SPCBs) for implementation not truly autonomous 3. No stress on Source reduction 4. No incentives to industries recycling waste 5. Fine too less to be effective 6. Clean-up field not touched 7. No rules, just guideline only given for collection, storage, transportation and disposal of hazardous waste 8. Procedural protections 9. Public have no access to information about the amount and type of hazardous wastes produced by industries
Opportunities	SO	WO
1. Environmental awareness & consciousness on is rising 2. ISO 14000 can be encouraged 3. Life cycle analysis can bring about source reduction 4. Governments share of implementation can be improved 5. EPA-60 days notice can be removed 6. Information networks can be put up with the latest information on hazardous wastes	1. Integrated Approach is essential [O_1, O_3, O_4, S_2, S3] 2. Eco Industrial Parks should be tried out with Government support-Zero Waste concept [O1, O3, O4, S3] 3. Hazardous waste information clearing houses should be put up to help industries [O6, S3]	1. Integrated approach with incentives, legislation and technology needed [O1, O4, W1] 2. New autonomous Implementing authority will improve implementation. [O4, S1] 3. Cleaner technologies should be encouraged and Government support given (O1, O2, O3, O4] 4. ISO 14000 encouragement will reduce production of hazardous wastes [O2, w2]. 5. Government should make it mandatory that all generators of hazardous wastes make information about wastes available to the public [O1, O4, W8]
Threats	ST	WT
1. Indian laws tend to become complex and obsolete 2. Illiteracy, Poverty & Rising Population 3. Rising consumerism 4. Widespread ground water pollution, soil & air pollution on the rise	1. Every city in India should have an Environmental Court with Judicial and technical experts [T3, T4]. 2. The Air Act and The Water Act have become absolute with the enactment of EPA - can be removed [T1, S1]	1. Simple Take Back legislation will reduce packaging wastes, [T3, T4, W1, W6] 2. Clean up laws and rules needed to control dumping of hazardous wastes [T2, T3, T4, W6, W7] 3. Free education has to be given by the Government till 10th to reduce illiteracy and poverty. 4. Incentives to minimise wastes should be part of the law itself [T3, T4, W3, W4, W5].

wastes, another's raw material. This can be realised in a number of ways, the most direct one being the Eco-Industrial Park (EIP) (Frosch, 1995).

Life cycle analysis should be encouraged in the Indian Industry. Information of Hazardous Waste Accounting system of all Industries should be made available to the public as this will help voluntary waste reduction by industries (Hearne, 1996). National Pollutant Release and Transfer Registers can be set up, this will help the government track the generation, release and fate of various pollutants.

India should have a pollution prevention information clearing house with information regarding cleaner production which our industries can use whenever needed. The Ministry of Environment and Forests wants to use a World Bank grant – initially $ 200 million – to build an ambitious information network for cleaner technologies. The proposal has been stalled. This must be

revived. Industry-Government interaction should be strengthened.

An Information exchange can be set up for exchanging hazardous wastes. This can act as a clearing house matching producers of wastes with potential buyers. The first such exchange was set up in Netherlands (Biswas & Agarwala, 1992). Similar exchanges are now operational in Canada, US and other countries. The only limitation is that only a fraction of hazardous wastes will be suitable for exchange.

Indian Government is planning to enact a law on energy conservation. Another enactment on recycling and source reduction is also the need of the hour. This will go a long way in helping our country to progress in the direction of sustainable development. Incentives should be given in the law itself in the form of cess rebate, income tax exemption etc. for abiding industries.

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There is a need for a fresh look into all the aspects of hazardous waste management. The Government should ask itself whether the strategy for hazardous waste management has succeeded. A change in the strategy by making amendments and introducing incentives is one way of doing it. While India in many ways has a strong comprehensive statutory environmental framework in place, there are a number of identifiable gaps:

- Foremost among these, as far as hazardous wastes are concerned, is the failure of the legal and regulatory system to address the problems associated with past contamination of soil and groundwater i.e. the "clean-up-technology" field.
- There are no rules at present under the Indian law specifying the collection, transportation, storage and disposal of hazardous wastes. Rules to regulate these important management aspects must be enacted at the earliest, as guidelines given by the Ministry alone will not help. Incentives for those abiding the rules must be introduced. One of the best ways to improve the management of hazardous wastes is to give all generators of hazardous wastes incentives to minimise wastes.

One of the best ways to improve the management of hazardous wastes is to give all generators of hazardous wastes incentives to minimise wastes.

- There are no standards that have been stipulated for pollution control equipment performance.
- The fines stipulated in many of the environmental offences are not set sufficiently high or imposed with adequate promptness to have the desired deterrent effect.
- The Water (Prevention and Control of Pollution) Act-1974 and the Air (Prevention and Control of Pollution) Act-1981 have become obsolete with the enactment of The Environmental Protection Act of 1986 as it covers everything; so they can be removed.

ISO 14000 implementation should be encouraged in Indian Industries. Two important aspects covered under this are auditing and life cycle assessment which will minimize hazardous waste production.

Conclusions

It can be concluded that an integrated approach is better for a developing country like India. Incentives should be made a part of legislation as this will encourage voluntary source reduction by Industries. A shift to a more preventive approach instead of the present remedial one (using more of in-process techniques instead of end of pipe treatment) is always better for the management of hazardous wastes.

A shift to a more preventive approach instead of the present remedial one (using more of in-process techniques instead of end of pipe treatment) is always better.

The hazardous waste legislation and management are quite weak in India now. This scene can be improved if the given recommendations are implemented.

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Green Productivity: The Case of Cement Industry

K. Nagender Rao

The Cement industry, by the very nature of its raw materials and production process, faces the problem of polluted environment. With the current burgeoning awareness about the need for controlling pollution at source, the industry, however, has taken giant strides toward 'greening' its environs. The article lists the steps taken in the direction of addressing this issue and the resultant positive impact on productivity.

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The Cement Industry, to many people implies dusty environment. All over the world, the cement industry has undergone tremendous technology transformation from wet process to dry process which has resulted in improvement in productivity in output, energy, fuel, etc. However, the technology transformation has led to the handling of dry powdered material from the raw materials, like limestone, laterite, bauxite, haematite, gypsum, flyash etc., and has aggravated the problems of environment. Its impact is causing concern not only to the employees working in the plant but also the surrounding areas/villages of 5-10 km., radius. One of the reasons why the cement industries are not attracting highly skilled and talented workforce is because of that neglected environment with heavy pollution and health hazards. However, the emergence of "TQM", "5s", Kaizen, Productivity and Quality concepts have transformed the face of the cement industry today. All the cement plants are meticulously planning their layouts with green lawns, plantations, rose gardens, lake views, fountains, etc., to create better environment for productivity improvement.

Impact on Environment

The cement industry which is 82 years old in India has an excellent record of growth during the past decade, both in terms of capacity and production. Presently, 54 cement companies are operating 106 cement plants in India with a capacity utilization of 81%.

Today, India is the world's fourth largest producer of cement after China, Japan and USA. The industry is on the fast track of production with an estimated growth of 95 million tons by the end of the century and 125 million tons by 2005 (table 1). The liberalized economic policies of India have led to the development of many sectors of economy including infrastructure, industry, etc., where Cement is in high demand.

Table 1: Indian Cement Industry Scenario

Factor	Present	5 Years Hence	10 Year Hence
Production (million tons)	63	95	125
Capacity (million tons)	78	115	140
Cement Demand Growth	6-7%	8-10%	10-12%
GDP Growth	4-6%	6-8%	8-10%

Though the growth of cement industry is an imperative need of the country to improve the economic standards of the people, the impact of the resulting environment on the society cannot be overlooked, The emissions from the cement industry should be regulated and minimized to the lowest possible limits, in order to eliminate its deleterious impact on society in general and employees in particular.

Keeping in view its growth, the Government of India has framed new standards for all new cement plants. The cement industry has spent around Rs. 3800 million (US $ 109 million) on pollution control by March 1995. New emission limits prescribed by the Government are presented in table 2.

Table 2: Emission Standards

Capacity	Emission Limits 1 mg/NM3	
	Production Area	Other Areas
Up to 200 TPD	250	400
7200 TPD (1987)	150	250

Emission Norms Comparison

The SPM emission norms comparison of various countries are shown in table 3.

Table 3: Emssion Norms in Some Countries

USA	Portugal	Japan	S. Africa	UK	Spain	India	Australia
				Existing			
100	100	100	120	150	170	150	250
				New			
50	50	100	120	150	100	50	250

Source: Cement Manufacturer's Association Report

The effective implementation and monitoring of norms will improve the environmental conditions of the society and contribute to Green Productivity remarkably. However, the reduction of emission levels requires huge investment. Its cost grows exponentially with reduction in SPM. It is estimated that the extra (additional) cost for reducing emission (SPM) levels from 150 Mg/NM3 to 50 Mg/NM3 is around Rs. 2500 million (US $ 715 million) in India.

The effective implementation and monitoring of norms will improve the environmental conditions and contribute to Green Productivity.

The dust concentration levels as compared for India and Japan are as shown in table 4.

Table 4: Dust Concentration Levels in India and Japan

	India	Japan
Tonnage Production per sq. km Range	385-880	3,700-5,400
SPM Norms Prescriber MG/NM3	50	100

Source: FICCI Publications

Factors Affecting Green Productivity in Cement Industry

Dust

Dust is one of the biggest problems of cement industry where it is generated through spillage, leakages, jammings, emissions, handling, etc., at every stage of operation:

* Drilling, blasting, crushing, transportation of limestone
* Grinding, pumping of raw meal from operation to operation
* Clinkerization and handling
* Coal crushing, grinding and handling
* Cement grinding and packing
* Raw material like coal, gypsum, bauxite, laterite, flyash handling
* Loading and unloading of materials and cement.

Oil and lubricants

Oil and lubricant spillages, leakages from equipment, machinery, oil drums, etc., in mining cement plant areas.

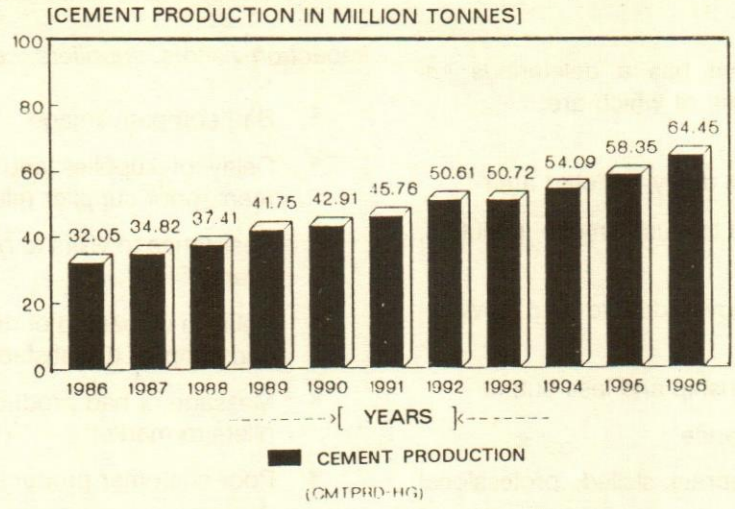

Fig. 1. Cement Production in India (1986 to 1996)

Water pollution

Inadequate water drainage and pumping systems, absence of water treatment plants, water logging and pipe line jammings are some of the common problems being faced in the Industry.

Plant layout and unplanned mining

Inadequate planning of industrial facilities like plant and machinery, mining areas, roads, lands, gardens, plantations areas, parks, colony buildings, parking yards., etc., are resulting in congestion. For example: stoppage of kiln production due to jamming of wet coal in the system during monsoon. This is a common problem in cement industry in the monsoon season which happens due to the absence of large coal storage sheds to meet the requirements of storage capacity of 3 months.

Vibration and noise

Crushing and grinding of big sized lumps into fine powder generate a lot of noise, vibration, and dust pollution in cement industries. Any increase in vibration and noise results in the stoppage of many key equipment and affects the productivity.

Heat

The process of conversion of raw meal into clinker requires a temperature of around 1400° – 1500° C. and it is being processed in rotary kilns and coolers. Handling of the very hot material and gases calls for high degree of safety and any negligence will result in accidents and loss of production.

Scrap and rejected materials

The scrap and rejected materials near the equipment and machinery, lack of cleanliness and improper method of working, etc., influence the productivity of the industry.

Flyash handling system

Inadequate flyash handling systems are causing pollution in the cement plants which have captive power plants.

Fire accidents & self ignition problems in coal yard

Fire accidents in the coal yard during summer often results in not only wastage of valuable resources but also pollution problems.

Vehicular emissions

Frequent movement of heavy truck/lorry transport is causing emissions and spillages and damaging the roads.

Emission from chimney and inadequate dust control

Absence of efficient dust controlling equipment and poor maintenance of existing facilities result in high chimney smoke, polluting the environment.

Influence of Pollution on Factors of Productivity

Impact on labour

The polluted environment has a deleterious impact on the labor factor, some of which are:

* Resistance to work in dusty, polluted area
* High allowances due to dust, smoke, pollution, heat, sound
* High employee turnover due to bad environment
* Poor quality workmanship and less output
* Low level of performance
* Industry does not attract skilled, professional manpower
* Health hazards and frequent absence from the work due to sickness
* Negligence of work
* Increase in accident rates
* Frequent stoppage of machinery and equipment by workmen due to unsatisfactory working conditions
* Low labor morale

It is a universal truth that, the happy employee gives his best in plant operation and increases production and quality of output. The unsatisfied employee, damages the equipment, practises wrong methods of operation and produces products of poor quality.

Impact on machinery/equipment

* Frequent machine stoppages due to dust, dirt and poor working environment and loss of production
* Lower equipment life due to fast wear rate
* High spares consumption and more inventory in stock and high inventory carrying costs
* Frequent spares replacement due to damage of spares
* Heavy leakage of lubricants around the machine area due to poor equipment maintenance and resulting accidents
* Increase in scrap and scrap disposal problems
* Inprocess material losses due to poor performance/stoppage of machine/equipment
* Unscheduled/unplanned breakdowns
* Costly maintenance and repair works

Impact on visitors, suppliers, customers and society

* Bad company image
* Delay of supplies and resultant delay in payment, poor supplier relationships
* Resistance to visits to plant by transporters/suppliers
* Delay in unloading of receipt materials by trucks and supplier dissatisfaction
* Message of bad product quality by visitors/suppliers to market
* Poor customer product image
* Reduction in customer service, quality and poor total quality image
* Reduction in market share/sales turnover
* Increase in customer complaints

Impact on neighbouring villages/agriculture/health and surroundings

* Dusty polluted surroundings and poor housekeeping
* Lower maintainability of colonies, houses and high maintenance cost
* Heavy deposits of dust (cement, coal, limestone powder, gypsum, etc.) in/on houses, plants, trees, green fields and equipment
* Health hazards to the people living in nearby villages
* Less agricultural productivity and arrest of growth of plants due to dust deposits
* Polluted water and drainage
* Poor roads and road maintenance
* Damages to houses due to frequent blasting in mines
* Heavy movement of trucks damages the roads and surroundings

Impact on health of industrial employees

The productivity of a plant depends upon the health and social environment of its workers. As far as the cement industry is concerned, there are no occupational diseases as such. Cement does not cause

any occupational malady like silicosis pulmoray, tuberculosis or respiratory problems among the workmen. The determining factor in silicosis is the presence of free silica. Silicates in clay do not have the contents which spread tuberculosis. Those working in free stone develop these diseases, whereas, those working on limestone do not. The French laws apparently recognize culaneous lesions as the only occupational malady. The skin diseases to which cement workers are susceptible include primary dermatitis, pyodermatities and cement itch.

Steps to Create Green Environment

Mines and mining area

In the cement industry, limestone mining area is spread over 600 to 1000 acres of land and regularly subjected to various operations like drilling, blasting, crushing of limestone and movement of heavy earth moving equipment in the area. These operations result in heavy dust emission and unless preventive measures are taken, they will have an impact on productivity of mining. In order to develop Environment Tailored Mine (EMT), the mines area is to be classified as: Used Mine Area, Effective Mining Area, Planned Mining Area, Future Mining Area. Various green development activities which can be taken up are as follows:

- Refilling of mine pits with over burden and plantation of trees like Babul, Bougainvillea, Cadamba, etc.
- Water sprinkling system on roads of mining area
- Fruit gardens in unutilized areas and refilled areas and fishponds to beautify the area
- Fountains
- Green grass landscape with flower plants and waterfall arrangements
- 60 ft., approach roads to excavation area with separate passages for the movement of HEM equipment.

Stacker and reclaimer area and raw material handling zone

The large open area contributes to a large amount of dust while unloading, stacking, transporting, shifting, handling, etc., operation of limestone, bauxite, gypsum, coal haematite, flyash etc. The following steps can address the problem:

- Water sprinklers/water spray system to minimize dust emission
- Effective layout of roads, stacking locations, handling locations, handling equipment etc.
- Fountains in the storage yards in specially allocated areas
- Green yard grass on well laid out places and extreme ends of the yard
- Tall green plants/trees grown on both sides of the yards, to absorb dust emission
- Dust collectors at transfer points
- Enclosed wide conveyor belts to eliminate material jamming, spillage and overflow
- Drainage system to eliminate wastes and dust (sludge)
- Segregation of unloading areas and effective control measures to minimize dust emission
- Telescopic chutes to adjust the height of fall of material on stack to minimize dust emission.

Raw mills, cement mills, coal mills, kilns and packing plant areas

While mining attached to cement plant has a large area of vacant land for the development of green land and plantations, the cement plant consists of a large number of operating equipment in planned layout. Hence, the plants has to consider the green environment requirements and future needs from the beginning while designing plant layout at the project stage. The new and existing plants should consider developing green environment factors as follows for overall productivity improvement:

- Prevention and elimination of dust emission from dust collectors, ESPS, bag filters and ensuring their efficiency
- Avoidance of spillage, overflow and jamming of material on belts, transfer points
- Prevention of oil and lubricants leakages near the machinery and maintenance of equipment cleanliness
- Removal of unwanted and waste material at the workplace
- Green grass developments at all available layout places after consideration of required facilities

- Hanging gardens and climbers in every floor and beautification of workplace-floors to motivate workmen
- Artificial water falls from the different floors and fountains on the ground near the mills at the maintainable locations to be developed.
- In order to suppress the minor dust powder in the environment, water spraying and clearing of floors, roads is essential in regular intervals
- Painting of buildings, walls, roads, borders with appropriate colours adds ornamental effect to the plants.

Developing Total Green Productivity in Industry

The ten steps for developing Green Productivity in the industry (Fig. 2) are as follows:

TGP Policy: The management should define a comprehensive Total Green Productivity Policy (TGP) covering aspects of Quality, Productivity, Green environment, Customer services, employee participation etc., in order to express the company's objectives clearly to the employees, suppliers, customers, share holders and the public in general.

Steering committee: A Central Steering Committee and organizational structure should be set up for Total Green Productivity by bringing all the existing circles/ teams Quality Circles, Task forces, 5S Committees, Housekeeping Committees, Value Engineering Teams, Cross functional teams, safety teams, etc. under one umbrella. The working methodology is to be streamlined in order to have a co-ordinated and single objective of Green Productivity. The Head of each department should be made the TGP Leader.

Department-wise identification of TGP factor: The next step is the identification of the factors affecting the green productivity (GP) in the department and determination of the existing level of GP, as per the GP Scale, (table 5), in order to assess the degree of improvement.

ISO-14000 standards and benchmarking: Establishing ISO-14000 Standards, documentation development, environmental benchmarking of the GP levels in each department and preparation of Action Plans for implementation are essential elements of a GP system.

Resource identification: Identification of resources like manpower, machinery, equipment, etc., are further requirements for implementation of the same.

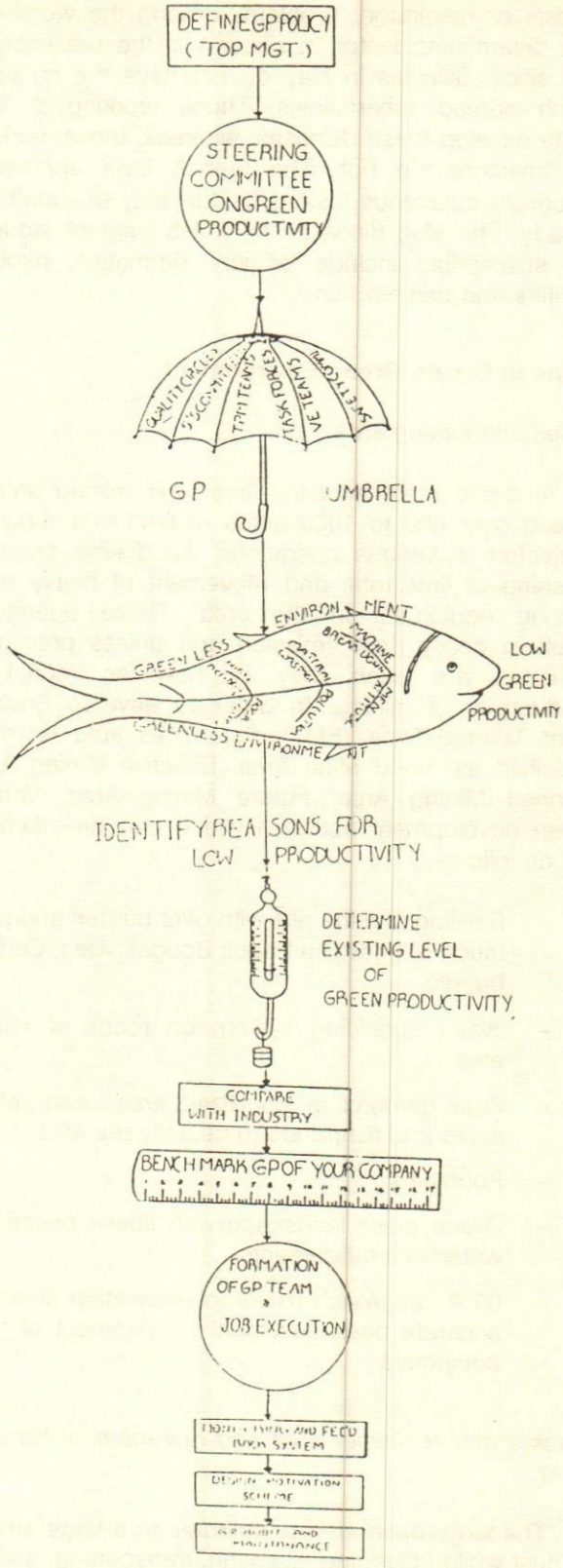

Fig. 2. Ten Steps of Developing GP in Industry

Budget: Preparation of budget proposals for implementation and maintenance of GP levels in each development and getting the approval of the steering committee of TGP.

TGP team and job execution: The formation of department-wise TGP teams, assigning the activities, providing the resources and monitoring the progress.

Monitoring and feed back: The usage of video display, photographs and presentations by the steering committees, to monitors the progress and conduct of Neighbor Interaction Meets (NIMS) of departments with other departments of others.

Motivation and recognition: Evolving motivation and recognition schemes to create healthy competitive spirit among departments.

TGP audits: Establishing TGP audit system in order to maintain standards and minimize deviations from the set systems.

Table 5: Green Productivity Scale

Green Productivity Factor	SCALE				
	Excellent	Very Good	Good	Average	Below Average
	10	08	06	04	00
Dust and spillage control in the plant and plant condition					
General cleanliness of the plant like roads, work places, colonies, temple, hospitals, guest houses, etc.					
Green plantation, beautification level in the plant and colony					
Condition of plant equipment and machinery and effectiveness of operation					
Employee response and treatment to external visitors					
Welfare facilities and social activities in the plant and surroundings and in nearby suburban areas, eg. water, roads, drainage, medical facilities, etc.					
Plant layout and arrangement of facilities for effective working					
Plant systems and procedures which include environment standards					

(Table 5 Contd.)

(Table 5 Contd.)

Image of company and product quality in society
Customer and visitor feedback system and sincerity of Management in implementation improvements
Control of wastage material and scrap generation
Demurrage cost incurred due to delays in receiving materials, loading, unloading delays, etc.
Contribution of manpower deployed due to poor environment and working conditions
Duplicate handling of materials, reworking, recycling on rejected materials
Employee turnover from the Company
Management efforts in controlling pollution and protecting environment
Accident rate in the plant
Health condition of employees and public in nearby vicinity
Degree of industrial peace in the company
Awareness and concern among employees, people in the area of green environment. Training and propagation efforts by the Company.

Scale Range	Grade	Rank
≥ 175 ≤ 200	A	Excellent
≥ 150 < 175	B	Very Good
≥ 125 < 150	C	Good
≥ 100 < 125	D	Fair
≥ 75 < 100	E	Average
< 75	No grade	Poor

Company Name

Designation of Person Interviewed

Company Address

Green Productivity Scale (GP Scale)

In order to determine the level of Green Productivity, the "Green Scale" has been evolved. This instrument may be filled by the employees of the

company, customers, suppliers, visitors to the plant. The average sample score is to be taken to determine the existing level of GP in the industry.

"GP" Relationship Matrix

An attempt was made to establish the relationship between the Green Scale and "Measurable factors of the Productivity" of the Cement Industry and GP Relationship Matrix was developed (table 6).

While referring to the GP Relationship Matrix, it is necessary to compare industries of similar age group having the same range of production capacity. Though it is applicable to all industrial sectors, the productivity measuring factors and their level may differ from industry to industry.

GP Scale in the range of between 75-100 is considered as Average Level for the purpose of basis and is taken as 1.0 and rest of the levels are multiplication factors of the average scale.

The Cement Industry's Green Productivity is measured against the following factors:

- Clinker produced per manday (MT/manday)
- Frequency of breakdowns per year
- No. of accidents per year
- Specific power consumption per MT of cement
- No. of customer complaints received per year
- Value of inventory of spares and stores/MT of cement
- Wastage of materials and scrap generation/MT of cement
- Demurrages paid by the company/year
- Employee turnover/year

Advantages of Green Productivity

Reduction in manpower deployment

The manpower deployed in workmen category in the Cement Industry is mostly engaged in removing spillages and the jammed material, cleaning of work places, roads, colonies, etc., and also in frequent maintenance activities as a result of poor environment.

The improvement in Green Productivity leads to the reduction in manpower (25-40%) of cement industry in India, as cleanliness and frequent maintenance of equipment, machinery, roads, colonies, etc., reduces the requirement of manpower.

Improvement in life of machinery and equipment

Green Productivity enhances the life of the equipment, as it reduces the wear rate due to dust and dirt and increases the attention of workmen on machinery maintenance. The reduction in machinery stoppages and breakdowns contribute to increase of output and ultimately improvement in productivity.

Reduction in inventory and spares consumption

Green Productivity reduces breakdowns and accordingly reduces the spares consumption and inventory of spares and stores. The wastage minimization in

Table 6: GP Relationship Matrix

Scale Range	Grade	Rank	Factor Wise Productivity Level Index								
			*1	*2	*3	*4	*5	*6	*7	*8	*9
> 175 < 200	A	Excellent	1.5	0.5	0.20	0.60	0.15-0.2	0.5-0.6	0.5-0.6	0.5	0.20
> 150 < 175	B	Very Good	1.4	0.6	0.4	0.7	0.4	0.7	0.7	0.6	0.4
> 125 < 150	C	Good	1.3	0.7	0.6	0.8	0.6	0.8	0.8	0.70	0.6
> 100 < 125	D	Fair	1.1-1.2	0.8-0.9	0.8	0.9	0.8	0.9	0.9	0.8-0.9	0.8
> 75 < 100	E	Average	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
< 75	No grade	Poor									

*1. Clinker produced per manday (MT/manday)
*2. Frequency of breakdowns per year
*3. No. of accidents per year
*4. Specific power consumption per MT of cement
*5. No. of customer complaints received per year
*6. Value of inventory of spares and stores/MT of cement
*7. Wastage of materials and scrap generation/MT of cement
*8. Demurrages paid by the company per year
*9. Employee turnover per year

the form of high inventories, dust spillages, scrap etc., results in the improvement of material productivity.

Reduction in consumption of lubricants

The consumption of lubricants reduces with Green Productivity, as it reduces leakages from machinery.

Employee efficiency and high morale

The operating efficiency of employees increases with reduction in dust level and better environment. Employee morale will be high and employee turnover reduced with better working and living conditions.

Reduction in accident rates

With the improvement in working conditions, unsafe conditions and accidents get eliminated. This ultimately removes the cause of low productivity due to accidents and low safety.

Environment protection

Reduction in emission levels reduces dust concentration over cement plant and neighboring villages and surroundings. This helps in plant growth and improvement in greenery.

Green Productivity enhances the life of the equipment, reduces breakdowns and the operating efficiency of employees increases.

Improvement in company image and market share

The company with green plants/trees, clean working environment projects better quality image and satisfies customers, suppliers, shareholders and visitors. Better image of quality in society gains better returns.

Better health conditions of employees and public in surrounding society

Green Productivity, contributes in improving the health condition of people and brings attitudinal changes in employees mind with better working conditions.

Case Study on Green Productivity Rajashree Cement, Adityanagar, India

M/s. Rajashree Cement is the Unit of Indian Rayon and Industries Ltd., located in Karnataka. This is a progressive group of companies under the dynamic leadership of its chairman Syt. Kumar Mangalam Birla. This group has widely diversified its activities in India and abroad, contributing to national growth and economy of India effectively. This has also helped part of the society to uplift its living standards by providing them employment in India and abroad. The group is in the production field of rayon filament yarn, textile, carbon black, argon gas and cement.

Rajashree Cement is one of the growth-oriented units which has achieved excellence in the field of energy efficiency, environment and safety through innovative ideas and modernization etc., for consistent operation and optimum utilization of natural/national resources through automation.

The Company has developed a culture of its own at the works, so as to benefit the locality around, developing close interaction with surrounding villages and the people. This has also enabled Rajashree to extend help and facility like self-employment, adult education, schooling for children, health services, recreation, training of people, transport facility and roads around the area, from 1983, i.e., from the date of establishment. Rajashree Cement is in the service of society around it.

Our Mission	
01.	To become the best cement unit in India through human and technical excellence.
02.	To foster the culture of involvement, participation team work and innovation.
03.	To achieve excellence in all efforts and activities by each one of us.
04.	To produce a premium quality of cement and extend best services to customers.
05.	To establish a neat, clean and green pollution free environment.
06.	Community should perceive us as a progressive, well-managed, professional organisation.

Flora of Adityanagar

Rajashree Cement, has made successful venture into environmental promotion by evolving master action plan on greenery, afforestation and horticulture. The company located at Malkhed has a large area useful for afforestation, horticulture development, fruit and vegetable gardens etc. The company has placed the land property at the custody of a society called The Society for Conservation and Promotion of Environment (SCOPE). Rajashree Cement has planted over 2 Lakh trees with the survival rate of 80 per cent. Besides afforestation, a large tract of land has been covered under landscaping viz., Mangalam Park, Children Park, Rose Garden, CCR Garden, New Adm. Garden, Rath Garden, Time Office Garden, Power Plant Garden, New Mines Complex Garden, School Garden, etc., besides these, a large number of fruit and ornamental trees have also been planted. The cement complex has an extensive stretch (25 acres) of Dood Lawn giving a lush green aesthetic visual.

Inland fisheries farming is done in water reservoirs of mines wherein 70,000 fingerlings of Katla breed of fish is reared. Waste water that is collected in Oxidation Pond as part of domestic and Industrial Waste is treated, recycled and used for horticulture purposes. Vanamhotsav Celebrations are regularly held wherein fruit and flowering saplings are distributed to surrounding villages free to popularize afforestation and horticulture activities among them.

Our Culture is Horticulture

Efforts Made at Rajashree Cement to Control Environment Pollution

* For development of green belt, a full time horticulturist has been appointed.
* Plantation of trees throughout the plant and premises has been done (area covered as green belt is approx. 46.5% of total factory area).
* Rose gardens have been created adjacent to the plant and near CCR-II.
* Lawns and gardens have been developed in the factory and colony premises. Water fountains have been provided at 7 locations.
* Water sprinklers are in continuous use in mines to suppress dust at blasting, excavation loading, unloading, transporting, crushing, etc.
* Fruit trees (Mango) are being grown in the premises.
* Huge water pits are developed for growing fish.
* Separate task force has been formed with representatives from Mechanical Engineering, Electrical Engineering and Environmental Engineering, to ensure regular monitoring and maintenance of pollution control equipments.
* Water spray system has been introduced at various critical material transfer points.
* Industry has purchased road sweepers to clean the roads inside the factory and colony.

Conservation of Natural Resources Like Material, Water and Electricity

Emission allowed as per KSPCB Norms	Actual emission level at Rajashree Cement	Raw material recovered for year	Remarks
376.40 kg/hr.	163.40 kg/hr.	1,651.0 tons	Due to this recovery of dust and reutilization of it in the process, RC has reduced the usage of fresh limestone by approximately 1,650.0 ton/year.

Less Power Utilization/Conservation

The Kwh used by Rajashree Cement per ton of cement is		
1993-1994	1994-1995	Remarks
111.76	107.15	Only for OPC Cement
115.56	112.53	Only for special grade cement

Net saving of Kwh/unit of cement production over last year is 4.61 units for OPC. Net saving of units over year for the production of 1,679,644 tons is approximately 7,743,158 units.

Water conservation

Rajashree Cement in its efforts for continuous improvement excelled in achieving reduction of water consumption per ton of cement as follows:

	1991-92	1992-93	1993-94	1994-1995
Water	1.242 M3/T	1.003 M3/T	0.9005 M3/T	0.8821 M3/T
Production	11.87 L.MT	14.74 L.MT	16.12 L.MT	16.80 L.MT

RC reduced 0.185 m^3/ton of water for its production during financial year 1994-95, a reduction of approximately 31073 m^3 of water utilization over last year and contributed in conservation of it.

□

Feature

Strategic Issues for Indian Industry

A.M. Shah

Identification and management of strategic issues is regarded as an important activity of an effective strategic management system. The present study attempts to identify the strategic issues for the Indian Organisations and assess their impact and the actions oriented towards them. Based on the data collected from 96 managers, the study identifies and discusses 14 strategic issues which need strategic management attention. It is concluded that, while the mangers of the organisations under study are aware of the critical importance of these issues, most have not taken the appropriate actions to address the issue. Therefore, it is suggested that Indian organisations should go for a detailed analysis of the issues identified in this study and take the necessary actions as early as possible.

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Strategic management has been evolving into a fairly distinct sub discipline in management studies. It has gone through revolutionary changes in the last decade and this rapid rate of change is expected to continue through the next (Lyles, 1990). Today it is considered a professional field, the ultimate aim of which is to promote the survival, growth and profitability of organisations. Strategic management is a process which combines three major interrelated activities, strategic analysis, strategy formulation and strategy implementation (Dess & Millar, 1993). Strategic analysis is the home work required to develop an appropriate strategy, strategy formulation is the process that transforms this home-work into a plan and strategy implementation is the process of putting the plan into action (Dess & Millar, 1993).

Strategic management rests on strategic decisions, (which are normally taken by the chief executives and the members of the top management team) and pertains to all the three areas. Strategic decisions have an impact on many aspects and functions of organisation and influence its direction, management and structure in fundamental ways (Srivastava & Grant, 1985). Strategic decisions involve choices among alternatives that confront the organisation with situations that are unstructured, complex and significant (Mintzberg et al, 1976; Mason & Mitroff, 1981). However, critical to the making of strategic decisions is the identification of strategic issues and gathering of information pertaining to them.

Strategic Issues

Top-level decision-makers of organisations are bombarded by a continuous stream of ill-defined issues, which vary with the environment in which an organisation exists. They may be wholly internal to the company or they may interface with the environment. Some of these represent possible strategic issues. The issues are strategic if managers perceive them to be relevant to firm performance (Dutton & Ashford, 1993). According to Ansoff, (1965) Strategic issues are events, developments or trends that are perceived by decision-makers

as having the potential to affect their organisations performance. A focus on issue sorting can be seen as an attempt at a better understanding of strategic issues diagnosis (Dutton, et al, 1989).

Identifying strategic issues helps decision-makers impose order on the environment (Dutton & Jackson, 1987). This identification process identifies the issue/issues as the relevant unit of analysis for tracing its impact on the performance of organisations. Given the complexity of such strategic issues, top managers categorize them to simplify and create meaningful perceptions (Dutton et al, 1989). The interpretations of issues at the very early stage of strategic decision-making delimit and constrain subsequent information collection, evaluation and choice. Therefore, organisation needs to identify the strategic issues facing their business continuously for directing their efforts towards them at the right time.

Organisation needs to identify the strategic issues facing their business continuously for directing their efforts towards them at the right time.

Despite the fact that the strategic issue identification and management is an important activity of the strategic management system, there is a dearth of empirical studies on the subject in the Indian context. The issue has assumed added significance after the liberalization of the Indian economy which has drastically altered the texture of the Indian business environment. Therefore, a study was attempted to find out the strategic issues of critical importance for Indian organisations so that the attention of their strategic management activities is diverted to these issues only.

Methodology

The data for the present study has been collected from 96 managers working in 34 industries, representing a wide range of product mix and functions. The respondents belonged to different types of organisations including food, drug, chemical, machinery, electronics and textile industries and financial institutions. The nature of business and access to managers were the determining criteria in the selection of the organisations and as such, randomness of the organisations/sample could not be ensured. Over 70 per cent of the respondents were from private sector industries, whereas the rest represented public sector undertakings 125 managers were approached for data collection, however only 96 provided usable data, indicating a response rate of 76.80 per cent. Most of the respondents had bachelors degree in science, management and engineering. Besides the responsdents had a total working experience ranging from 6 to 20 years and their age ranged from 30 to 52 years.

The questionnaire method was adotped as the primary tool for collecting information. The questionnaire was basically designed to collect information for larger and different study on strategy implementation and contained 22 issues assumed to be of critical importance for Indian organisations. These issues were identified on the basis of review of literature and personal discussions with some executives. The respondents were asked to choose the issues which in their opinion were of strategic importance and deserve the immediate attention of the organisations. The said questionnaire contained the meaning of strategic issues, and respondents were requested to go through if first before choosing the issues. Ranks were assigned to the issues on the basis of their frequency of mention by managers as strategic issues.

Results & Discussion

The findings of the study are summarized in tables 1 and 2. Table 1 reports the strategic issues and their importance. The results reflect that more than 90 per cent of the respondents viewed the factors, environmental analysis, competition, quality management and competitive strategy as of critical importance. Environment creates both problems and opportunities for organisations. Organisations depend on the environment for scarce and valued resources and they often must cope with unstable, unpredictable external events. The environment affects organisational structure, internal processes and managerial decision-making, more than any other factor. The fundamental purpose of environmental analysis is to provide information about events and relationship in a company's outside environment, the knowledge of which would assist top management, in its task of charting the company's future course of action. However, environmental scanning activities may be focussed only on external sectors or trends that have been of strategic relevance historically (Daft, et al, 1988).

The table also reveals that 91.66 per cent of the respondents reported competition as a strategic issue. The past few years have witnessed significant changes in the Indian economy with the government relaxing its grip on business substantially. This has led to a situation of stiff competition in many industries. In the given scenario, developing some core competence in their

respective areas of business is the only way for firms to compete internally and internationally. However, nurtured in a protected closed economy, most of the Indian organisations are finding the emerging competition a threat to their existence. While Indian organisations consider competition as a strategic issue, they need to accelerate the pace of their efforts to meet the emerging fierce local and international competitions successfully.

Table 1: Strategic Issues and their Importance

Strategic issues	Frequency	% Response	Rank
Environmental Analysis	91	94.79	1
Competition	88	91.66	2.5
Quality management	88	91.66	2.5
Competitive strategy	87	90.62	4
Technology	84	87.50	5
Human Resource Management	81	84.37	6
Restructuring	75	78.12	7.5
Innovativeness	75	78.12	7.5
Foreign Collaboration	67	69.79	9
Performance	65	67.71	10
Strategy implementation	63	65.63	11
Leadership	61	63.54	12
Internal Analysis	60	62.50	13
Diversification	51	53.13	14

Similarly an overwhelming number of respondents identified quality management as an issue importance. Todays' competitive arena revolves around quality that is driven by the voice of the customer. Quality has immensely contributed to the success of several companies such as Sundaram Fasteners, Core Healthcare

Nurtured in a protected closed economy, most of the Indian organisations are finding the emerging competition a threat to their existence.

etc. Sundaram Fasteners took advantage of an offer to make radiator caps for General Motors and redefined their production and quality norms on General Motor's terms. Core Healthcare defined itself as a global company from day one, and fixed quality norms at least on par with the best in the world. In a short period of time, these two companies have become the leaders in their respective market segments. Therefore, improvements in quality are necessary for the success of the organisations in the competitive environment. Quality should be as defined by the customer and measured through the customer's perception of how well companies meet or exceed requirements and expectations.

The 4th most cited issue of competitive strategy reflects the managers' concern about how to develop and position their strategies to gain competitive advantages. In today's competitive environment, a business should hold some advantage relative to its competition, for achieving success. In this context organisational strategy must focus on forming something new, different, qualitatively better and at least potentially more profitable. There are two generic strategies identified by Porter (1980) that are followed by firms to be competitive viz., cost leadership strategy and differentiation strategy. Under cost leadership strategy, a firm sets out to become the low cost producer in its industry. However, it works only if competition is based exclusively on cost and buyer preferences are determined by cost. Nirma Washing Powder's phenomenal success was essentially due to its cost leadership strategy. Nirma found ways to add value to its products while

Table 2: Strategic Issues of Critical Importance: Analysis of Impact and Actionability

	Impact			Action	
Strategic issues	Positive	Neutral	Negative	Action No	Action
External Environment	21.98	51.65	26.37	38.46	61.54
Competition	18.18	60.23	21.59	43.18	56.82
Quality management	12.50	69.32	18.18	67.04	32.95
Competitive strategy	44.83	55.17	–	56.32	43.68
Technology	33.33	66.67	–	30.39	69.05
Human Resource Management	44.44	55.56	–	55.56	44.44
Restructuring	28.00	56.00	16.00	46.66	53.34
Innovativeness	46.66	53.34	–	50.67	49.33

Note: Most frequently çited issues are identified as strategic issues of critical importance.

containing cost increases. The company was able to employ women and children at low cost and manually mix ingredients to produce a washing power without significant overhead expenses. The other generic strategy– differentiation strategy requires the organisation to be unique in its industry along some dimensions that are widely valued by buyers. The logic of this strategy demands that a firm choose attributes in which to differentiate itself from its rivals. The growth of Good Knight brand mosquito repeller into a Rs. 500 million company in about seven years can be essentially attributed to the value it could add to the customer in terms of convenience in use. This strategy is becoming more relevant as competition intensifies and firms attempt to meet customer requirements precisely, often by operating in niche markets. In fact the key to long term success is being able to do certain things better than your competitors can. Such superior organisational capabilities provide a competitive advantage that is much more sustainable than one based on something you can build or buy.

Differentiation strategy requires the organisation to be unique in its industry along some dimensions that are widely valued by buyers.

87.50 per cent of the respondents mentioned technology as a strategic issues, showing that managers accorded great importance to the adoption of modern technology. Technology factor is wholly internal to the organisations and concerns the speed and flexibility of technological response. As soon as new technology is available, the organisations should adopt it to the needs of customers. Although Indian industry is not known for technological leadership, there are several firms which have been able to use their technological process to build competitiveness. Ranbaxy Laboratories and Dr. Reddy's Laboratories are but two pharmaceutical companies that invest heavily in R&D and have been successful.

Human resources is the most sensitive, reactive and proactive resource of the organisations. A great majority of the managers surveyed cited the issue of managing human resources as of strategic importance. This may be because, human resources hold the key for organisational success if strategically positioned but under adverse circumstances, the same human resources could foil every positive move and induce atrophy. The development of an increasingly talented work force having the necessary commitment and motivation is essential for the success of organisations. This calls for effective human resource management practices and the ability to draw upon the commitment and creativity of employees, which is the best source of competitive advantage, especially during critical times.

Human resources is the most sensitive, reactive and proactive resource of the organisations. A great majority of the managers surveyed cited the issue of managing human resources as of strategic importance.

78.12 per cent of the respondents viewed restructuring and innovativeness as strategic issues. Attaching high importance to these factors looks appropriate because liberalization of the Indian economy has ushered in various challenges for the Indian companies and is compelling them to restructure and promote innovativeness for countering the emerging fierce local and international competition. Porter (1987) states that restructuring can be a sound strategy for realizing under-utilized potentials. Restructuring begins with a determination of future requirements. The process is usually cumulative with the major focus on activities, destined for improvement (Knorr, 1990). Innovativeness gives organisations the necessary competitive edge in the market. Organisations should innovate products and services continuously in order to attract and hold customers. However, innovation does not occur when needed, it is through a conscious decision and commitment to personally foster innovation that senior management can bring about continuous improvement as an operating philosophy.

A further examination of the table reveals that 67.69 per cent of the respondents cited foreign collaboration as strategic issue. This may be because the growth of many companies in India is attributable to the strategy of foreign collaboration. In recent years a number of companies have decided to join hands with foreign companies for technical, financial and/or managerial assistance. While better performance is the ultimate aim of all organisations, managers gave it lesser importance as compared to other factors. This may be because better performance will automatically result by according more importance to other factors listed in table 1. Moreover, sometimes, better performance is deliberately sacrificed by the organisations in the short run for ensuring long term prosperity. In particular, Indian organisations need to invest in building key resources in the process of developing the relevant sources of competitive advantage. The process of liberalization is still on a low key and organisations which fail to take this opportunity to build strengths will have to repent later.

Strategy implementation which is process of translating strategic plans into results was identified as a strategic issue by 65.63 per cent of the managers. Generally managers do not pay as much attention to planning the implementation of their strategies as they give for formulating them. This may be because the development and selection of strategies to pursue is considered to be easier and less time consuming than implementing them. However, this may prove disastrous, because the most elegantly conceived, most precisely articulated strategy is virtually worthless unless it is implemented successfully. A strategy implementation process can fail because of a failure to do the things required during implementation to ensure that a well formulated strategy is successful, or due to a poorly conceived plan that no amount of implementation effort can rescue.

The most elegantly conceived, most precisely articulated strategy is virtually worthless unless it is implemented successfully.

The other factors—leadership, internal analysis and diversification were given less importance comparatively. They were ranked 12th, 13th and 14th respectively in the order of importance. The less importance attached to leadership, and internal analysis may be because these are internal factors and within the control of management. According lesser importance to diversification may be because of the fact that Indian organisations have generally diversified too far and too fast, which has affected their efficiency and performance adversely in most of the areas. Besides, as capital markets get more efficient and methods of corporate control grow more sophisticated, shareholders exert increasing pressure on companies to participate only in activities that create shareholder value. Therefore, Indian companies need to identify their core businesses and organise them efficiently. Non-core businesses not adding value should be eliminated. In their core businesses, companies should articulate how they can win and not just stay in the game.

Indian organisations have generally diversified too far and too fast, which has affected their efficiency and performance adversely in most of the areas.

The study also assesses the perception of managers towards the top eight strategic issues in terms of their impact on their organisations and whether any action has been oriented towards them or not (table 2). The results reflect that majority of the respondents ranging from 53.34 per cent to 70.12 per cent viewed the impact of strategic issues as neutral. This perception of managers indicates that Indian companies have not yet felt the positive/negative impact of these strategic issues largely. This may be because most of the Indian companies are still reorienting themselves to the changes that liberalization has forced on them. They are in the process of restructuring and reengineering their business for successfully responding to the emerging challenges. However, some respondents (ranging from 11.49 per cent to 46.66 per cent) expressed their opinion regarding the impact of these issues as positive. This shows that these strategic issues are controllable in their companies. This may be because the companies have taken the necessary actions at the right time and avoided the threats. However, some managers (ranging from 16.00 per cent to 26.37 per cent reported that four strategic issues, external environment, competition, quality management and restructuring have started to affect their organisations negatively. This may be either because the companies have not responded to these issues properly or the changing environment has rendered their efforts inadequate. Therefore, the organisations need to assess the signals meticulously and prepare the plan of action effectively.

Most of the Indian companies are still reorienting themselves to the changes that liberalization has forced on them.

While majority of the respondents reported the issues identified in table 2 to be critical importance, it is surprising to note that no action has been taken in these areas by the majority of the sample organisations. A large number of respondents (ranging from 32.14 per cent to 69.05 per cent) reported that no action has been taken by their organisations in these top eight strategic areas. In particular, the strategic issues, technology, restructuring, external environment, and competition have received no attention in the majority of the companies. This may be either because the companies feel that these issues are within their purview or they may be using their time making arrangements for the large amounts of funds required to initiate action in these areas. Companies can not afford to neglect these issues altogether in the present context. In the short run, any firm with a strategic advantage can survive and prosper, but in the long run, only the organisation that continuously analyse the strategic issues and identify the

critical success factors and take the appropriate actions will continue to possess that strategic advantage and be able to survive and prosper. However, it is encouraging to observe that a good number of organisations have initiated action on all these strategic areas. In particular, the actions taken in the areas of quality management, competitive strategy, human resources, restructuring and innovativeness would go a long way in improving the performance of the Indian companies.

Conclusion

The major purpose of this study was to identify the strategic issues for Indian industry and then to assess their impact on the organisations and examine whether any action has been taken towards these issues or not. Although the present study does not work out a detailed analysis of strategic issues, it does identify the broader areas of strategic issues so that the companies can direct their efforts towards them.

The study indicates that more than 70 per cent of the respondents rated the issues, environmental analysis, competition, quality management, competitive strategy, technology, human resource management, restructuring and innovativeness to be of critical importance to their company's future success. More than 53 per cent of the managers also reported the other issues identified in table 1 as of critical importance. While the study identifies strategic issues for Indian industry, organisations need to possess pure managerial talent and expertise in order to develop and carry through a satisfactory action plan for achieving their objectives in the current turbulent times.

The interpretive analysis of the top eight strategic issues reveals that most of the managers viewed them in neutral terms with no implied organisational action. Although from one side the majority of the respondents viewed the top eight issues of critical importance, they have not been able to express their assessment clearly pertaining to the impact of these issues. This may be because companies are still trying to reorient themselves towards the challenges and issues ushered in by liberalization. They are in the process of restructuring and re-engineering their business for successfully responding to the emerging challenges. Therefore, it was difficult for managers to determine the impact of strategic issues on organisations and actions taken by them specifically in most of the cases. However, Indian organisations should assess the relevance of these issues to their business immediately and take the appropriate actions as early as possible.

In this context, speed would be the competitive weapon. Those who take the necessary actions immediately and get to the market first, obtain and hold market share the longest. Some of the most successful organisations base their success on speed. Citibank introduces three new financial services a week. Honda and Toyota can take a car from concept to market in three years whereas it takes General Motors five years to do the same thing. When it comes to decision-making, two things are of utmost importance, actual time it takes to resolve an issue and the minimum or ideal time it could take if things were perfect. The ideal time for decision-making and implementation needs to be determined and actions should be taken accordingly. However this calls for a detailed analysis of strategic issues and the identification of critical success factors. Therefore, a series of studies needs to be undertaken to identify the critical success factors under the dimensions of each strategic issue identified in the present study. As Boynton and Zmud (1984) have suggested the development of critical success factors, are a means which, when successfully completed, Will ensure competitive performance of an organisation.

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Feature

HRD Climate in Indian Industry

V.K. Jain, K.C. Singhal & U.C. Singh

A study was conducted in two public sector undertakings to assess whether their 'development climate' was conducive for optimal orientation of their employees. The authors report the conclusions of the study and suggest a few recommendations.

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Economic liberalisation has imposed pressures on our organisations creating, as it has, an emphasis on better quality and higher productivity, greater efficiency and more effectiveness, changing technology and high customer orientation. In this changing environment, organisations find it difficult to survive unless they continuously prepare their employees to meet the challenges ahead. The employees are required to be dynamic and pro-active. HRD is an essential process to prepare the organisation to have an impact on the environment through its people and thus ensure its survival and growth (Rao, 1994).

An optimal level of "Development Climate" is essential for facilitating HRD. It encompasses the following:

Pro-activity

Employees are action oriented and willing to take the initiative.

Openness & risk taking

Employees feel free to express their ideas and are willing to take risks, experiment with new ideas and new ways of doing things.

Collaboration

Employees collaborate with each other and have a feeling of belonging to the same family and working for a common cause.

Trust & authenticity

Employees, departments and groups trust each other and can be relied upon.

Confrontation

Employees face problems and issues without hiding or avoiding them.

Autonomy

Employees have some freedom to act independently within the boundaries of their role/job (Rao, 1991).

The elements of HRD climate can be grouped into three broad categories – general climate, OCTAPAC culture and HRD mechanisms.

The general climate items deal with the importance given to HRD in general by the top management and line managers.

The OCTAPAC items deal with the extent to which openness, confrontation, trust, autonomy, pro-activity, authenticity and collaboration are valued and promoted in the organisation.

HRD mechanisms measure the extent to which these measures are implemented seriously.

HRD climate can be developed if the top management has a strong belief in the capabilities of its people; its policies show high concern for employees; HRD staff has a supportive role and the line managers are committed. HRD sub-systems effectiveness also help in building HRD climate.

Objectives of the Study

Considering the significance of HRD climate in the organisation a study was undertaken with the following objectives:

- To examine the nature of HRD climate existing in the public sector undertakings.
- To study the difference, if any, in the HRD climate of these undertakings.
- To study the relationship between HRD climate and HRD mechanisms and effectiveness variables.
- To find out the relative contribution of the HRD sub-systems and effectiveness variables, when combined together, to the HRD climate.

Methodology

Two public sector organisations, BHEL and NFL, were selected for the present study. A sample size of 8 per cent was taken from the total population of executives of the two units of BHEL i.e. Bhopal and Hardwar and two units of NFL i.e. Nangal and Panipat. The study was confined to the three managerial levels, top, middle and lower; the executives selected in each category from BHEL were 68, 106 and 127 and those from NFL in the same categories were 16, 30 and 46 respectively.

To achieve the objectives, information was collected by using structured questionnaires. Three different sets were used, one each for top, middle and lower managerial level.

Each set included questions on personal history data, HRD mechanisms, effectiveness variables and HRD climate. Likert's (1961) 5-point scale was used.

The personal history data included questions on salary, qualification and experience. Qualification was converted into scores on 5-point scale. HRD mechanisms covered three HRD sub-systems including management policy on HRD, potential appraisal and organisation development for the top level executives; five HRD mechanisms for the middle level executives including goal-setting, role analysis, performance appraisal, career planning and executive development and training sub-system for the lower level executives. The entire data on the HRD mechanisms was converted into scores on 5-point scale.

Questions on HRD effectiveness variables including individual efficiency, organisational efficiency and productivity were included in each HRD sub-system to elicit the opinions of the executives on these variables. The data was transformed into scores and a composite score of all the sub-systems on each variable at each level was obtained and designated as scores on individual efficiency, organisational efficiency and productivity.

Questions pertaining to HRD climate were included in the questionnaire at appropriate places. HRD climate scores were derived on the basis of these questions.

Statistical Analysis

To analyse the results, various statistical tools were used including co-efficient of correlation, t-test and Z-test. The item-wise mean scores of the total sample for the two organisations at different levels are presented in tables 1 to 3. Since the questionnaire used a five-point scale, average scores of 3 and around indicate a moderate tendency on the dimension existing in that organisation and indicate average HRD climate on the dimension giving substantial scope for improvement. Scores around 4 indicate a fairly good degree of HRD climate on that dimension where most employees have positive attitudes to the HRD policies and practices of

the organisation on that dimension and thereby to the organisation itself. Mean scores around 5 are indicative of an HRD climate at a desirable level. In order to make the interpretations easier, the mean scores were converted into percentage scores using the formula (Rao, 1991:39):

Percentage score = (Mean score – 1) × 25

This was done on the assumption that a score of 1 represents Zero per cent, 2 - 25 per cent, 3 - 50 per cent, 4 - 75 per cent, a score of 5 representing 100 per cent.

The percentage scores indicate the degree to which a particular dimension exists in that company out of the ideal 100. Thus, it is certainly desirable for the organisations to have percentage score above 50 on each item as well as overall on all items.

Results & Discussion

From tables 1 to 3, it is evident that the two public sector organisations have scored above 60 per cent on their overall HRD climate scores at all the three levels, indicating that a reasonably good HRD climate exists. No company at any level has scored 75 per cent, indicating that there is a good degree of potential for improvement.

In NFL, however, there exists fairly good HRD climate as indicated by table 1 at the top management level (overall score = 74 per cent) showing that the executives at the top level support HRD policies and practices in their organisation.

The overall score at the middle and lower levels of management in NFL was 66.25 and 63.25 per cent (table 2 and 3) respectively, indicating the need for improvement in the 'development climate' at these levels.

In BHEL, the overall score of 67.75 per cent at the top level (table 1), 68.25 per cent at middle level (table 2), and 60.00 per cent at the lower level (table 3) are indicative of a reasonably good HRD climate at these levels but at the same time these scores point out that there is a good scope for improvement at all the levels in general and at the lower level in particular.

Table 1: Item-wise Mean and Percentage of the Total Sample for the Top Management on HRD Climate

	Items	BHEL		NFL	
		Mean	Percentage	Mean	Percentage
1.	Management's belief about HR importance	3.72	68.00	4.06	76.50
2.	Contribution of HRD to organisational objectives	3.59	64.75	4.31	82.75
3.	Management's commitment of HRD	3.44	61.00	4.06	76.50
4.	Atmosphere of trust and openness in the organisation	3.87	71.75	4.25	81.25
5.	Freedom to employees to take initiatives	3.40	60.00	3.88	72.00
6.	Managements belief about development of employee potential	4.09	77.25	4.06	76.50
7.	Identification of employee potentials for career planning	3.38	59.50	3.44	61.00
8.	Achieving effectiveness by increasing intergroup competence	3.94	73.50	4.19	79.75
9.	Encourging individuals to improve their capabilities	3.88	72.00	4.06	76.50
10.	Feeling of responsibility in individuals and groups	3.84	71.00	4.06	76.50
11.	Management's belief about the role of employee co-operation in achieving ogranisational goals	3.62	65.50	3.56	64.00
12.	Management's commitment to effect change in beliefs, attitudes and values of the people	3.76	69.00	3.88	72.00
13.	Management's awareness about environmental changes	3.66	66.50	3.63	65.75
	Total (Over All)	3.71	67.75	3.96	74.00

Table 2: Item-wise Mean and Percentage of the Total Sample for the Middle Management on HRD Climate

	Items	BHEL		NFL	
		Mean	Percentage	Mean	Percentage
1.	Management's importance to maintain interpersonal relations	4.20	80.00	4.10	77.50
2.	Management's involvement in developing career plans	4.38	84.50	4.30	82.50
3.	Management's belief about the usefulness of performance appraisal in increasing organisation efficiency	3.61	65.25	3.67	66.75
4.	Management's efforts in identifying and utilising employee potentials	3.84	71.00	3.87	71.75
5.	Promotions as significant aspect of career development	3.55	63.75	3.10	52.50
6.	Promotions on the basis of actual potentials of employees	3.85	68.75	3.67	66.75
7.	Employees' belief that career planning in the organisation is sufficient to achieve their goals	3.34	58.50	3.43	60.75
8.	Management's belief that individual objectives help in achieving organisational objectives	4.40	85.00	4.23	80.75
9.	Management's belief that executive development increases efficiency and productivity	2.42	35.50	2.47	36.75
	Total (Over All)	3.73	68.25	3.65	66.25

Table 3: Item-wise Mean and Percentage of the Total Sample for the Lower Management on HRD Climate

	Items	BHEL		NFL	
		Mean	Percentage	Mean	Percentage
1.	Management's interest in training to increase individual efficiency	3.94	73.50	4.15	78.75
2.	Training helps in increasing productivity	3.76	69.00	3.98	74.50
3.	Training prepares individuals for future challenges	2.78	44.50	2.98	49.50
4.	Training increases confidence in job	2.84	46.00	2.78	44.50
5.	Employee training increases understanding between superiors and subordinates	3.75	68.75	3.76	69.00
	Total (Over All)	3.40	60.00	3.53	63.25

Comparative Interpretation of HRD Climate Data

An item-wise comparison shows that at the top management level, existence of better HRD climate was observed in NFL as compared to BHEL (table 1). A percentage score of more than 75 was scored by the executives in NFL on items including management's belief about the importance of human resources, the contribution of HRD towards organisational objectives and management commitment towards HRD (item 1, 2 and 3), atmosphere of trust and openness in the organisation (item 4), management's belief about development of employee potentials (items 6), achieving effectiveness by improving inter-group competence (item 8), encouraging individuals to improve their capabilities (item 9) and feeling of a sense of responsibility in the individuals and the groups (item 10). On the contrary, in BHEL, a percentage of more than 75 was scored on one item relating to the organisation's belief that individual potentials can be developed (item 6). On other items, in both the organisations, the percentage score varied between 59.5 and 75.00 per cent. It can, therefore, be inferred that moderate

HRD climate existed on items including freedom to employees to take initiative (item 5), identification of employee potentials for career planning (item 7), management's belief that co-operation can help in achieving organisational objectives (item 11), management's commitment to effect changes in beliefs, attitudes and values of people (item 12) and management's awareness about environmental changes (item 13).

At the middle management level, in both the organisations, as shown in table 2, a percentage of more than 75 was scored on items including management's importance to maintain inter-personal relations (item 1), its involvement in developing career planning (item 2) and management belief that achievement of individual objectives helps in achieving organisational goals (item 8). Poor HRD climate existed in both the organisations on the aspect relating to management's faith that executive development would increase efficiency and productivity in the long run (item 9). On other items, average HRD climate existed in both the organisations on items relating to management's belief that performance appraisal analysis is helpful in increasing organisational efficiency (item 3), management's efforts in identifying and utilising employee potentials (item 4), promotions are an important aspect of career development (item 5), promotions are based on actual potentials of employees (item 6) and employees belief that career development in their organisation is sufficient to their development and achievement of goals (item 7). There was similarity to some extent in both the organisations as indicated by the means on all the items, as also in the overall means.

At the lower management level, as presented in table 3, a score of 75 per cent and around was obtained in both the organisations on the item relating to management's interest in training to increase individual efficiency (item 1). In NFL, increase in productivity through training was also rate positively high (item 2), but average HRD climate was observed on this item in BHEL. Average HRD climate also existed on the dimension that employee training increases understanding between superiors and subordinates (item 5). On other items such as, training increases confidence in the job (item 4) and training prepares individuals for future challenges (item 3), moderately poor HRD climate was observed in both the organisations. The overall mean score and the item-wise mean score were similar to certain extent in both the organisations.

Relationship Between HRD Climate & Other Variables

The relationship between HRD climate and other variables was studied at each of the three levels in the two organisations, BHEL and NFL. The following discussion highlights the correlation co-efficients in each organisation between HRD climate and other variables.

In order to examine the difference in the two organisations over the co-efficients of correlation, the Z-test was applied.

Top management level

The co-efficients of correlation at the top management level between the HRD climate and other variables including personal history factors, effectiveness variables and HRD sub-systems are presented in tables 4 and 5 for BHEL and NFL respectively.

Table 4: Co-efficients of Correlation Between Personal Factors, Effectiveness and HRD Variables and HRD Climate in BHEL (n = 68)

Variables	Co-efficient of Correlation
Personal factors	
Qualification	–0.088
Salary	0.011
Experience	0.117
Effectiveness variables	
Individual efficiency	0.765**
Organisational efficiency	0.506**
Productivity	0.751**
HRD variables	
Management policy on HRD	0.709**
Potential appraisal	0.607**
Organisation development	0.822**

** Significant at 1% level.

Table 4 shows that HRD climate in BHEL has very small but negative relationship with the qualification of the executives ($r = -0.088$), indicating that higher qualification need not necessarily contribute towards better HRD climate. The relationship of HRD climate with salary ($r = 0.011$) and experience ($r = 0.117$) was positive but negligible. These relationships were statistically not significant. As such 1, 0 and 1 per cent variation in HRD climate is predictable from qualification, salary and experience respectively. The table shows that the co-efficients of correlation between HRD climate and other two, effectiveness and HRD variables, ranged between 0.506 and 0.822. All these relationships were found to be statistically significant. There was positive correlation between HRD climate and organisation development ($r = 0.822$), HRD climate and individual efficiency ($r = 0.765$) and HRD climate and productivity ($r = 0.751$). These correlation co-efficients, 0.822, 0.765

and 0.751, predict that 68, 59 and 56 per cent variations in HRD climate are due to OD, individual efficiency and productivity. The relationships of HRD climate with management policy on HRD (r = 0.709), potential appraisal (r = 0.607) and organisational efficiency (r = 0.506) were also positive and explain that 50, 37 and 26 per cent variations in the HRD climate are predictable from the variances of management policy on HRD, potential appraisal and organisational efficiency.

Table 5 exhibits that in NFL, the relationships of HRD climate with productivity (r = 0.840) and organisation development (r = 0.767) were positive and high. A variance of 71 and 59 per cent respectively is predictable in HRD climate due to these variables. The co-efficients of correlation of HRD climate with individual efficiency (r = 0.600), organisational efficiency (r = 0.709), and management policy on HRD (r = 0.733) were positive and found to be statistically significant. The correlation between HRD climate and potential appraisal (r = 0.433) was positive but not significant. The correlation co-efficients of 0.600, 0.733 and 0.433 indicate that 36, 50, 54 and 19 per cent variances in HRD climate are predictable from the variations of individual efficiency organisational efficiency, management policy on HRD and potential appraisal. The correlation between HRD climate and qualification (r = 0.210) and HRD climate and salary (r = 0.201) were small and positive but were not significant. Strangely, HRD climate in NFL has negative correlation with experience (r = –0.169) which shows that higher experience in NFL does not necessarily help in building better HRD climate. Thus, only 4, 4 and 3 per cent variations in HRD climate are predictable from qualification, salary and experience respectively.

Table 5: Co-efficients of Correlation Between Personal Factors, Effectiveness and HRD Variables and HRD Climate in NFL (n = 16)

Variables	Co-efficient of Correlation
Personal factors	
Qualification	–0.210
Salary	0.201
Experience	–0.169
Effectiveness variables	
Individual efficiency	0.600**
Organisational efficiency	0.709**
Productivity	0.840**
HRD variables	
Management policy on HRD	0.733**
Potential appraisal	0.433**
Organisation development	0.767**

** Significant at 1% level.

The Z-values shown in table 6 to study the difference of correlation co-efficients show a great deal of similarity in the two organisations as no significant difference of HRD climate with other variable could be established. It can be inferred that HRD climate in the organisations is affected by variations in effectiveness variables and HRD variables to a large extent.

Table 6: Z-Values for Difference of Correlation Co-efficients on HRD Climate and Other Variables in BHEL and NFL at the Top Management Level

Variables	Z-value
Personal factors	
Qualification	0.99
Salary	0.64
Experience	0.95
Effectiveness variables	
Individual efficiency	1.04
Organisational efficiency	1.08
Productivity	0.81
HRD variables	
Management policy on HRD	0.16
Potential appraisal	0.79
Organisation development	0.49

Middle management level

Tables 7 and 8 present the co-efficients of correlation between HRD climate and other variables in BHEL and NFL respectively.

A study of table 7 shows that in BHEL there is positive and significant correlation of HRD climate with effectiveness variables as well as HRD variables. The correlation co-efficients between HRD climate and productivity (r = 0.820), HRD climate and organisational efficiency (r = 0.754) were positively high and indicate that 67 and 57 per cent variations in the HRD climate are predictable due to productivity and organisational efficiency. The correlation between HRD climate and goal-setting (r = 0.380) indicates a variation of 14 per cent in the HRD climate due to goal-setting. The co-efficients of correlation between other effectiveness and HRD variables and HRD climate were moderately high and ranged from 0.526 to 0.737. As such 54, 47, 45, 30 and 28 per cent variations in the HRD climate are forecasted from the variations of individual efficiency, role analysis, performance appraisal, career planning and executive development, respectively. Qualification and salary show negative correlation with HRD climate, indicating that higher qualification and salary do not necessarily

contribute to good HRD climate. Although the correlation co-efficients of –0.031 and –0.108 respectively, are not significant, a variation in these variables may cause zero and 1 per cent variation in the HRD climate. Experience has positive relationship with HRD climate (r = 0.140) but it was found to be statistically not significant. Only 2 per cent variations in the climate is predictable due to this variable.

Table 7: Co-efficients of Correlation Between Personal Factors, Effectiveness and HRD Variables and HRD Climate In BHEL (n = 106)

Variables	Co-efficient of Correlation
Personal factors	
Qualification	–0.031
Salary	–0.108
Experience	0.140
Effectiveness variables	
Individual efficiency	0.737**
Organisational efficiency	0.754**
Productivity	0.820**
HRD variables	
Goal-setting	0.380**
Role analysis	0.687**
Performance appraisal	0.673**
Career planning	0.544**
Executive development	0.526**

** Significant at 1% level.

By examining table 8, it can be observed that there exists positive and significant relationship between the HRD climate and effectiveness and HRD variables in NFL.

High degree of correlation of HRD climate was noticed with individual efficiency (r = 0.920), organisational efficiency (r = 0.887), productivity (r = 0.887) and career planning (r = 0.834). Consequently 85, 79, 79 and 70 per cent variations in the HRD climate can be forecast from changes in individual efficiency, organisational efficiency, productivity and career planning. Positive correlation of HRD climate with other effectiveness and HRD variables existed in NFL. Correlation co-efficients of 0.737, 0.712, 0.668 and 0.589 indicate that 54, 51, 45 and 35 per cent variations in HRD climate can be predicted from variations in executive development, role analysis, goal-setting and performance appraisal. Positive but not significant relationship of personal factors with HRD climate was also observed which is indicative that 1, 6 and 1 per cent variations in this variable are due to qualification, salary and experience respectively.

Table 8: Co-efficients of Correlation Between Personal Factors, Effectiveness and HRD Variables and HRD Climate In BHEL (n = 30)

Variables	Co-efficient of Correlation
Personal factors	
Qualification	0.119
Salary	0.235
Experience	0.092
Effectiveness variables	
Individual efficiency	0.920**
Organisational efficiency	0.887**
Productivity	0.887**
HRD variables	
Goal-setting	0.668**
Role analysis	0.712**
Performance appraisal	0.589**
Career planning	0.834**
Executive development	0.737**

** Significant at 1% level.

Table 9 exhibits Z-values for difference of correlations on HRD climate and other variables in BHEL and NFL at the middle management level. No significant difference was observed between HRD climate and personal factors in the two organisations.

Table 9: Z-Value for Difference of Correlation Co-efficients on HRD Climate and Other Variables in BHEL and NFL at the Middle Management Level

Variables	Z-Value
Personal factors	
Qualification	0.70
Salary	1.61
Experience	0.23
Effectiveness variables	
Individual efficiency	2.98**
Organisational efficiency	1.95
Productivity	1.16
HRD variables	
Goal-setting	1.88
Role analysis	0.22
Performance appraisal	0.64
Career planning	2.73**
Executive development	1.66

** Significant at 1% level.

The difference between the correlation co-efficients between individual efficiency and HRD climate was found to be significant.

Among the HRD variables, career planning and HRD climate show significant difference in the correlation co-efficients in the two organisations. The correlation co-efficient between these variables is quite high in NFL (r=0.834) as compared to BHEL (r= 0.544). The relationship of these two variables, individual efficiency and career planning, with HRD climate in NFL indicates better developmental climate in the organisations on these aspects. Z-values also indicate some differences in correlation co-efficients on HRD with organisational efficiency, goal-setting and executive development but they were found to be statistically not significant. Broadly speaking, the two organisations are similar to a large extent as regards the relationship between HRD climate and other variables. Further, it can be inferred that HRD climate at this level also is affected by the variations in effectiveness and HRD variables to a large extent in both the public sector undertakings.

Lower management level

At this level, the correlation co-efficients as given in table 10 ranged between –0.88 and 0.955 in BHEL and between –0.081 and 0.966, as per table 11, in NFL. Negative but not significant correlation existed, between HRD climate and qualification (r=–0.009) and HRD climate and salary (r=–0.088), in BHEL. It indicates that at this level also high qualification and high salary do not necessarily contribute towards better HRD climate. Experience, however, has positive but not significant relationship with HRD climate.

In all 0, 1 and 0 per cent variations in HRD climate can be accounted for qualification, salary and experience. Individual efficiency, organisational efficiency and productivity have moderately high and positive relationship with HRD climate. The correlation co-efficients of these variables, 0.488, 0.537 and 0.637 respectively, indicate 24, 29 and 41 per cent variations in the HRD climate due to these variables. Training has positively high relationship with HRD climate (r=0.955). It can be inferred that 91 per cent variances in the HRD climate are accounted for due to this variable.

In NFL, as exhibited in table 11 qualification has negative but not significant correlation with HRD climate (r=–0.081). Salary and experience have, however, positive but not significant relationship with HRD climate. Only 1, 0, and 0 per cent variations in the HRD climate can be forecast from qualification, salary and experience respectively. The relationship of HRD climate with other variables is positive and statistically significant. High correlation of this variable with training (r=0.966) explains 93 per cent of variations in HRD climate due to training. Correlation co-efficients of HRD climate with the effectiveness variables, 0.338, 0.634 and 0.676 indicate 11, 40 and 46 per cent variations in the variables due to individual efficiency, organisational efficiency and productivity.

Table 10: Co-efficients of Correlation Between Personal Factors, Effectiveness and HRD Variables and HRD Climate in BHEL (n=127)

Variables	Co-efficient of Correlation
Personal factors	
Qualification	–0.009
Salary	–0.088
Experience	0.026
Effectiveness variables	
Individual efficiency	0.488**
Organisational efficiency	0.537**
Productivity	0.637**
HRD variable	
Training	0.955**

**Significant at 1% level.

Table 11: Co-efficients of Correlation Between Personal Factors, Effectiveness and HRD Variables and HRD Climate in NFL (n=46)

Variables	Co-efficient of Correlation
Personal factors	
Qualification	–0.081
Salary	0.018
Experience	0.053
Effectiveness variables	
Individual efficiency	0.338*
Organisational efficiency	0.634**
Productivity	0.676**
HRD variable	
Training	0.966**

*Significant at 5% level.
**Significant at 1% level.

No significant differences were, however, observable by the Z-test (table 12) in the correlation co-efficients of the two organisations indicated in tables 10 and 11. It can be inferred that HRD climate at this level in the two organisations is affected by the variances in effectiveness and HRD variables.

Table 12: Z-Values for Difference of Correlation Co-efficients on HRD Climate and Other Variables in BHEL and NFL at the Lower Management Level

Variables	Z-value
Personal factors	
Qualification	0.41
Salary	0.60
Experience	0.16
Effectiveness variables	
Individual efficiency	1.03
Organisational efficiency	0.84
Productivity	0.39
HRD variable	
Training	0.80

On the basis of the above discussion, it is evident that the relationship of HRD climate with the independent variables, including personal factors, effectiveness and HRD variables, in the two organisations have similarity to a large extent at all the three managerial levels.

Relative Contribution of the Independent Variables to the HRD Climate

In order to arrive at some meaningful conclusions regarding the relative contribution of the independent variables on HRD climate in the public sector organisations in general and in these two organisations in particular, the opinions of the executives of the two organisations have been clubbed and the co-efficients of multiple regression (bs), the co-efficient of determination, R^2, and the value of F as a measure of testing the fitness of regression have been obtained.

Top management level

The co-efficient of determination (R^2) between the HRD climate and 9 independent variables at this level is 0.934, as exhibited in table 13.

It can be inferred that 93 per cent variations in the HRD climate is being explained by the independent variables including personal factors, effectiveness and HRD variables. The value of F for the present regression has been found to be statistically significant.

As regards the individual contribution of each variable to the HRD climate, productivity has the highest contribution (0.67) followed by OD (0.63) and management policy (0.45). Experience has the lowest contribution (0.04). Salary has evidenced as a non-contributing factor to the HRD climate. It is startling that organisational efficiency contributes negatively (–0.34) to the HRD climate. The regression co-efficient is statistically significant.

Table 13: Co-efficients of Multiple Regression (bs) R^2 and F-value of the Various Independent Variables for the Top Management Level (n = 84)

Independent variables	Co-efficients of multiple regression (bs)	Standard error
Qualification	0.4137	0.2908
Salary	–0.0005	0.0002
Experience	0.0379	0.0364
Individual efficiency	0.1487	0.1696
Organisational efficiency	–0.3445**	0.1307
Productivity	0.6715**	0.1886
Management policy on HRD	0.4481**	0.0543
Potential appraisal	0.2711**	0.0472
Organisational development	0.6285**	0.0458

R^2 = 0.934; F (9, 74) = 130.745**

**Significant at 1% level

The results contained in table 14 have been obtained by dropping certain variables which had not made any significant contribution to the HRD climate. F-value for dropping such variables was fixed at 4.00. The values of b, R^2 and F for the selected variables are given in table 14.

Table 14: Co-efficients of Multiple Regression (bs), R^2 and F-value of the Selected Independent Variables for the Management Level (n = 84)

Independent variables	Co-efficients of multiple regression (bs)	Standard error
Organisational efficiency	–0.4080**	0.1239
Productivity	0.7308**	0.1856
Management Policy on HRD	0.4665**	0.0538
Potential appraisal	0.3030**	0.0348
Organisation development	0.6346**	0.0402

R^2 = 0.931; F (5, 78) = 225.665**

**Significant at 1% level

The table shows that all the three personal factors i.e. qualification, salary and experience and one effectiveness variable i.e. individual efficiency have been

dropped in the selection of variables in the multiple regression model.

The value of R^2 is 0.931, indicating that the variables removed had almost no effect on R^2. The organisational efficiency indicates significantly negative contribution (0.41) of this variable to the HRD climate. It is because of the fact that in the opinion of the executives, greater significance to the human resources in the organisation may hamper organisational efficiency which in turn will affect the developmental climate adversely. The contribution of other variables in the HRD climate ranges from 0.30 to 0.73. Productivity has the highest contribution (0.73) followed by OD (0.63) and management policy on HRD (0.47) while potential appraisal has the lowest contribution (0.30). It is thus evident that HRD variables contribute significantly to the HRD climate. Among the effectiveness variables, productivity makes a significant contribution to the HRD climate.

Middle management level

The relative contribution of the 13 independent variables to the HRD climate has been presented in table 15. The Value of R^2 (0.833) is statistically significant at 0.01 level. The table shows that the relative contribution of the independent variables ranged from –0.06 to 0.75. Productivity has the highest contribution (0.75) to the HRD climate followed by individual efficiency (0.39) while organisational efficiency has a low contribution of 0.01. Strangely goal-setting has the lowest, (negative) contribution (–0.06) to the HRD climate.

Table 15: Co-efficients of Multiple Regression (bs), R^2 and F-value of the Various Independent Variables for the Middle Management Level (n = 136)

Independent variables	Co-efficients of multiple regression (bs)	Standard error
Qualification	0.0351	0.2456
Salary	0.0000	0.0002
Experience	0.0125	0.0267
Individual efficiency	0.3896**	0.1183
Organisational efficiency	0.0087	0.1705
Productivity	0.7536**	0.1546
Goal-setting	–0.0578	0.0958
Role analysis	0.1174**	0.0350
Performance appraisal	0.1214	0.1594
Career planning	0.1894	0.1523
Executive development	0.0524	0.1377

R^2 = 0.833; F (11, 124) = 61.586**

**Significant at 1% level

Table 16 explains that the variables which were found to be non-significant were dropped. By dropping these variables the value of R^2 has increased to 0.839.

Table 16: Co-efficients of Multiple Regression (bs), R^2 and F-value of the Selected Independent Variables for the Middle Management Level (n = 136)

Independent variables	Co-efficients of multiple regression (bs)	Standard error
Individual efficiency	0.4962**	0.0589
Productivity	0.8231**	0.0800
Role analysis	0.1020**	0.0307

R^2 = 0.839; F (3, 132) = 233.163**

**Significant at 1% level

The co-efficients of multiple regression (bs) showing the contribution of the selected independent variables are 0.50 for individual efficiency, 0.82 for productivity and 0.10 for role analysis. The regression further explains that the contribution of role analysis has gone down from 0.12 to 0.10 in the final selection of the model. Other variables do not contribute significantly to the building of HRD climate.

From the above, it can be inferred that role analysis is the only HRD variable which contributes to the building of HRD climate. In the discussions with the executives it was found that there are no clear-cut strategies for career planning and advancement, promotion-system, executive development, performance appraisal etc. Goal-setting is not a regular practice in most of the departments. Despite the fact that all these variables were found to be closely related to each other, their contribution to the HRD climate was not found to be significant due to the reasons mentioned above. There is, therefore, a great need to overhaul these HRD variables and bring them in co-ordination with other HRD variables in the organisation.

There are no clear-cut strategies for career planning and advancement, promotion-system, executive development, performance appraisal etc. Goal-setting is not a regular practice. Despite the fact that all these variables were found to be closely related to each other, their contribution to the HRD climate was not found to be significant due to the reasons mentioned.

Among the effectiveness variables, productivity was once again found to be the highest contributory variable

to HRD climate followed by individual efficiency. Thus, at the middle level, individual efficiency has a big role in building HRD climate. About the organisational efficiency once again the executives have felt that it is affected more by technological changes, task-orientation etc. and less by the introduction of HRD. Therefore, its contribution in building HRD climate is very small as indicated in table 15.

At the middle level, individual efficiency has a big role in building HRD.

Lower management level

The co-efficients of multiple regression (bs) at this managerial level as shown in table 17 indicate that the contribution of the independent variables to the HRD climate ranges from –0.00 to 0.68. The R^2 (0.926) has been found to be statistically significant. The contribution of training to the HRD climate is 0.68 followed by individual efficiency (0.48), productivity (0.28) and organisational efficiency (0.22). Salary has proved to be a non-contributing factor to the HRD climate.

Table 17: Co-efficients of Multiple Regression (bs), R^2 and F-value for Various Independent Variables for the Lower Management Level (n = 173)

Independent variables	Co-efficients of multiple regression (bs)	Standard error
Qualification	0.0276	0.0998
Salary	–0.0005	0.0001
Experience	–0.0124	0.0109
Individual efficiency	0.4768**	0.0924
Organisational efficiency	0.2183**	0.848
Productivity	0.2789**	0.0889
Training	0.6768**	0.0278

R^2 = 0.926; F (7, 165) = 306.196**
**Significant at 1% level

Regression co-efficients (bs) of the finally selected variables are presented in table 18. The table indicates that R^2 did not change even after dropping the three variables relating to personal history. The model selected all the remaining variables including the effectiveness variables i.e. individual efficiency, organisational efficiency and productivity and the only HRD variable i.e. training. It can be inferred that contrary to the belief at the top level, executives at the lower management level, have the opinion that increased organisational efficiency due to the development of human resources would help in building better HRD climate.

Contrary to the belief at the top level, executives at the lower management level, have the opinion that increased organisational efficiency due to the development of human resources would help in building better HRD climate.

Table 18: Co-efficients of Multiple Regression (bs), R^2 and F-value for Selected Independent Variables at the Lower Management Level (n = 173)

Independent variables	Co-efficients of multiple regression (bs)	Standard error
Individual efficiency	0.4711**	0.0916
Organisational efficiency	0.2144**	0.0840
Productivity	0.2725**	0.0883
Training	0.6791**	0.0276

R^2 = 0.926; F (4, 168) = 539.235**
**Significant at 1% level

On the whole, HRD climate is mainly a function of the effectiveness variables including individual efficiency, organisational efficiency and productivity, and the HRD variables including management policy on HRD, organisation development, role analysis and training. Other variables like potential appraisal, goal-setting, career planning, performance appraisal, executive development and organisational efficiency can also contribute to the HRD climate if they are taken in the right spirit and the organisation makes clear cut policy on these variables suitably linking them with other variables. Most of the executives at the top level are not clear about the HRD concept resulting in the wrong opinion that organisational efficiency would negatively to the HRD climate.

Conclusions

* Reasonably good HRD climate was found in both the public sector organisations under study NFL, better as compared to BHEL.
* HRD climate was positively associated with the effectiveness variables and HRD sub-systems. But it had no relationship with the personal factors.

* All the three HRD sub-systems, management policy on HRD, potential appraisal and OD, contribute significantly to the HRD climate. Among the effectiveness variables, productivity had the positive contribution to the HRD climate. Organisational efficiency was found to contribute negatively to the HRD climate. It is due to the fact that the top executives are not clear about the HRD concept.

* Reasonably good HRD climate was found to be prevailing at the middle management level too in both the organisations.

* The relationship of HRD climate with the personal factors in the two organisations was negligible but its relationship with the effectiveness variables and HRD sub-systems was positive and significant.

Significant difference was observed between the correlation co-efficients of the two organisations relating to HRD climate and career planning and HRD climate and individual efficiency.

Individual efficiency, productivity and role analysis contribute significantly to the HRD climate.

The public sector organisations can improve their HRD climate by modifying their existing HRD sub-systems and integrating them with the HRD programme. Some sub-systems like career planning, EDP, goal-setting and performance appraisal need to be properly structured.

Good HRD climate was observed in both the public sector undertakings at the lower management level also. Training, productivity, individual efficiency and organisational efficiency contribute positively to the HRD climate.

Thus, it can be ascertained that the public sector organisations in general and BHEL and NFL in particular possess reasonably good HRD climate at all the three managerial levels. Due to lack of clarity about the HRD concept organisational efficiency is deemed to contribute negatively to the HRD climate but a detailed understanding of the concept and its proper implementation would set at naught all these apprehensions. Although the top management is committed towards HRD, there is need to implement the HRD sub-systems in an integrated manner as a part of the HRD programme if it has to effectively contribute to the HRD climate. So far only a few sub-systems, including management policy on HRD, potential appraisal, OD, role analysis and training are working in the organisations. Other sub-systems are not properly integrated to the HRD programme and need to be overhauled.

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Feature

Accommodating New Economic Policy in India's Social Dynamics: A Critical Review

Bhaskar Majumder

The Government of India (GOI) declared its New Economic Policy (NEP) in 1991. This policy is consistent with the acceptance of the principle of globalisation by Government aiming at the formation of an outward-oriented economy and allowing free play of market forces and backed by the belief that the Indian industrial economy has wide, diversified and increasingly competitive base. However, if India's socio-cultural fabric has to accommodate NEP, then the latter will have to bring about a sea-change in the quality-cum-productivity of an individual in the working age. This is where we talk about the necessity for formation of a new vibrant socio-economic order with or without NEP, states the author.

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The people of India in the late twentieth century have accepted the principle of capitalist globalization by consensus [Rao, 1992]. It is a fact that the post–disintegrated USSR has left for the world population of 1990s a unipolar world giving the Third World Countries (TWCs), including India no options but to be integrated with the Developed Marked Economies (DMEs). In keeping with the situation, the Government of India (GOI) declared its New Economic Policies (NEP) (GOI, 1991) "as a part of macro economic stabilization and structural adjustment policies (SAP) advocated by the multilateral agencies like the World Bank (WB) and the International Monetary Fund (IMF)" (Bhalla, 1995, p. 7). It is not surprising that "in an age when deforestation in one country reduces the entire biological richness, when chemicals released on one continent can lead to skin cancer on another, and when CO_2 (carbon dioxide) emissions anywhere hasten climate change everywhere, economic policy making is no longer exclusively a national concern" (Brown et al., 1991, p. 171).

New Economic Policy

The NEP, 1991 found "little reason for the interference of Government .....in the import of technology by Indian firms .....This policy measure will remove the delay and uncertainty which clouds the relationship between Indian and foreign firms and their Indian counterparts" [GOI, 1991, p. 4]. This has been done to make the economy more 'outward-oriented' and 'to provide much freer play of market forces' [GOI, 1991, p. 5].

The purpose of the GOI was "to unshackle the industrial economy from the cobwebs of unnecessary bureaucratic control" [GOI, 1991, p. 6]. This is in keeping with the observation made by the Asian Development Bank (ADB): "The development of a vibrant private sector that can absorb resources released from inefficient, often state–run activities will require a more accommodating policy environment. Winning the political consensus

necessary to push ahead with reform at the microeconomic level is the key that will ultimately determine whether South Asia's growth potential will be fully realized" (ADB, 1995, p. 13). As a part of NEP, the trade policy declared by the GOI says: "India can grow faster only as a part of the world economy and not in isolation. Our trade policy must therefore create an environment that will provide strong impetus to export and render export activity more profitable" [GOI, 1991, p. 24]. In this policy of essentially export-linked imports, "essential imports of sensitive items such as POL (Petrol, Oil and Lubricants) and fertilizers were fully protected" [GOI, 1991, p. 24]. While the twin pillars of the NEP viz., industrial policies and trade policies did not directly address the primary sector of Indian economy, it is obvious that agriculture and India's rural economy are to be affected by linkage effects, and that the effect however small immediately, cannot be ignored primarily because of the vast size of the rural economy. For example, as a reflection of SAP and associated NEP, "in case of India... the fiscal compression resulted in partial withdrawal of subsidies to fertilizers. More important, fiscal compression resulted in the decelaration of public investment in irrigation, power and other rural infrastructure including agricultural research....." [Bhalla, 1995, p. 8].

Fiscal compression resulted in the decelaration of public investment in irrigation, power and other rural infrastructure including agricultural research.

It is too early to make any final comment on what effect NEP will exert on the different social strata of Indian economy. Some aspects related to exhaustion of possibilities regarding resources-cum-technology are often bypassed by these policy declarations. For example, as observed by Worldwatch Institute: "Falling water tables are now commonplace in heavily populated countries such as India and China, which are overpumping aquifers in their effort to satisfy the growing need for irrigation water (Brown et al., 1991, p. 12.) Also, ".....the phenomenal growth in world output from 1950 to 1984 was due largely to the ninefold growth in fertilizer use. In large measure, other major advances in agriculture, such as the near-tripling of irrigated area and the adoption of ever higher yielding varieties, greatly enhanced the potential to use more fertilizer profitably. But as the nineties begin, many countries have reached the point where using additional fertilizer does little to boost food output" (Brown, 1991, p. 12). We avoid the question of technological potentiality, assuming that it exists, and concentrate on dimensions of the relevant NEP with reference to India's social dynamics in particular. This is precisely because when the GOI announced its NEP, it adopted parallely the Eighth Five-Year Plan (1992-1997) which declared that "it is a plan for managing.....the transition from centrally planned economy to market-led economy without tearing our socio-cultural fabric" (Planning Commission, 1992, p. 1). It is interesting to note that the requirements of an Open–Door Industrialisation (ODI) strategy as reflected in NEP is completely opposed to the fabric (Majumder, 1992).

Social Dynamics

A society is the composition of individuals carrying ideas reflected in their actions. The existence of an individual is social when he participates in activities useful to the rest of the society. An economy stands on this social structure when the individuals as economic agents participate in economic activities with clear objective functions in mind, i.e., their conscious participation in economic activities in a society.

Social dynamics is revealed in the motion of men. The motion of one section of men may be obstructed by the other in a given power-structure. These motions of men, constrained or not, on shifting circumferences of a society, whether or not inside the boundary of a nation state, are always guided by some revealed parameters or image of the parameters in the consciousness of the individuals. Some of these parameters are socio-politically accepted as platforms for actions of individuals. In the absence of a consensus-based objective function maintainable for the society for human security these motions may become distorted and may deviate from the desired orbit.

Social dynamics takes one shape when the dominant mode of production is pre-capitalistic (i.e., a hierarchic arrangement of people in the social ladder, people interacting by visible personal relations) and different shape when it is capitalistic (i.e., impersonal social relations indicated by the invisible market). In the former, revealed physical force works, rationalized by 'tradition', 'precedence', 'convention' etc., while in the latter, coercion is hidden under the guise of market forces (e.g., via exclusion of people not possessing any marketable property or exit of people by the forces of market). In the former, people are included by caste-custom-prejudice etc., while in the latter people are included on the basis of money. The former stands on aristocracy approximated by birth while the latter stands on a legal structure apparently appropriate to ensure a civil society in the form of a 'market society'. On the assumption that a birth-neutral society is more

progressive, the latter is more progressive. When non-market aristocratic, autocratic coercion crosses the upper limit as considered by some individual pioneers in the process of social thought, one regime, e.g., the former becomes ripe to give birth to the latter. In other words, social dynamics or motion of men characterising an era with all its established and guiding principles and doctrines leaves a clue to its obsolescence at a later date, or the current rationality of people paves the path for its being termed 'past irrationality' at a later date. The triumph of present over the past in the triumph of world-view at present over what it was in the past. Change of era thus is conditional upon motion of men occupying the centre of world-view at present.

Social dynamics takes one shape when the dominant mode of production is pre-capitalistic and a different shape when it is capitalistic.

Social choices

While non satiety is one root of social dynamism, societies are not similar over time in terms of satiety. Similarly the attitude of the individual/group towards life determines partially the nature of aggression/militancy and hence the nature of turbulence or tranquility. But then it is difficult to compare individuals/groups in terms of aggression. While individual aggression degrades/elevates an individual socially, social aggression is too obscure to be called an elevation/degradation, because the society as an ideology-complex is obscure. How and why do people initiate activities? The initial manifestations are resistance against nature and aggression over nature, both for survival. People aim at meeting basic needs in ascending order when they transform nature. Each one has to initiate economic activities for survival and uplift in quality of life. Collective initiation in absence of any initial consensus follows from the existential inadequacy of a single individual. Man becomes social independent of his own will; he is compelled to be social for his own inadequacy, thus implying redundancy of the question of initial consensus. At a later stage, the emergence of a consensus becomes relevant and there is no contradiction between these two situations.

Social choice is revealed in social interactions of individuals and accepted or rejected by the process of consensus. But for consensus to work, unobstructed/non-coerced participation of people willing to participate is a pre-condition. The willingness to participate in the process of consensus is often socially conditioned, e.g., by some indicators like heredity or birth-specificity, education and hence consciousness about one's power of expression, and institutions related to religion, politics, public administration etc. While these indicators imply the existence of actual and potential social opportunities individuals are often constrained by institutions to have access to these opportunities to form the basis of a consensus. The invisibility or non-cardinal nature of the constraints does not imply non-existence of the constraints. This is not to imply that an individual in a country dominantly characterised by individualism is not bound by consensus and revealed social choice. An adverse effect on a single individual following social interaction is a sufficient condition for a change in the prevailing social order. To explain, if out of an individuals participating in society, (n-1) individuals have reasons to think that they are not being deprived while the n-th individual has such reasons to think, the social order is warranted to be altered.

While capitalist society honours the market, the latter itself may not be independent of 'personal ties of influence, status' etc. However, the multi-institutional dimensions of the capitalist civil society may afford to conceal the 'personal character' of the claimed-to-be impersonal nature of the market (Poulantzas, 1979). Whether or not it is understood at a particular point of time, social choice and consensus may be spurious, meant essentially for the exclusion of the majority of people at the bottom of the social ladder. Often people become allies of such a consensus without temporarily understanding its true implications. The quality of polity, its form of governance thus may be spurious and thus the quality of socio-economic development may be spurious.

Often people become allies of a consensus without temporarily understanding its true implications.

Social structure—various strata

While the social structure in countries like India is not 'individual centred', the individual is also not 'achievement centred'. A society conditioned by a productivity-neutral past cannot bring about a required change in the system. Why is a change in the system required? A social process incorporating a set of actions reveals its own contradictions at a stage at least because of its failure to satisfy the (socio-cultural) non-satiety of a section of individuals. The intellectual organ of the society accepts the task of questioning the existing norms and principles by its developed logic/ethics

or new normative principles. There then comes about the possibility of emergence of a new social order.

Polity plays a major role in shaping social dynamics. In the context of countries like India having a political system of parliamentary democracy, apparently an individual is not assigned any special role. What matters is collective choice and representation. Paradoxically, this polity is characterised by a type of cartel or collusion (Bhagwati, 1995). Often polity-determined quota (and inside polity, the dominant role played by the dominant party and inside the latter, the dominant role played by the leader) works in shaping the internal distribution of assignments. In particular, the activities and culture of

Polity plays a major role in shaping social dynamics. In the context of countries like India having a political system of parliamentary democracy, an individual is not assigned any special role.

the majority of people in Indian society, i.e., the rural inhabitants, are shaped by hierarchy and caste-division, inherited from a remote past and continued without any radical break, that leads to a tight, stable social structure immune to all the turbulences in and around the boundary of this particular society. This is valid inspite of the emergence of commodity production following 'railway and steamship' during the second half of the 19th century and the capitalist imperial domination as well as following the thrust of globalisation during the last quarter of the 20th century (Ludden, 1990 & Nayyar, 1995). The socio-cultural fabric has remained intact.

What are the manifestations of this fabric? Apparently these lie in the existence of a large reserve army of unskilled population in the working age having

The real roots of the constraints that limit people at the bottom layer from having access to socio-political opportunities for participating in the game are illiteracy, ignorance and miseducation of the masses, alienation of academic elite from the masses, a system of public administration soft towards the elite, concealed vulnerability of the elite in the shape of dependence on and collusion with foreign rulers and powers.

little power to generate and absorb technologies and information for changing the social order. In essence, these people are constrained from being mature by an elite-determined non-competitive, non-aggressive or passive, pseudo-accommodative, unemployment–insensitive society. The real roots of the constraints that limit people at the bottom layer from having access to socio-political opportunities for participating in the game that at least affects them are illiteracy, ignorance and miseducation of the masses, alienation of academic elite from the masses, a system of public administration soft towards the elite, concealed vulnerability of the elite in the shape of dependence on and collusion with foreign rulers and powers (Myrdal, 1982; Mahalanobis, 1985 & Majumder, 1995a).

People at the bottom strata of Indian society remain satisfied with the status of being followers without any revealed voice of dissent. The state authority on the whole enjoys the power to suppress any occasional voice of dissent. At the extreme, any initiative by an individual or non-government organisation is either not recognized or assaulted, leading to its abortion or suppression by the government or dominant political coalition, or any interest group affiliated to either of these two. What people at the bottom can expect is to be potential beneficiaries offered by the 'divisible pool' in the hands of the government. Society and polity thus remain government centered.

In this situation, the NEP 1991 claimed that "there is little reason for the interference of Government, inherently involving delays and hampering business decision making, in the import of technology by Indian firms" (GOI, 1991, p. 4). Also that "automatic permission will be given for foreign technology agreements in high priority industries", and that "no permission will be necessary for hiring of foreign technicians, foreign testing of indigenously developed technologies (GOI, 1991, p. 9). This claim is consistent with the acceptance of the principle of globalization by the GOI (GOI, 1991, p. 4) aiming at the formation of an outward-oriented economy and allowing freer play of market forces (GOI, 1991, p. 5) and backed by the belief that the "Indian industrial economy has a wide, diversified and increasingly competitive base" (GOI, 1991, p. 2).

What these claims by the Government ignore is the question of manpower, the ability of an individual to be qualitatively competitive internationally. Application of science or technological revolution does not occur in vacuum but in the sphere of production of commodities by man in human society. The NEP 1991 requires formation of a 'global individual' at home, in terms of his competence and creativity, depending on his acquiring education and training. The social structure as we have

inherited and are passing through is not very conducive to formation and development of such a 'global individual' in terms of participation in processes of change. Also, productivity and profitability of final output cannot be ensured artificially relying on repetitive import of technologies and technicians from abroad. Non-existence of resistance from indigenous people at this moment against parasitic dependence on developed market economies (DMEs) does not rule out the possibility of resistance which exists potentially.

The social structure as we have inherited is not very conducive to formation and development of 'global individual'. Productivity and profitability of final output cannot be ensured artificially relying on repetitive import of technologies and technicians from abroad.

If this socio-cultural fabric has to accommodate NEP, then the NEP will have to bring about a sea-change in the quality-cum-productivity of an individual in the working age, will have to ensure that the individual gets the chance to apply his potential in productive jobs and can minimize over time the chance of being obsolete by technological advancement. There is nothing in NEP that can ensure these. This is where we should talk about the necessity for formation of a new vibrant socio-economic order, with or without NEP.

A New Order

The real challenge to the people outside the elite-consensus in the TWCs like India today essentially lies in changing their location in the power-structure embedded in the long-term socio-cultural fabric designed by the elite against change. Rather than the change being externally determined, it has to come from within. To be an active member of the global family what is important first is to set things right at home. What matters while accepting an objective function by consensus is the quality of development that encompasses the quality of life, including work life of people, and not a heroically projected cardinal rate of growth of output supposedly attainable by some macroeconomic indicators like rate of investment and productivity of investment etc. (World Bank, 1991). In fact, the environment and security of investment are socially conditioned. In this respect, it seems to be a false proposition that establishing a democratic government is the end–result of the political aspirations of the people and the economic aspirations of the investors. The alternative is not to invite autocratic anarchy, or dynastic rule in any form, but to ensure free functioning of the democratic state as an arrangement of autonomous institutions like the judiciary and the election commission and a free press, keeping a continuous vigil on the functioning of the government, i.e., the executive arm of the state. Still then, the state as a super-institution may fail to stop repression by any wing of the government on the people in the bottom layer. A check on this can be ensured by the expansion of the socio-economic opportunities of these people, in turn, primarily via land reforms and public works through decentralized planning (Dreze and Sen, 1995; Lieten, 1994; Joshi 1982; Aziz, 1993). Techno-globalization via 'externally oriented market reforms' of the type much appreciated by the ADB may only work as an external stimulus. Its acceptance and absorption require preparation of people at home and that gears us to the question regarding the response of the followers to the new paradigm initiated by the leaders. Accordingly, ensuring basic living conditions of man is an indispensable precondition for acceptance of the new paradigm by the followers. This is not an attempt to invert the given pyramidal power-structure people have come to accept, but an attempt to jerk the base of the pyramid up by the standing on base. (Majumder, 1995b). If the objective of the Indian economy remains economic self-reliance accepting a frame of capitalist globalization, it has to rely on development of manpower that aims at ensuring consensus and state–power. The economy will then become competent to declare NEP for its implementation as an integral part of the goal globalization rather than being compelled to accept it.

The alternative is to ensure free functioning of the democratic state as an arrangement of autonomous institutions like the judiciary and the election commission and a free press, keeping a continuous vigil on the functioning of the government.

Techno-globalization via 'externally oriented market reforms' may only work as an external stimulus. Its acceptance and absorption require preparation of people at home.

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Feature

Participative Management in Himachal Road Transport Corporation

Jai Singh Parmar & Kuldeep Kumar

Though participative management in India had its inception in the year 1947, so far it has failed to achieve the objectives for which it was created. The most important reason for this is the lack of interest on the part of management and the lack of awareness. The situation in Himachal Pradesh in this regard is distinctly unique and merits detailed analysis. The present study is an attempt to promote regional studies for establishing a better understanding of labour management relations.

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The concept of participative management has been described as a social, emotional and psychological involvement of workers in the affairs of the management. Many authors have viewed it as a measure which will reduce the alienation of the workers at the work place. Some have declared it as a panacea for all tensions between labour and management as it builds a good relationship between them. It is believed that it will increase worker involvement and thus ensure their commitment. It is used as a technique of associating the workers with the management decision-making affairs in general and in those decisions which affect the workers directly in particular.

Himachal Road Transport Corporation (henceforth referred as HRTC) is one of the biggest public sector undertakings in the State providing transportation services. These services are vital for the acceleration of the developmental process of the State. The scheme of participative management was adopted in HRTC since its inception in 1974 as per the provisions of the Industrial Dispute Act, 1947. It was considered to be the first step towards the implementation with the objective that each unit functioning in this corporation may be able to seive its local problems and contribute in a positive manner for maintaining cordiality of relationship between labour and management.

Initially, the experiment of works committees was received by all enthusiastically but with the passage of time, this forum of participative management lost its attractiveness, and, became non-functional. The major reason for its failure may be summed up as the lack of interest on the part of the workers and management towards the scheme due to ignorance of its concept and role. The management thought it obligatory to form the works committees under the provision of Industrial Dispute act, and just completed the formalities without any additional effort. The workers thought that it may be an act of the management to weaken the trade union movement in the corporation, hence, they lost interest in

this forum. In 1987 when these committees become non-functional the management constituted the unit councils as an alternative, but this experiment was also short lived. The government, then constituted a high power committee in the year 1988 under the chairmanship of secretary transport with five members from the State Co-ordination Committee, (an apex body of the trade unions) to review the performance of the corporation and suggest measures for improvement. This committee also met with the same fate and became non-functional within two years of its formation. Presently, the management has recognised all the six unions working the corporation and also the State Co-ordination Committee; this committee represents the workers and a management committee has been formed including Managing Director, Executive Director and other officers of the corporation. The State Co-ordination Committee of unions nominates its members to initiate the negotiation process with the management.

The Study

Cordial employee-employer relations are of paramount importance for the growth, survival and smooth functioning of an organisation. Active collaboration between labour and management results both in an improvement in the level of real wages and the working conditions of the workers and also in greater or more economical, production, beneficial to the total community. The significance of the present study arises from the strategic importance the corporation, HRTC enjoys, in the development of the state; a little disruption in its work leads to enormous losses. This necessitate understanding of the factors responsible for maintaining industrial harmony in the Corporation.

Active collaboration between labour and management results both in an improvement in the level of real wages and the working conditions of the workers and also in greater or more economical production, beneficial to the total community.

Methodology

The present study was aimed at knowing the viewpoints of workers, trade union leaders and managerial personnel about the worker's participation in management followed by the Corporation. A bid is also made to ascertain the claim of HRTC management that it is eased the worker's problems and always believes in maintaining the cordiality in the relations between labour and management.

Since the corporation employs more than 8000 employees the census method of investigation was not feasible and the sampling method of investigation was used. The corporation operates throughout the State and for administrative purposes it has been divided into four divisions which have 21 depots and 3 major workshops under their control. Six depots including the Head Office were randomly selected for the purpose of the present study. All these depots are under Shimla division. The sample of the respondents constituted workers, trade union leaders and managerial personnel. Random sampling method is used in the present study because the homogeneity and comparability were found to be higher. For selection of sample units lottery method was used. Representation to all categories of workers, trade union leaders and managerial personnel was assured; therefore, it can be construed as a representative sample. While selecting the respondents care was taken to give more weightage to experience. Three different sets of questionnaires were prepared for obtaining required information and Likert Type Scaling technique was used. The information thus collected has been analysed with the help of various statistical tools and techniques. Through the Likert Type Scale the score was calculated; with the help of Weighted Average Score (WAS), for Strongly Agree (SA), five marks were allotted, four marks were allotted to Agree (A), three marks for Neither Agree Nor Disagree (NAND), two for Disagree (D) and one for Strongly Disagree (SD).

Results & Discussion

Objectives of workers participation in management

In order to assess the workers' attitude towards workers' participation in management in HRTC, the respondents were given eight objectives and were asked to rank them in order of priority (table 1). "Improvement of Productivity" was found to be the first objective of workers' participation in management. "Industrial Relations" and "Prevention of strikes" were the next major objectives of the participative management in the corporation.

Functioning of management committees

To analyze the functioning of the management committee in HRTC, the question addressed to the member of management committee was how often do you receive the notice of the meeting on time (table 2). All trade union leaders replied that they receive the notice sometimes; 50 per cent of the managerial personnel

Table 1: Objectives of Worker's Participation in Management

Objectives	1		2		3		4		5	
	WG1R	WS	WG2R	WS	WG3R	WS	WG4R	WS	WG5R	WS
Improvement of Productivity	20	160	10	70	5	30	5	25	3	12
Improvement of Industrial Relations	17	136	10	70	6	36	4	20	5	20
Prevention of Strikes	4	32	15	105	10	60	6	30	6	24
Improvement of Discipline	3	24	2	14	7	42	10	50	10	40
Befooling the Workers	1	8	1	7	3	18	5	25	5	20
Redressal of grievances of Workers	2	16	2	14	5	30	4	20	7	28
Sharing the information with workers	3	24	4	28	6	36	8	40	5	20
Improvement of Workers in Decision making	1	8	7	49	9	54	9	45	10	40

(Table 1 Contd.)

Objectives	6		7		8		9	10
	WG6R	WS	WG7R	WS	WG8R	WS	TWS	Ranks
Improvement of Productivity	3	9	3	6	2	2	314	1
Improvement of Industrial Relations	5	15	2	4	2	2	303	2
Prevention of Strikes	5	15	3	6	2	2	274	3
Improvement of Discipline	8	24	6	12	5	5	211	5
Befooling the Workers	6	18	20	40	10	10	146	8
Redressal of grievances of Workers	7	21	5	10	19	19	158	7
Sharing the information with workers	9	27	8	16	8	8	199	6
Improvement of Workers in Decision making	8	24	4	8	3	3	231	4

Note: First priority was given a score of Right (WG1R), Second priority a score of seven (WG2R), third priority a score of six (WG3R), fourth priority a score of five (WG4R), fifth priority a score of four (WG5R), sixth priority a score of three (WG6R), seventh priority a score of two (WG7R) and eighth priority a score of one (WG8R)

Ranking was done on the basis of Total Weighted Score (TWS)

WS—stands for Weighted Score

WG1R, WG2R, WG3R, WG4R etc.—stand for workers giving first Rank, Second rank, Third Rank, Fourth rank etc.

said that they receive the notice always. 33.34 per cent of trade union leaders and 50 per cent of managerial personnel received the agenda of meetings always (table 3). 50 per cent of trade union leaders and 25 per cent of managerial personnel received the agenda often whereas 16.66 per cent and 25 per cent of trade union leaders and managerial personnel respectively received the agenda only sometimes. None of the respondents stated that he never received the agenda of the meetings. On the basis of this information, it can be concluded that meetings of management committee are held regularly and notice and agenda of the meetings are sent to the members in advance. This is done with the objective that the members may prepare themselves for the meetings and participate in the proceedings effectively.

To assess the value of the discussion which took place among the workers and management representatives in the management committee meetings, the respondents were asked: "whether they feel that the discussions at the committee meetings were free and frank" and "whether they are satisfied with the issues discussed in the meeting" or not (tables 4 and 5 respectively). All trade union leaders and managerial personnel feel that the discussion in the management committee meetings were free and frank without any pressure from any side; all the respondents were also found to be

Table 2: Receiving Notice of the Meeting Management Committees

Particulars	No. of Trade Union Leaders	No. of Managerial Personnel
Always	–	4 (50.00)
Often	–	4 (50.00)
Sometimes	6 (100.00)	–
Never	–	–
Total	6 (100.00)	8 (100.00)

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

Table 3: Receiving Agenda of the Meetings of Management Committees

Particulars	No. of Trade Union Leaders	No. of Managerial Personnel
Always	2 (33.34)	4 (50.00)
Often	3 (50.00)	2 (25.00)
Sometimes	1 (16.66)	2 (25.00)
Never	–	–
Total	6 (100.00)	8 (100.00)

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

Table 4: Are the Discussions at the Committee Meetings Free and Frank?

Particulars	No. of Trade Union Leaders	No. of Managerial Personnel
Those who said discussion was free and frank	6 (100.00)	8 (100.00)
Those who said discussion was not free and frank	–	–
Total	6 (100.00)	8 (100.00)

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

Table 5: Satisfaction about Issues Discussed in the Meetings

Particulars	No. of Trade Union Leaders	No. of Managerial Personnel
Those who said they were satisfied	6 (100.00)	8 (100.00)
Those who said they were not satisfied	–	–
Total	6 (100.00)	8 (100.00)

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

satisfied with the issues discussed (table 5). Therefore, it can be concluded that meetings of the committees are held in cordial atmosphere and relevant issues are taken up in this body.

Assessment of management committees (Workers' view point)

Workers' opinion about the management committees (presented in table 6) indicate that majority of workers (96.08 per cent) feel that these committees are useless for them, only 3.92 per cent were found to be in favour of the usefulness of management committees. Further the workers were asked whether these committees are "successful", responses regarding this have been presented in table 7. Majority of workers excepting a handful of those who are the members of the Co-ordination Committee and the negotiating team are not aware of the formation and functioning of the committee. The workers by and large are ignorant about these committees.

Table 6: Usefulness of Management Committees

Particulars	No. of Workers	Percentage
Useful	–	–
Slightly useful	2	3.92
Useless	49	96.08
Total	51	100.00

Table 7: Success of Management Committees

Particulars	No. of Workers	Percentage
Successful	–	–
Unsuccessful	3	5.89
Do not Know	48	94.11
Total	51	100.00

Regarding the effects of the management committees on efficiency, labour management relations and discipline, (table 8) only a handful of workers believe that the management committees have resulted in bringing improvement in labour-management relations and discipline. Large number of workers (84.31 per cent, 80.39 per cent and 88.23 per cent) replied that there is no improvement in efficiency, labour-management relations and discipline respectively, with the formation of management committees. Trade union leaders on the other hand, have expressed fair attitude towards the performance of the management committees whereas 64.44 per cent, 62.22 per cent and 60.00 per cent of the managerial personnel stated that there are improvements in efficiency, labour-management relations and discipline respectively, by the formation of management committees in this corporation.

Table 8: Effects of Management Committees on Efficiency, Labour Management Relations & Discipline

Particulars	Efficiency			Labour Management Relations			Discipline		
	No. of Workers	No. of T.U.L.	No. of M.P.	No. of Workers	No. of T.U.L.	No. of M.P.	No. of Workers	No. of T.U.L.	No. of M.P.
Improvement	–	17 (36.96)	29 (64.44)	3 (5.89)	25 (54.34)	28 (62.22)	2 (3.92)	17 (36.96)	27 (60.00)
No Improvement	43 (84.31)	23 (50.00)	7 (15.56)	41 (80.39)	16 (34.79)	11 (24.44)	45 (88.23)	25 (54.34)	9 (20.00)
Donot know	8 (15.69)	6 (13.04)	9 (20.00)	7 (13.72)	5 (10.87)	6 (13.34)	4 (7.85)	4 (8.60)	9 (20.00)

Note: Figure in the brackets show percentages to the column totals
T.U.L. denotes Trade Union Leaders
M.P. denotes Managerial Personnel

Attitude of the managerial personnel and trade union leaders towards worker's participation in management in HRTC

Various forms of participative management are operating in HRTC. In all, fourteen statements were addressed to the trade union leaders and managerial personnel so as to elicit information regarding their attitude towards the participative management (tables 9 and 10).

62.21 per cent of the trade union leaders 'Strongly Agreed' with the statement "Special Training is needed to change the attitude of workers and managers for making Workers' participation in management a success", and 34.79 per cent expressed agreement. Weighted Average Score (WAS) was worked out to be 3.89. So far as the managerial personnel were concerned, 22.22 per cent 'Strongly Agreed' with this statement, whereas 13.33 per cent agreed and 4.89 per cent 'Neither Agreed Nor Disagreed'. The Weighted Average Score was found to be 4.53. On the basis of this it can be concluded that both the managers and trade union leaders agree that special training is needed to change the attitude of workers and managers for making workers' participation in management a success. Therefore, it is assumed that the attitudinal change can be brought out by way of special training which would be useful for the success of participative management.

For the statement "Due to the conflict of interest between labour and management it is not possible to have any successful scheme of participative management" the WAS, for the trade union leaders was found to be 2.28 and in case of the managerial personnel 2.44. This means that trade union leaders and managerial personnel do not accept this statement in entirety. Proving the viewpoint that conflict in interest between labour and management is not a barrier for the successful operation of participative management.

For the statement "The multiplicity of trade unions is not conducive to workers' participation", the WAS was found to be 2.19 in case of trade union leaders and 2.55 for the managerial personnel. This means that the majority of the trade union leaders and managerial personnel do not think that multiplicity of the unions is not conducive to workers' participation in management. Regarding the statement, "The politicalisation of trade unions is not conducive to workers' participation" the WAS found to be 1.91 in the case of trade union leaders and 2.28 for managerial personnel. This means that the trade union leaders do not believe that the politicalisation of the trade unions affects workers' participation in management, whereas the majority of the managerial personnel feel that politicalisation of the trade unions is not conducive to the workers' participation in management.

Both the categories of respondents expressed disagreement with the statement. "Workers' participation at various levels based on direct election would weaken the position of trade unions". The WAS for this statement was found to be 1.23 in the case of trade union leaders and 2.37 for managerial personnel. This proves that the workers' participation in management at various levels based of direct election would not affect the position of trade unions.

WAS for the statement "participative management is not possible as the existing system is management dominated", was found to be 1.93 in case of trade union leaders and 2.17 in case of managerial personnel. Majority of trade union leaders and managerial personnel expressed disagreement with this statement.

"Participative management is not possible as the managers are authoritarian in nature and do not want to share powers" a large majority of trade union leaders expressed agreement with this statement, whereas a large majority of managerial personnel did not agree. The WAS for this statement was 4.34 in case of trade

Table 9: Attitude of Trade Union Leaders Towards Workers' Participation in Management

Statements	M = 46					
	SA	A	NAND	D	SD	WAS
Special training is needed to change the attitude of workers and managers for making participative management a success	30 (65.21)	16 (34.79)	–	–	–	3.89
Workers' participation in management will not succeed in India	3 (6.52)	2 (4.34)	–	24 (52.17)	17 (36.97)	1.91
The top management of HRTC is not seriously interested in making participative management a success	26 (56.52)	20 (43.47)	–	–	–	4.56
Due to conflicts of interest between labour and management it is not possible to have any successful scheme of participative management	4 (8.69)	5 (10.87)	–	28 (60.87)	9 (19.57)	2.28
The belief that the workers are inherently inferior to managers will not allow participative management to be a success	–	4 (8.69)	2 (4.14)	20 (41.47)	20 (41.47)	1.78
The multiplicity of trade unions is not conducive to workers' participation	3 (6.52)	7 (15.21)	2 (4.14)	18 (39.13)	16 (34.79)	2.19
The politicalisation of trade unions is not conducive to workers' participation	2 (4.34)	4 (8.69)	2 (4.34)	18 (39.13)	20 (43.47)	1.91
Workers' participation in management at various levels based on direct election would weaken the position of trade unions	–	–	–	11 (23.91)	35 (76.08)	1.23
Participative management is not possible as the existing system is management dominated	2 (4.34)	3 (6.52)	5 (10.87)	16 (34.79)	20 (43.47)	1.93
Participative management is not possible as the managers are authoritarian in nature and do not want to share powers	31 (67.39)	9 (19.75)	–	3 (6.52)	3 (6.52)	4.34
It is necessary to have legislation to make Workers' Participation in Management at all levels a success	11 (28.51)	30 (65.21)	5 (10.87)	–	–	4.13
The workers are competent to participate in decision making at various levels	25 (54.34)	18 (39.13)	3 (6.52)	–	–	4.60
The Government is not providing the necessary push to make workers' participation a success	12 (26.08)	10 (21.71)	20 (43.47)	2 (4.34)	2 (4.34)	3.60
Public sector enterprises should provide a lead in respect of workers' participation in management	31 (67.39)	11 (23.91)	2 (4.34)	1 (2.17)	1 (2.17)	4.52

Note: Figures in Parentheses show percentage responses to the total number of trade union leaders interviewed

The Weighted Average Score was calculated by giving scores as 5 for (SA) Strongly Agree, 4 for Agree (A), 3 for Neither Agree Nor Disagree (NAND), 2 for Disagree (D), and 1 for Strongly Disagree (SD)

union leaders and only 1.75 in case of managerial personnel. This means, that trade union leaders believe that the managers are authoritarian in nature and they do not want to share powers, whereas the managers do not share the sentiment. "It is necessary to have legislation to make workers' participation in management at all levels a success", a large majority of both categories of respondents expressed agreement with this statement. The WAS for this statement was worked out as 4.48 and 4.13 in case of managerial personnel and trade union leaders, respectively. This makes it clear that considering the present socio-political environment in India, the support and help of the government is a pre-requisite to make workers' participation in management a success at all levels. "The workers are competent to participate in decision making at various levels" this statement was agreed by a majority of both categories of respondents. The WAS for this statement was 4.60 and 4.40 in the

Table 10: Attitude Managerial Personnel, Towards Workers' Participation in Management

Statements	M = 45					
	SA	A	NAND	D	SD	WAS
Special training is needed to change the attitude of workers and managers for making participative management a success	10 (22.22)	25 (34.79)	6 (13.33)	4 (4.89)	–	4.53
Workers' participation in management will not succeed in India	–	2 (2.44)	3 (6.66)	22 (48.89)	18 (40.00)	1.75
The top management of HRTC is not seriously interested in making participative management a success	1 (2.22)	4 (8.89)	3 (6.66)	20 (44.44)	14 (31.11)	2.06
Due to conflicts of interest between labour and management it is not possible to have any successful scheme of participative management	3 (6.66)	9 (20.00)	3 (6.66)	20 (44.44)	10 (22.22)	2.44
The belief that the workers are inherently inferior to managers will not allow participative management to be a success	–	–	2 (4.34)	23 (51.11)	19 (42.22)	1.64
The multiplicity of trade unions is not conducive to workers' participation	3 (6.66)	9 (20.00)	2 (4.44)	17 (37.78)	14 (31.11)	2.55
The politicalisation of trade unions is not conducive to workers' participation	2 (4.44)	9 (20.00)	1 (2.22)	21 (46.67)	12 (26.67)	2.28
Workers' participation in management at varions levels based on direct election would weaken the position of trade unions	5 (11.11)	6 (13.33)	3 (6.66)	18 (40.00)	18 (28.89)	2.37
Participative management is not possible as the existing system is management dominated	3 (6.66)	6 (13.33)	3 (6.66)	17 (31.78)	16 (35.56)	2.17
Participative management is not possible as the managers are authoritarian in nature and do not want to share powers	1 (2.22)	2 (4.44)	1 (2.22)	22 (48.89)	19 (42.22)	1.75
It is necessary to have legislation to make Workers' Participation in Management at all levels a success	24 (53.33)	19 (42.22)	02 (4.44)	–	–	4.48
The workers are competent to participate in decision making at various levels	16 (35.56)	28 (62.28)	1 (2.22)	–	–	4.40
The Government is not providing the necessary push to make workers' participation a success	7 (15.56)	16 (35.56)	9 (10.00)	8 (17.78)	5 (11.11)	3.26
Public sector enterprises should provide a lead in respect of workers' participation in management	20 (44.44)	21 (46.67)	4 (8.88)	–	–	4.35

Note: Figures in Parentheses show percentages to the total number of Managerial Personnels interviewed

The Weighted Average Score was calculated by giving scores as 5 for (SA) Strongly Agree, 4 for Agree (A), 3 for Neither Agree Nor Disagree (NAND), 2 for Disagree (D), and 1 for Strongly Disagree (SD)

case of trade union leaders and managerial personnel, respectively.

The statements, "The Government is not providing the necessary push to make worker's participation in management a success" and "Public sector enterprises should provide a lead in respect of workers' participation in management" were supported by a majority of trade union leaders and managerial personnel. The WAS for these statements were found to be 3.26 and 4.35, respectively in case of trade union leaders and managerial personnel.

Conclusion & Policy Implications

The management of an undertaking is said to be participative if it gives its workers the chance to influence its decision making process at levels or spheres. In HRTC, since its inception, a number of schemes have been launched under various nomenclatures, to secure amenity in the employee and employer relationship and to provide a scope for settling industrial disputes at the lowest possible level. However, with the passage of time these forms of participative management in this corporation lost attractiveness due to the lack of interest on the part of the workers and the management. Hence, today this scheme exists on paper only. The reason for this can be attributed to the indifferent attitudes of the management and trade union leaders. After assessing the workers' view points regarding the scheme of workers participation in management in HRTC, it appears that the scheme has been a failure because the management of this corporation does not encourage it and provide the necessary impetus.

The day to day functioning of the corporation is largely effected by the Board Directors which lays down the policies for the corporation, but in this highest level of decision making body, employees have not been represented. Therefore, steps should be initiated in this direction and the workers given a share at this level too. The majority of the workers pointed out that workers participation in management does not exist in this corporation, whereas the managerial personnel expressed that the same is existing, though the workers are unaware of it. The objectives of workers participation in management should be clearly defined and its purpose should be to not only maximize production but also to sharing the gains of productivity with the workers. Demarcation should be made among the various participative forums in an organisation. Incentives should be provided to educate the workers as well as the management representatives on workers participation in management forums in accordance with the objectives of participative management. □

The scheme has been a failure because the management of this corporation does not encourage it and provide the necessary impetus.

Feature

Multi-Attribute Decision Model for Assessment of Quality

Rambabu Kodali

The key to an organisation's success in the present competitive world lies in its capability to meet the customer demand. Attainment of world class goals is possible only by striving for never-ending improvement in all aspects of performance. Improvement is a process that must never stop. In this way, a real competitive edge can develop by steadily widening the advantage over static or slow-changing competitors. This paper describes the multi-attribute decision model using Analytic Hierarchy Process (AHP) for the assessment of the quality status of organisations. The model is evaluated by a case study.

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In recent years, many organisations have embarked on the quality journey, a process whose goal is to improve the quality of both goods and services through the application of efficient quality management methods. Once the aims of total quality have been defined, the organisations themselves set a series of objectives they intend to achieve through total quality management. These business objectives are effectively the benefits to be gained and, although they vary from organisation to organisation. The often realized benefits include (Peratec, 1994):

* Improvement of profitability by increased operational efficiency
* Cultural and behavioural change
* Prevention of waste
* Improvement of customer satisfaction
* Maintaining or increasing market share
* The achievement of product and business excellence
* Releasing the organisation's people potential
* Improvement of product of service quality, product safety and reliability
* Minimization of loss to the individual, the company and the community
* Associated improvements in operational safety, occupational health and the environment
* Encouragement of each individual's personal improvement, innovation and creativity.

Quality: The Concept & Assessment

The concept of quality, in the twentieth century, has evolved from a narrow focus on control to one

that permeates all aspects of the modern business enterprise. Quality is a requirement to compete successfully in today's global market place. It is defined in many ways. The American National Standards Institute (ANSI) and the American Society for quality Control (ASQC) define quality as "the totality of features and characteristics of a product or service that bears on its ability to satisfy given needs". Today most managers agree that the main reason to pursue quality is to satisfy customers. In highly competitive markets, merely satisfying customer needs will not achieve success. To beat the competition, organisations often must exceed customer expectations. Hence, most progressive organisations now define quality as meeting or exceeding customer expectations. Quality of a product or service, refers to the totality of its features and characteristics that bear on its ability to satisfy the customer's needs. For an organisation to survive and flourish, quality has to be achieved at an economic cost. The economic achievement of quality cannot be ensured through inspection and test alone. Every department and individual has a contribution to make towards this end.

Quality of a product or service, refers to the totality of its features and characteristics that bear on its ability to satisfy the customer's needs.

Many organisations have started on the quest for quality either because of customer pressure for ISO 9000 certification or because they themselves have realized the strategic advantage it would give them over their competitors. In general, it takes 2 years, for obtaining this coveted certificate which is only a first step towards the ultimate goal: total quality management. Reaching this goal may take at least 5 years (Dahlgaard, 1995).

Continuous improvement is part of the management of all systems and processes. Achieving the highest levels of quality and competitiveness requires a well defined and well executed approach to continuous improvement. Such improvement needs to be part of all operations and all work unit activities in an organisation. Improvement is driven not only by the objective to provide better quality, but also by the need to be responsive and efficient, both of which confer additional marketplace advantages. To meet all of these objectives, the process of continuous improvement must contain regular cycles of planning, execution, and evaluation. This requires a quantitative basis for assessing progress and for deriving information for future cycles of improvement. Quality must be measured (Dean & Evans, 1994). In this paper, a multi-attribute decision model using AHP for the assessment of the quality status of organisations has been proposed.

Development of Model

The AHP has been well received in literature and applications of this methodology have been reported in numerous fields (Saaty, 1980). The general approach of the AHP is to decompose the problem and to make pairwise comparisons of all elements on a given level with respect to the related elements in the level just above. A highly user friendly computer model is developed which assists the user in evaluating his choices. The schematic of the model is shown in Fig. 1.

Description of the AHP

A through analysis of the problem is required along with the identification of the important system attributes involved. The selection of the attributes has been determined through literature survey, and consultation with the industry personnel. The attributes and sub-attributes used in AHP to achieve a common goal are as follows:

Quality of Product Design	[QPD]
* Acceptance of Design by Approval Body	[ABA]
* Acceptance of Design by Customers	[ABC]
* Ease of Manufacturing	[EOM]
* Safety & Reliability Tests	[SRT]
Quality of Facilities	[QOF]
* Production Facilities	[PRF]
* Installation Facilities	[INF]
* Packaging Facilities	[PAF]
* Inspection & Test Facilities	[ITF]
Quality of Human Factor	[QHF]
* Employee Motivation	[EMM]
* Training Programmes for Employees	[TPE]
* Training Programmes for Customers	[TPC]
* Flexible Workforce	[FWF]
Quality of Vendors	[QOV]
* Assessment of Vendor Capabilities	[AVC]
* Vendor Surveillance	[VES]
* Accuracy of Vendor Measuring Instruments	[AVM]
* Traceability in case of defects	[TOD]

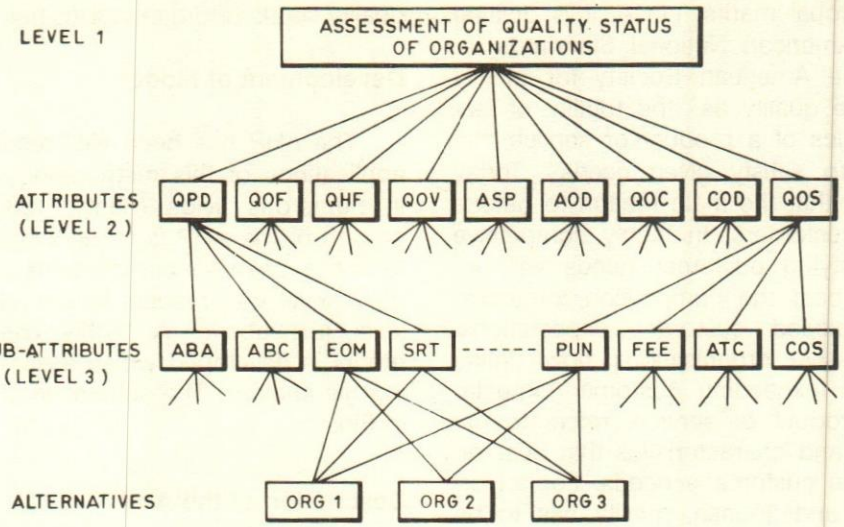

Fig. 1 Schematic of the AHP Model

Availability of Systems & Procedures [ASP]
- * For Design Calculations & Review [DCR]
- * For Vendor Qualification & Approval [VQA]
- * For Issual of Tools, Documents etc. [ITD]
- * For Storage & Preservation of Materials [SPM]
- * For Final Product Testing [FPT]

Availability of Documents [AOD]
- * Drawings at Workstation [DOW]
- * Calibration Records [CAR]
- * Design Change Validation Reports [DCV]
- * Quality Cost Reports [QCR]

Quality of Conformance [QOC]
- * % Conformance at Receipt Stage [CRS]
- * % Conformance at Manufacturing Stage [CMS]
- * % of Scrap & Reworks [SAR]
- * % Accepted on Concession [AOC]

Cost of Damage [COD]
- * Damage during Storage [DDS]
- * Damage during Transit [DDT]
- * Out-of-Warranty Returns [OOW]
- * Internal/External Failure Costs [IEF]

Quality of Service [QOS]
- * Punctuality [PUN]
- * Feedback [FEE]
- * Accessibility to Customers [ATC]
- * Cost of Service [COS]

Alternatives

The alternatives are the three organisations which are to be compared and evaluated. Form the given set of alternatives, the model evaluates the assessment of quality status for the given set of attributes. The alternatives are:

- * Organisation 1 [ORG 1]
- * Organisation 2 [ORG 2]
- * Organisation 3 [ORG 3]

AHP methodology

The attributes of the quality management can be arranged in levels for relative comparison to determine the quality status of organisations. The AHP provides a comprehensive structure to combine intuitive, rational and irrational values during the decision making process. The guidelines of the AHP recommend an initial focus on the top level, then moving on the to criteria affecting the focus in the second level followed by sub-criteria in the third level and so on from the more general to the more particular and definite.

To apply the principle of comparative judgments, a matrix of pairwise comparison of the relative importance of the elements in the second level with respect to the

overall focus of the first level, is carried out. A scale is given for entering such judgements (see appendix).

Steps of the process

The following are the steps to follow in using the analytic hierarchy process (Roger, 1987).

- Define the problem and determine the objective.
- Structure the hierarchy from the top through the intermediate levels to the lowest level.
- Construct a set of pairwise comparison matrices for each of the lower levels. An element in the higher level is said to be a governing element for those in the lower level, since it contributes to it or affects it. The elements in the lower level are then compared to each other based on their effect on the governing element above. This yields a square matrix of judgments. The pairwise comparisons are done in terms of which element dominates another. These judgments are then expressed as integers. If element A dominates over element B, then the whole number integer is entered in row A, column B and the reciprocal is entered in row B, column A. If the elements being compared are equal, number one is assigned to both positions.
- There are n(n–1)/2 judgments required to develop the set of matrices in step 3 (reciprocals are automatically assigned in each pairwise comparison).
- Once the data is entered, the consistency is determined using the eigenvalue ($Aw = \gamma$ (max) w is solved. The consistency index C.I. derived from the departure of the γ (max) from n is compared with the corresponding average values for random entries yielding the consistency ratio, C.R.)
- Steps 3-5 are performed for all levels and clusters in the hierarchy.
- Hierarchical composition is now used to weight the eigenvectors by the weights of the criteria and the sum is taken over all weighted eigenvector entries corresponding to those in the next lower level of the hierarchy.
- The consistency of the entire hierarchy is found by multiplying each consistency index by the priority of the corresponding criterion and adding them together. The result is then divided by the same type of expression using the random consistency index corresponding to the dimensions of each matrix weighted by the priorities as before. The Consistency Ratio (C.R.) should be about 10 per cent or less to be acceptable. Else, the quality of the judgments should be improved, perhaps by revising the manner in which the questions are asked in making pairwise comparisons.
- The desirability index for each alternative is calculated by multiplying each value in 'weight of sub-criteria' column by the corresponding value in 'criteria weight' column, then multiplying by the value for each respective alternative and summing the results.

For use in this problem, the focus is developed. In this case, it is for the assessment of the quality status of organisations. The attributes are compared with each other on a pairwise comparison with respect to the case study described in table 1. The relative weights or priorities are obtained. A highly user-friendly software, the multi-attribute decision model, (AHP process), has been developed in turbo C for assisting the user in making pairwise comparison of the attributes as well as for the alternatives and for analysing the user inputs.

Table 1: Case Study

Product	:	Cars
Market	:	Medium
Company goals	:	Maintain competitive edge
Quality	:	High
Market segment	:	Upper income level

Table 2: Weightages for Different Attributes

Attribute		Principal vector
Quality of product design	(QPD)	0.234
Quality of facilities	(QOF)	0.175
Quality of human factor	(QHF)	0.161
Quality of vendors	(QOV)	0.124
Availability of systems & procedures	(ASP)	0.079
Availability of documents	(AOD)	0.033
Quality of conformance	(QOC)	0.081
Cost of damage	(COD)	0.066
Quality of service	(QOS)	0.046

The relative importance of each of these attributes is given in table 2. From the analysis, it appears that the organisation 1 option is the best under the circumstan-

ces of the developed case study (tables 3, 4, 5). The reliability of the judgments supplied by the user can be estimated from the graphs (Figs. 2-4) that are generated between the principal vector for each alternative and its corresponding deciding criteria.

Table 3: Weightages of Attributes for Alternatives

Subcr	Wt. of Subcr. Level 3	Wt. of Criteria Level 2	ORG 1	ORG 2	ORG 3
ABA	0.275	0.234	0.539	0.297	0.164
ABC	0.467	0.234	0.639	0.274	0.087
EOM	0.151	0.234	0.092	0.201	0.707
SRT	0.106	0.234	0.619	0.284	0.096
PRF	0.091	0.175	0.131	0.192	0.677
ITF	0.164	0.175	0.092	0.201	0.707
PAF	0.183	0.175	0.623	0.239	0.137
INF	0.562	0.175	0.532	0.366	0.102
EMM	0.529	0.161	0.707	0.201	0.092
TPE	0.225	0.161	0.113	0.168	0.719
TPC	0.172	0.161	0.619	0.284	0.096
FWF	0.073	0.161	0.096	0.284	0.619
AVC	0.458	0.124	0.648	0.122	0.230
VES	0.324	0.124	0.118	0.201	0.681
AVM	0.138	0.124	0.102	0.366	0.532
TOD	0.079	0.124	0.174	0.103	0.723
DCR	0.074	0.079	0.118	0.201	0.681
VQA	0.118	0.079	0.715	0.187	0.098
ITD	0.176	0.079	0.539	0.164	0.297
SPM	0.283	0.079	0.532	0.102	0.366
FPT	0.348	0.079	0.098	0.334	0.568
DOW	0.090	0.033	0.096	0.251	0.653
CAR	0.115	0.033	0.118	0.201	0.681
DCV	0.272	0.033	0.701	0.213	0.085
QCR	0.523	0.033	0.532	0.366	0.102
CRS	0.436	0.081	0.098	0.334	0.568
CMS	0.335	0.081	0.619	0.284	0.096
SAR	0.150	0.081	0.343	0.575	0.082
AOC	0.079	0.081	0.532	0.366	0.102
DDS	0.440	0.066	0.532	0.366	0.102
DDT	0.318	0.066	0.113	0.168	0.719
OOW	0.156	0.066	0.103	0.174	0.723
IEF	0.086	0.066	0.619	0.284	0.096
PUN	0.440	0.046	0.118	0.201	0.681
FEE	0.318	0.046	0.156	0.620	0.224
ATC	0.156	0.046	0.092	0.154	0.755
COS	0.086	0.046	0.665	0.231	0.104

Table 4: Data Summary

Subcr.	ORG 1	ORG 2	ORG 3
ABA	0.035	0.019	0.011
ABC	0.070	0.030	0.010
EOM	0.003	0.007	0.025
SRT	0.015	0.007	0.002
PRF	0.002	0.003	0.011
ITF	0.003	0.006	0.020
PAF	0.020	0.008	0.004
INF	0.052	0.036	0.010
EMM	0.060	0.017	0.008
TPE	0.004	0.006	0.026
TPC	0.017	0.008	0.003
FWF	0.001	0.003	0.007
AVC	0.037	0.007	0.013
VES	0.005	0.008	0.027
AVM	0.002	0.006	0.009
TOD	0.002	0.001	0.007
DCR	0.001	0.001	0.004
VQA	0.007	0.002	0.001
ITD	0.008	0.002	0.004
SPM	0.012	0.002	0.008
FPT	0.003	0.009	0.016
DOW	0.000	0.001	0.002
CAR	0.000	0.001	0.003
DCV	0.006	0.002	0.001
QCR	0.009	0.006	0.002
CRS	0.003	0.012	0.020
CMS	0.017	0.008	0.003
SAR	0.004	0.007	0.001
AOC	0.003	0.002	0.001
DDS	0.015	0.011	0.003
DDT	0.002	0.004	0.015
OOW	0.001	0.002	0.007
IEF	0.004	0.002	0.001
PUN	0.002	0.004	0.014
FEE	0.002	0.009	0.003
ATC	0.001	0.001	0.005
COS	0.003	0.001	0.000

Table 5: Decision Index for the Desirability of Each Alternative

Decision Index of ORG 1	:	0.4323
Decision Index of ORG 2	:	0.2609
Decision Index of ORG 3	:	0.3068

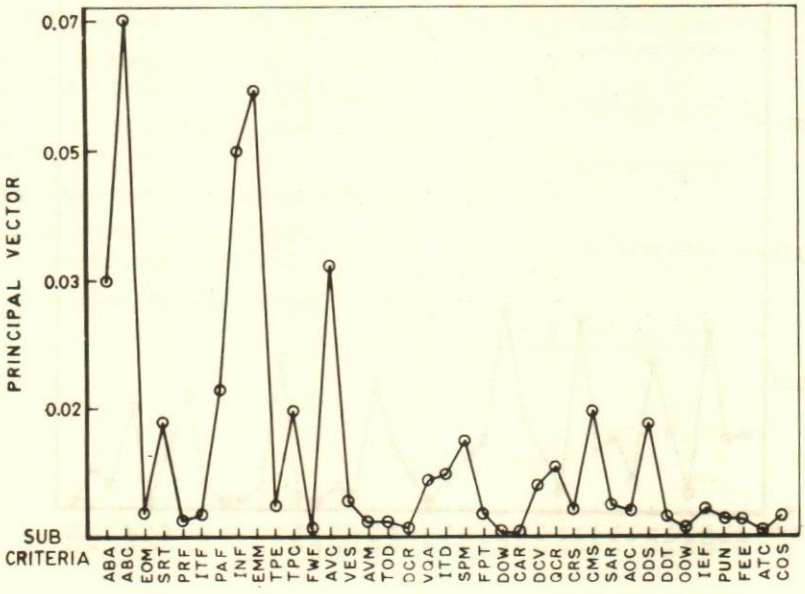

Fig. 2. Data Summary Graph
Alternative: ORG 1

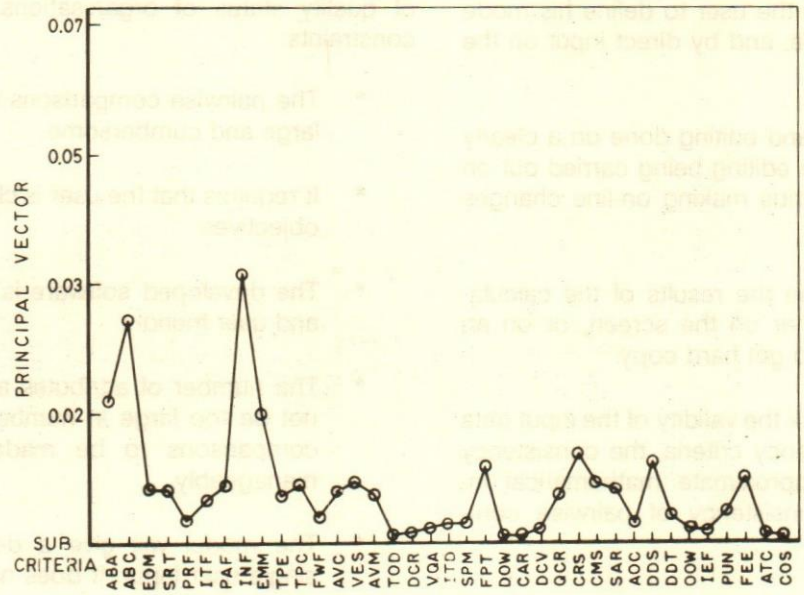

Fig. 3. Data Summary Graph
Alternative: ORG 2

Usefulness of the Model

The model has been developed for assessment of the quality status of organisations for the case study. The inputs to the model help to clarify the goals of the organisation as they require insights for constructive discussion. The following are the salient features of the model:

Feature

Marine Fishing Industry of Kerala: Recent Productivity Trends

Ramakrishnan Korakandy

The Marine Fishing Industry of Kerala which had witnessed a drastic fall in productivity during the major part of the last decade has registered some notable improvements in the current decade. This trend seems to be the result of a number of factors like improvement in the craft and gear used by the traditional fishermen, extension of fishing of further offshore areas and conservatory measures taken by the Government of Kerala since 1989. This paper seeks to present the main trends in productivity in major segments (craft-gear combinations of the industry) and their variation over the different coastal districts of the state.

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Productivity in the fishing industry is usually measured in terms of the catch-per-unit of effort (CPUE). Unit effort is defined as the unit labour time (man-hours) spent on fishing. The CPUE in this sense is the ratio of catch to the corresponding effort of labour and shows the relationship between the output of fish and the input of labour. It should, however, be noted that the CPUE is not really a measure of the contribution and efficiency of labour alone; it is actually the joint contribution of the various factors participating in the process of production. It is a measure of efficiency in general, reckoned in terms of one specific factor, labour. Labour is taken as the denominator, because it is the most convenient factor amenable for easy measurement. This measure, however, has the apparent bias of projecting one factor, labour when all other factors are playing equally important roles.

The alternative method is to take the catch per unit of operation or of a normal fishing trip[1]. This paper uses of term productivity in this sense[2].

Recent Trends in Productivity

Mechanised trawlers

Productivity of the coastal trawlers, which, now number about 4500, has shown significant improvement since 1989. Table 1 shows the catch, effort and CPUE of coastal trawlers for the period from 1985 to 1995.

Table 1 makes it clear that the CPUE which ranged between 227 kg and 287 kg during the period from 1985 to 1988 has increased to move between 334 kg and 494

1. The recent estimates of CPUE by Central Marine Fisheries Research Institute give this measure of productivity.
2. The value of price of the catch per unit of effort (value productivity) is, however, not taken into account in this discussion for practical difficulties of numerous computations and paucity of price data.

kg during the following years. The average CPUE increased from 265 kg during 1985-87 to 451 kg during 1993-95 marking an increase of 70 per cent[3]. The CPUE reached its peak during 1993 when it was 494 kg. Productivity remained above the 400 kg mark throughout the period since 1992. It may be noted that approximately 40 per cent of the catches were crustaceans and molluscs which are high valued species.

Table 1: Catch, Effort and CPUE of Coastal Trawlers

Year	Catch (Tonnes)	Effort (000 Units)	CPUE (Kg)	3-yearly moving average of CPUE
1985	97037	370	262	–
1986	115507	402	287	265
1987	143913	586	245	253
1988	196020	863	227	269
1989	199217	595	334	326
1990	221958	532	417	378
1991	212736	553	384	267
1992	248356	542	458	445
1993	299301	606	494	463
1994	317285	725	438	451
1995	215287	508	423	–

Source: CMFRI (Central Marine Fisheries Research Institute)

Table 1 also reveals that the fishing effort applied by the trawlers during this period was consistently high, ranging between 532000 units (trips) in 1990 and 725000 units (trips) during 1994. Fishing effort was slightly lower during 1995 when it was only 508000 units. Interestingly, the catch obtained by the sector shows a cumulative increase throughout the period since 1985 with only two exceptions during 1991 and 1995. It probably indicates that the sources of increase in productivity are qualitative changes in the fishing effort[4] and the fishing environment brought about by favourable weather conditions and the ban on monsoon trawling[5].

3. The time trend was found to be positive with value of 'r' being 0.84 and coefficient of 'b' at 0.0305.

4. It is reported that the coastal trawlers have begun to move to deeper waters since the conflict between the traditional fishermen and the mechanised trawlers have became intense and the inshore areas are reserved exclusively for the traditional fishermen. These vessels are also now better equipped with new gear designs and fine nets.

5. The period since 1989 is reported to be favourable characterised by good monsoon and satisfactory discharge to the sea leading to optimum ecological condition for good fishing. The period also witnessed the imposition of a ban on trawling during monsoon which avowedly is the breeding season for many pelagic varieties of fish caught in the seas off Kerala.

Mechanised gill netters

Productivity of the mechanised gill netters was found to be considerably lower than that of the trawlers. It was just 118 kg per unit of operation in 1994 and 128 kg in 1995. The fishing effort applied by these vessels during this period was also found to be quite small a mere 8316 units in 1994 and 10955 units in 1995. The corresponding catches were 985 tonnes and 1380 tonnes respectively. The predominant catches of these vessels are, however, the high valued pomfrets and seer fishes.

Mechanised hook and line fishery

Productivity of the mechanised Hook and Line fishing units is found to be superior to that of the gill netters. The CPUE was 265 kg in 1994 and 237 kg in 1995. The corresponding catch and effort were, however, less. They were 852 tonnes and 3211 units respectively for 1994 and 956 tonnes and 4033 units respectively for 1995. The dominant catches of this sector are, however, medium priced species like sharks, rays and catfishes.

Purse-seine fishery

Productivity of the purse-seine fishery is apparently the highest. The CPUE was 1648 kg in 1994 and 2573 kg in 1995. The purse-seine fishery which is legally banned in the inshore waters in the state is still carrying out operations on a limited scale from Cochin. The fishing effort applied by the sector was 3744 units in 1994 and 1643 units in 1995, bringing a total catch of 6160 tonnes and 4228 tonnes respectively during the two periods. The predominant catches of the purse-seine fishery are sardines, mackerels, anchovies, etc.

Motorised ring-seine fishery

The traditional sector, which has gone in for large scale motorisation and other technological changes in fishing gear and equipments has witnessed remarkable improvements in productivity during recent years. The ring seine fishery which is the adaptation of purse-seining by country crafts using outboard engines, has shown considerable improvements since 1986. Table 2 shows the catch, efforts and CPUE of the ring seine fishery from 1986 to 1995. There has been a sharp increase in the CPUE of the sector from 1989 onwards, which coincides with the period of general improvement in productivity noted in the case of trawlers, earlier. Productivity rose to its first peak at 1031 kg in 1990, which came down to a low in 1993 at 581 kg and climbed again to reach a high level at 1117 kg in 1995. Productivity increased from an average of 601 kg during 1986-88 to 801 kg

This improvement seems to be the result of a number of factors like the modifications made in the craft and gear used by the fishermen, the extension of fishing to further offshore regions, the conservation measures taken by the Government of Kerala and the favourable weather conditions obtained during this period.

the lead. The trawl fishery, the hook and line fishery and the gill-net fishery maintained productivity in this order.

In the motorised sector, productivity continued to the highest in the ring-seine fishery, followed by the boat-seines and mini-trawlers. Productivity was found to be low in the motorised gill net, disco net and hook and line fisheries.

Productivity in the pure traditional (non-motorised) sector was comparatively low with the boat-seines, shore seines and other seines showing slightly better positions. Productivity was extremely low in the case of hook and line, gill net and cast net fishing.

Among the districts, Alleppey, Ernakulam, Trichur, Malappuram and Kozhikode are found to show relatively high levels of productivity during 1994 and 1995. The two southern and two northern districts were showing comparatively low levels with the least in Trivandrum district exhibiting the least level. In Trivandrum, the fishermen are trying to build up the resource base by constructing artificial fish habitats. In the process, they are also trying to introduce new institutions favouring privatisation, and 'communalisation' of ownership of the seas off their coast. Its ramifications are, however, not fully understood by the fishermen of the region.

Acknowledgment

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Feature

Policy Modelling for Fertiliser Subsidy in India Using System Dynamics

B.S. Sahay, Prem Vrat & P.K. Jain

Fertiliser subsidy is a growing concern in India. While the Government faces the growing burden of fertiliser subsidy in the budget, the fertiliser manufacturers are scared of subsidy withdrawal and farmers are worried about the consequent price increase. The paper attempts to examine different policies regarding fertiliser subsidy on indigenous and imported nitrogenous fertilisers and suggests its withdrawal in a phased manner to ensure increased availability of fertilisers to farmers at affordable prices on the one hand, and reasonable return on investment and healthy development and growth of the fertiliser industry, on the other.

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India has made great strides in the development of fertiliser industry and ranks as the fourth largest producer in the world. The country has acquired self-reliance in the field of agriculture. Achieving self-sufficiency in food has indeed been a formidable task and sustaining it is going to be more challenging in view of growing population in India (Desai, 1991; GOI, 1990). The Government has been conscious of its responsibility in this regard. It has created adequate indigenous fertiliser capacity and ensured its efficient utilisation with a view to meeting the increasing demand, to the extent possible, through increased domestic production and availability of fertilisers. Availability of fertiliser has been made possible due to appropriate pricing policy, containing the subsidy element for fertiliser industry. This process of pricing is referred to as the Retention Price System (RPS) which has been in vogue for more than a decade. However, the mounting subsidy is causing great concern to the Government in the context of the changed economic environment. In this context, while the industry is scared of its withdrawal, farmers are worried about the price increase of fertiliser. If the consumer price is allowed to be raised in tune with the increasing input cost, the demand is likely to be affected. If not, then production could suffer, once again affecting the demand of fertiliser. Hence there exists the dire need for balance amongst these three important issues.

Fertiliser Price

The consumer prices of fertiliser are fixed by the Government under the provision of the Essential Commodities Act, 1955, in order to make fertilisers available to the farmers at uniform prices throughout the country. These prices were deliberately kept low and steady for long periods. The selling price of urea which was Rs. 2,350 per tonne in July, 1981 remained at the same level till July, 1991 save for a brief period between June 1983 and January 1986 when it was reduced to

taken out from the net of subsidy w.e.f. 25th August, Paton, 1986; Roberts, 1983).

Rs. 2,150. In July 1991, the price was increased to Rs. 3,300 per tonne which was reduced to Rs.3,160 in August 1991. By August 1992, the price was

location of the plant. In fact, the ratio between the lowest retention price and highest retention price of urea has been as much as 1:2 (Gulati & Sharma, 1990;

The obective of system dynamics study is to attain some desired goals through modifications of the system. For this a system boundary is defined and a model of the system is built. The systematic procedural steps in SD modelling include the following (Bora et al., 1990; Forrester, 1961; Sahay, 1994):

- Define the problems to be solved and goals to be achieved.
- Describe the system with a causal loop/influence diagram.
- Formulate the structure of the model, i.e., develop the flow diagram for systematising symbols, arrow designator and the format of system dynamic modelling in the form of DYNAMO equations.
- Collect the initial data needed for model operation either from historical data and/or from discussion with the executives/planners having knowledge and experience of the system under study. These are the initial values of all the level variables, constants policy data, multipliers delay constants, table functions.
- Validate the model on some suitable criteria to establish sufficient confidence in the model.
- Use the model to test various policy actions to find the best way to achieve prescribed goals.

Causal loop diagram characterises the initial view of the problem and serves the purpose of communication between the modeller and the policy maker. However, the formulation of an operational model of the system is based on more specific structural details, like rates or policy variables, accumulation or level, auxiliaries, constants, information flows and delays. Flow diagrams represent such details and specific aspects of the model-structure (Forrester, 1961; Pugh & Paton, 1986; Roberts, 1983). The model structure leads to a simple system of equations that suffice for representing the information feedback systems. The equations show how to generate the system conditions for a new point in time, given the conditions of the model which are evaluated repeatedly to generate a sequence of steps equally spaced in time. The time interval between solutions is relatively short, determined by the dynamic characteristics of the real system which is being modelled (Forrester, 1961).

Special computational aids and software package help simulation calculations of the system dynamics models. The DYNAMO compiler developed at MIT, USA and the DYSMAP compiler developed at the Management Centre of University of Bradford, are the two most widely used compilers for simulating system dynamics models. Professional DYNAMO Plus compiler by Pugh-Robert Associates is the most popular on micro-computers (Pugh & Paton, 1986).

System Dynamics Model for Fertiliser Subsidy

Subsidy is given on both indigenous and imported fertilisers. Subsidy on indigenous fertiliser depends on the retention price, consumer price, dealers' margin and transportation expenses. In turn, retention price depends on the type of feedstock used, technology, vintage of the plant, actual production and capacity utilisation, etc. Similarly, for imported fertiliser, subsidy depends on landed price, pool handling expenses, dealers' margin etc. Inflation has a significant bearing on subsidy whether it is given on indigenous or imported nitrogenous fertilisers. Feedstock for nitrogenous fertilisers are naptha, natural gas, external ammonia, coal, fuel oil, etc. All these issues and variables/parameters are interlinked to develop the pricing and subsidy model.

The model starts with the causal loop diagram followed by the flow diagram for fertiliser demand and related areas. The demand model consists of 9 level variables, 12 rate variables, 95 auxiliary variables, etc. The causal loop diagram, drawn after detailed discussions with fertiliser experts, economists, practising executives and academicians is shown in Fig. 1. The parameters which are interacting with each other forming loops in the models are identified, and the interactions are shown. The causal loop for the above mentioned model is converted into a flow diagram with the help of level variables, rate variables, auxiliary variables, exogenous variables and constants. Based on the flow diagram, different dynamo equations are formulated to develop the model. The model is run on computer using DYNAMO plus compiler and simulated for 20 years upto 2001 AD with 1980-81 as base year (Bumb, 1992; Coyle, 1979; Desai, 1991; Fertiliser Statistics 1980-94). The model is validated qualitatively and quantitatively in order to project the future on longer time horizon (GOI, 1990; Sethi, 1991). Finally, these insights are used for policy experimentation to generate different scenarios about the national economy for fertiliser sector.

Policy Experimentation

The basic purpose for SD modelling is to help choose the path(s) for economic development at the national level and organisational growth at the company level (Sahay et al., 1993). It is made feasible as the SD models present the different courses of action

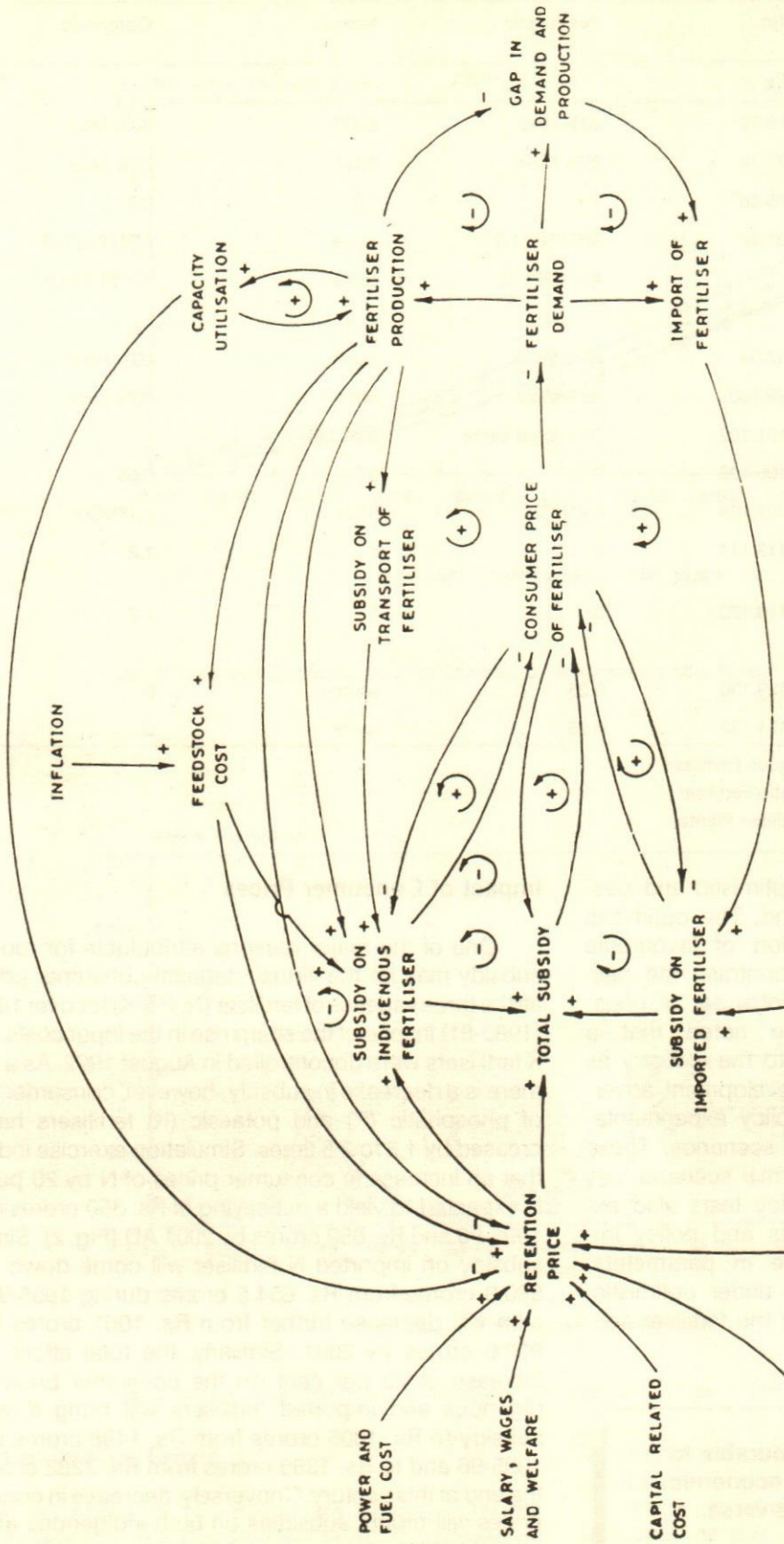

Fig. 1. Causal Loop Diagram for Pricing and Subsidy Model for Fertiliser Sector

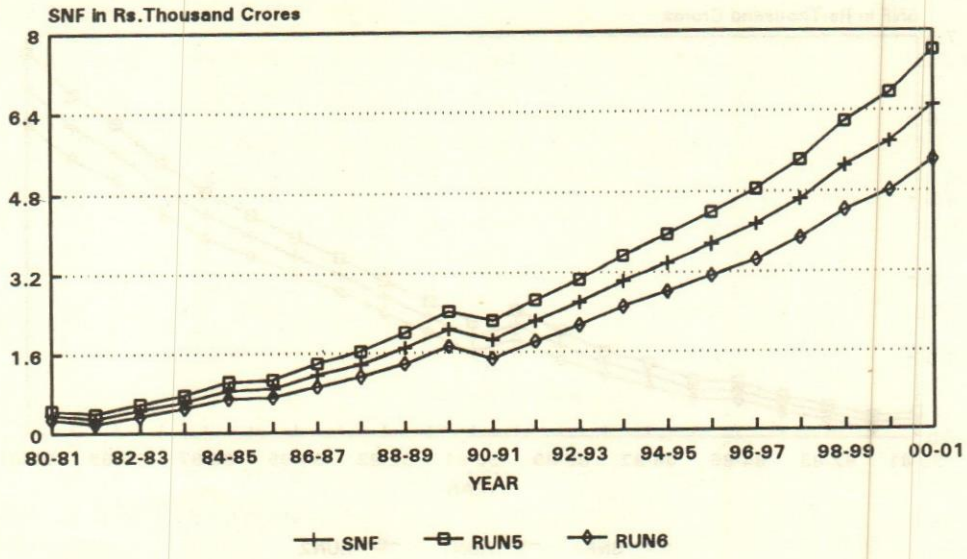

Fig. 4. Impact of Retention Price on Subsidy on Indigenously Mfd. N Fert. under Different Scenarios

Increase in landed price will, obviously, entail additional burden on the exchequer in terms of more subsidy.

entail additional burden on the exchequer in terms of more subsidy.

Impact of Retention Prices

The retention price has a direct bearing on subsidy. There are many factors which affect retention prices, e.g., feedstock cost, capacity utilisation, vintage of plant, technology etc. Efforts have been made to analyse the effect of retention price on the subsidy on nitrogenous fertiliser (N). As shown in Fig. 4, ten per cent change in retention price enables the exchequer to save Rs. 569 crores on N during 1995-96 and Rs. 1092 crores by the end of this century. However, when the retention price is not contained but is increased by 10 per cent, the subsidy is likely to jump to Rs. 1092 crores by 2001 as shown in Fig. 4.

Combined Impact

This policy is tested to see the combined effect of retention price and consumer price on subsidies regarding indigenous fertilisers. As shown in Fig. 5, 20 per cent increase in consumer prices and 20 per cent decrease in retention price of N fertiliser has an appreciable impact on subsidy. In fact, subsidy goes down to Rs. 1758 crores during 1995-96 and Rs. 3410 crores by the end of the century including subsidy on transportation. However, increase of 20 per cent in retention prices and reduction of 20 per cent consumer prices will result in a steep rise in subsidy by the end of the century, i.e., Rs. 4997 crores during 1995-96 and Rs. 9599 during 2001 as shown in Fig. 5. Thus, it is obvious that increase in consumer prices and decrease in retention prices could have effected control on rising subsidy.

Increase in consumer prices and decrease in retention prices could have effected control on rising subsidy.

Impact of Feedstock Cost

Policy testing of feedstock is of great importance particularly when the prices of feedstock for N (natural gas and naptha) are administered. There are a number of feedstocks used for the production of N fertilisers. For policy testing, we centre our discussion on major

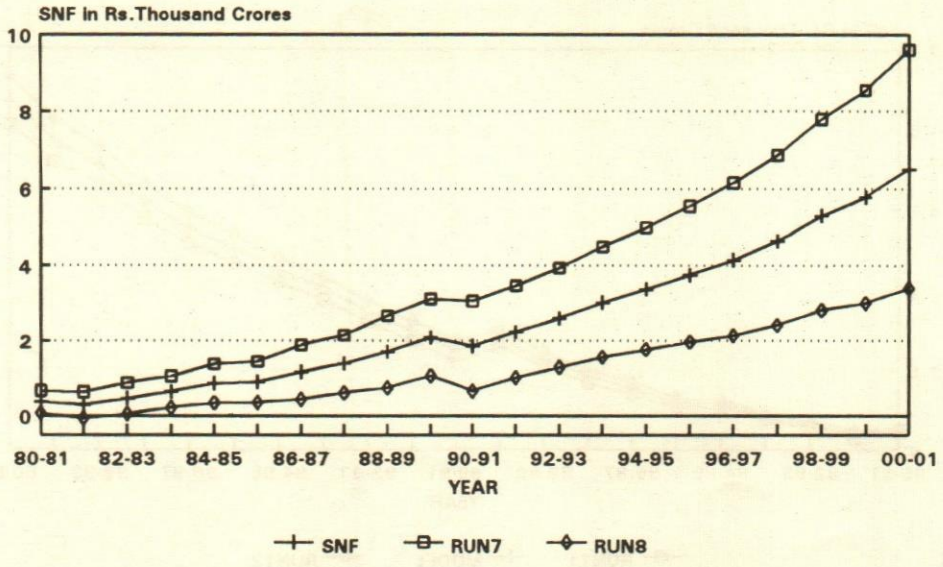

Fig. 5. Impact of Retention Price and Consumer Price on Subsidy on Mfd. N Fert. (SNF) under Different Scenarios

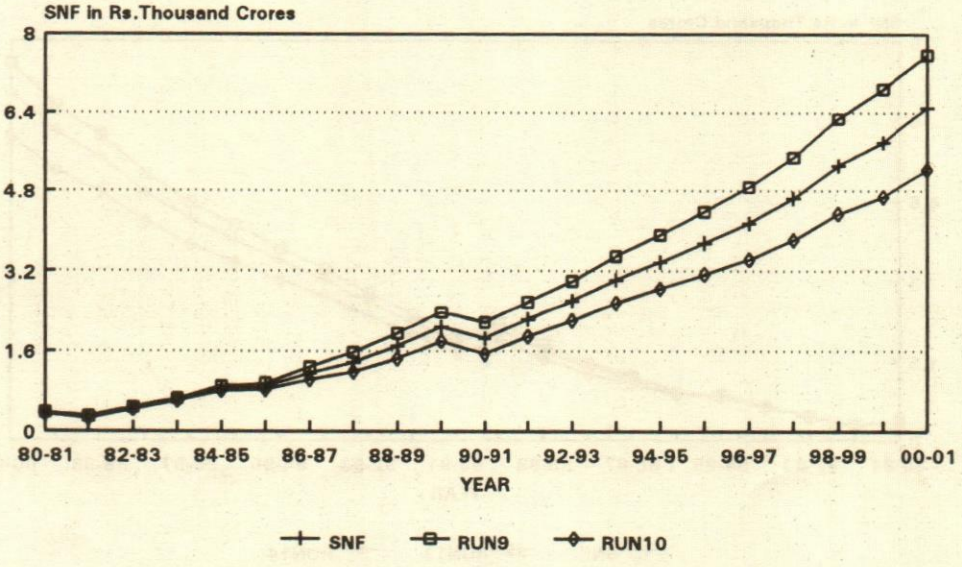

Fig. 6. Impact of Feedstock cost of Mfd. Nitrogenous Fertiliser on Subsidy (SNF) under Different Scenarios

feedstocks used in the production of N. The model shows that 20 per cent cut in the prices of natural gas and naptha is likely to save subsidy to the tune of Rs. 1282 crores by 2001 as shown in Fig. 6.

Impact of Inflation Rate

Consumer prices of fertilisers were kept almost constant, in the past, for more than 10 years, not-

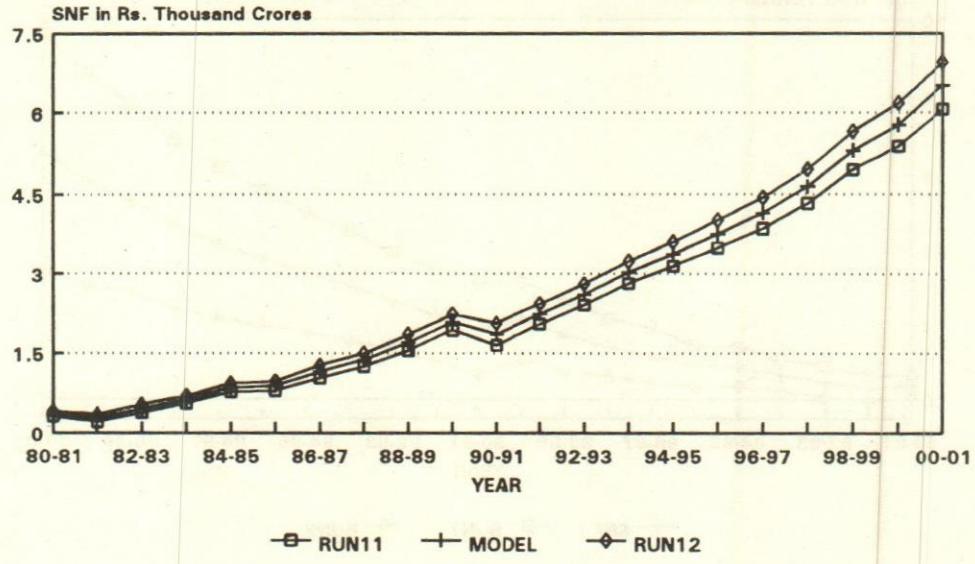

Fig. 7. Impact of Capacity Utilisation of N Plant on Subsidy on N Fertiliser (SNF) under Different Scenarios

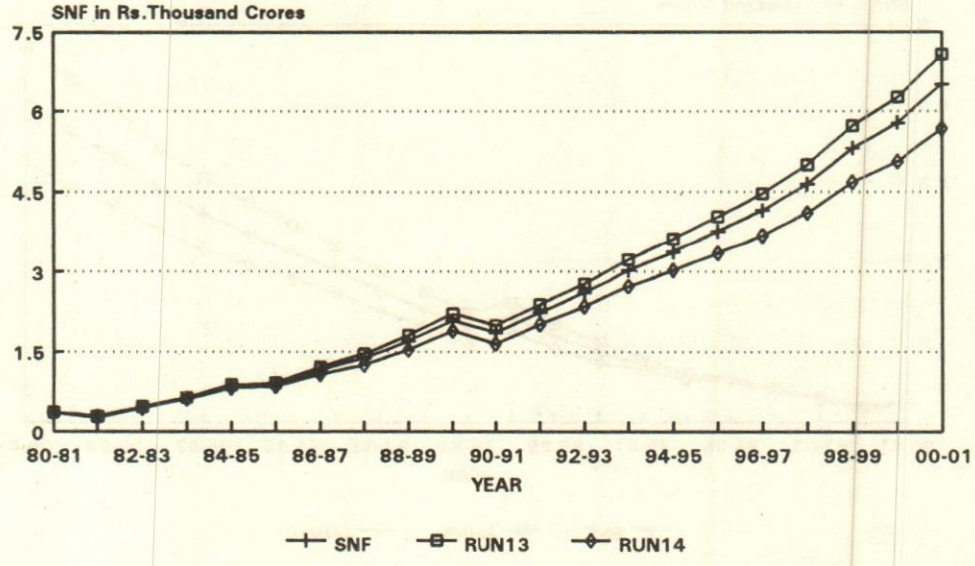

Fig. 8. Impact of Royalty and Import Duty on Subsidy on Mfd. N Fertiliser under Different Scenarios

withstanding general rise in prices. This is one of the basic reasons for mounting subsidy. If the inflation rate dips by just 1 per cent, a saving of Rs. 2200 crores may be made on subsidy by 2001. In sharp contrast, 9 per cent inflation is likely to entail an additional burden of Rs. 6030 crores as the subsidy will zoom to a new height of Rs. 18830 crores by the end of the century.

Impact of Capacity Utilisation

Plant operation has a significant bearing on retention price and, in turn, on subsidies. Policy testing is done under both pessimistic and optimistic situations to see the impact on capacity utilisation. Policy test is carried out with 10 per cent change in capacity utilisation. The model reveals that capacity utilisation is negatively correlated to subsidy i.e, when capacity utilisation is more, subsidy burden is less or vice- versa as shown in Fig. 7. If capacity utilisation is increased by 10 per cent subsidy saving is likely to be of the order of Rs. 231 crores during 1995-96. The figure is likely to be at Rs. 442 crores by 2001.

Impact of Royalty & Import Duty

Government is charging 15 per cent royalty on natural gas to gas based nitrogenous plants in addition to transportation cost. In this context, the policy has been tested under two extreme conditions—when royalty is increased by 10 per cent and when it is reduced to zero. If the Government decides to waive royalty on feedstocks, saving on subsidy is likely to be to the tune of Rs. 1357 crores. However, if royalty is increased to 25 per cent, subsidy will be affected adversely as shown in Fig. 8.

Recommendations & Conclusions

By the end of the century, fertiliser demand will increase to 17.61 million tonnes (nitrogenous, phosphatic and potassic fertilisers demand being 11.36, 4.40 and 1.85 million tonnes respectively) and the likely production being 12.7 million tonnes (9.25 million tonnes of nitrogenous fertiliser and 3.45 million tonnes of phosphatic fertiliser), there will be a wide gap to be met by imported fertilisers. It is suggested that too much dependence on imported fertilisers should be avoided to save foreign exchange and overcome problems of its uncertain and erratic supply. Efforts should be made to augment indigenous production. There is a need for a two-pronged strategy in terms of improving the capacity utilisation of the existing units on the one hand and creating additional capacities including modernising/retrofitting the existing fertiliser units on the other.

Subsidy on nitrogenous fertiliser should continue and its withdrawal is suggested only in a phased and planned manner. As the subsidies on phosphatic and potassic fertilisers are withdrawn, the expected total subsidy on nitrogenous fertiliser is estimated at a staggering sum of Rs. 4450 crores during 1995-96 and Rs. 8076 crores by 2001. Likewise, subsidy on indigenously manufactured nitrogenous fertiliser is estimated at Rs. 3795 crores during 1995-96 and Rs. 7015 crores by the beginning of 21st century. Similarly, subsidy on imported N fertiliser would be Rs. 654 crores during 1994-95 and Rs. 1061 crores by 2001-02 AD.

That the withdrawal of subsidy will adversely affect the demand for nitrogenous fertiliser needs no emphasis. In the case of nitrogenous fertiliser it is estimated that the decontrolled price of nitrogenous fertiliser, subsequent to removal of subsidy, will shoot up to more than Rs. 5000 per tonne during 1994-95. Since such a price is obviously likely to adversely affect its use, the following recommendations are made to overcome this situation.

- Since the prices of feedstocks for nitrogenous fertiliser are administered, these should be preferably freezed for at least five years. This apart, Government should consider slashing down the prices of natural gas by at least 30 pr cent, transportation cost of natural gas by 50 per cent from the prevailing rate and complete waiver of royalty of 15 per cent levied on natural gas. These reductions will bring down the input costs and hence are likely to check the price rise of fertilisers.
- It is also suggested that power tariff and railway freights for transporting fertiliser and feedstock be reduced.
- All taxes levied by Central and State Governments on fertilisers, feedstocks, spares and machineries etc. should be removed/substantially reduced.
- Fertiliser industry should be asked to improve their plant operation in order to bring down the average retention prices both in the case of nitrogenous and phosphatic fertiliser plants. Those units whose retention prices are more than the average retention price projected in the model should undergo immediate modernisation to make themselves viable.
- To phase out the subsidy element in a gradual manner, it is suggested that the price of nitrogenous fertiliser should be increased by at least 20 per cent every year for the next five years. This will bring the consumer price in tune with the retention price.
- Balanced and proper use of fertiliser should be encouraged. This is possible through awareness programmes organised jointly by the Government and the industry for the benefit of the farmers.

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Feature

Women Entrepreneurs in Assam: A Profile

Monica Banerjee & R.K. Talukdar

A study was conducted in Assam to analyse the profile of women entrepreneurs engaged in agricultural enterprises. Also, the characteristics of women belonging to 'high' and 'low' categories of extent of entrepreneurship were compared. The authors draw conclusions from the results of the study and present policy directions.

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An entrepreneur is one who undertakes to organise, own and run an enterprise (Mohiuddin, 1993, p. 2). An entrepreneur is also one who wants to set up a commercial venture on his/her own with determination, zeal, enthusiasm and with basic knowledge of the business he/she wants to set up; and above all he/she is willing to take risks on his/her own (Goswami, 1996, p. 4). The essence of entrepreneurship rests in creating something new (Selvam, 1992). A woman entrepreneur is an adult, innovative woman who undertakes to organise, own and run an enterprise, especially a commercial one, often at personal financial risk.

The concept of 'women as entrepreneurs' is becoming a global phenomenon today. All over the world, women are playing a vital role in the business community. In India, however women have made a comparatively late entry into the business scenario mainly due to the orthodox and traditional socio-cultural environment. But in the North-Eastern region, which includes Assam as well, it is the woman who has been enjoying a special status in the society. Although women entrepreneurs face various problems in the process of establishing, developing and running their enterprises, nevertheless, their scope of development is very high in Assam with more women making deliberate entry into this field. A study was undertaken to analyse the emerging profile of women entrepreneurs in Assam, as an outcome of their awareness towards their role.

Methodology

The study was conducted in four purposively selected districts—Kamrup, Sonitpur, Jorhat and Dibrugarh having comparatively more number of women entrepreneurs. Women running agricultural enterprises like nursery raising, cut flowers and potted plants raising were purposively selected for the study owing to the vast potential of these units for flourishing in the state. Out of 80 such women entrepreneurs, 60 of them were selected randomly as respondents. Data were collected by personal interview technique with the help of a questionnaire. The frequency, percentages,

Table 1: Operational Definition and Measurement Technique of Independent Variables

Variable	Indicator	Measurement technique	Scoring technique
Age	Chronological years	Questionnaire	1 score for each completed year
Education	Formal education received	- do -	Trivedi and Pareek (1963) with slight modification
Family type Nuclear/joint	- do -	–	
Total annual income of the family	Total earnings of family members form all sources in a period of one year	- do -	1 score for each Rs. 1000 rounded off
Place of residence	Rural/Urban	- do -	–
Source of finance	Banks and other financial institutions/friends and relatives/no outside source	- do -	–
Source of labour	Hired/not hired	- do -	–
Job involvement	Psychological identification with job (Lodahl and Kejner, 1965)	Job involvement scale (Lodahl & Kejner, 1965; Kalita, 1991)	Max. Score = 68 Min. Score = 0
Role conflict as a housewife	Incongruity of expectations associated with a role (Sell et al., 1981, P. 43)	Role conflict scale (Rizzo et al., 1970)	Max. Score = 88 Min. Score = 0
Role conflict as an entrepreneur	- do -	- do -	- do -
Achievement motivation	Concern to excel	Scale developed r_{tt} = 0.91	Max. Score = 80

mean, coefficient of variance and Fisher's 't' were used to analyse and draw conclusions from the data.

Independent variables & their measurement

After a thorough review of literature on the profile of women entrepreneurs (Kalita, 1991; Lodhal & Kejner, 1965) and discussions with behavioural scientists, 11 factors were selected. Table 1 presents their operational definitions and measurement techniques in brief.

Measurement of extent of entrepreneurship

Extent of entrepreneurship has been operationalized as the extent of qualitative and innovative activities carried out by a woman entrepreneur in her respective enterprise to increase production spontaneously, where her activities are also a manifestation of internal mental events and processes. On the basis of review of literature (Sell et. al, 1981; Rizzo et. al 1970; Trivedi & Pareek, 1963) and discussion with behavioural scientists, a few dimensions of entrepreneurship were identified. The dimensions selected were knowledge about the enterprise, attitude towards the enterprise, reason for venturing into entrepreneurship, market strategy (in terms of distribution channel, consumer segmentation, price fixing criteria), forward integration (in terms of promotional activities and special arrangements), need for achievement, need for influencing others, need for independence, risk taking calculation, problem recognition ability, managerial ability, decision making ability and position of enterprise in life.

The extent of entrepreneurship was calculated as the per cent of total sum of scores obtained by the respondent on each of the above 13 dimensions of entrepreneurship.

On the basis of scores obtained under 'extent of entrepreneurship' by the respondents, the top 25.00 per cent and bottom 25.00 per cent were identified and put separately under HIGH (high extent of entrepreneurship) and LOW (low extent of entrepreneurship) groups, respectively. The individual scores on various socio-economic and psychological characteristics, taken as independent variables, were computed against the individual scores on the extent of entrepreneurship of HIGH and LOW groups and the dominant characteristics were identified.

Results & Discussion

Profile of the women entrepreneurs

The distribution of the respondents on the basis of their socio-economic and psychological characteristics is presented in table 2.

Table 2: Distribution of Respondents according to their Socio-economic and Psychological Characteristics

n = 60

Variable	Categories	Score/Income range	f	%
Age	Young	up to 35 years	6	10.00
	Middle aged	35 - 50 years 50	26	43.34
	Old	50 years & above	28	46.66
Education	No education	0	0	0.00
	up to primary	1	0	0.00
	up to middle	2	2	3.34
	high school	3	12	20.00
	higher secondary	4	23	38.33
	graduate & above	5	23	38.33
Family type	Nuclear	–	40	66.67
	Joint	–	20	33.33
Total annual income of the family	Lower income gr.	Rs. 50000-110000	15	25.00
	Middle income gr.	Rs. 110000-170000	20	33.33
	Higher income gr.	Rs. 170000-210000	25	41.67
Place of residence	Rural	–	5	8.33
	Urban	–	55	91.67
Source of finance	Banks & other financial institutions	–	10	16.67
	Friends and relatives	–	2	3.33
	No outside source	–	48	80.00
Source of labour	Hired	–	28	46.67
	Not hired	–	32	53.33
Job involvement	Low	32 - 46	12	20.00
	Medium	47 - 56	35	58.34
	High	57 - 66	13	21.66
Role conflict as entrepreneur	Low	21 - 29	33	55.00
	Medium	30 - 35	15	25.00
	High	36 - 41	12	20.00
Role conflict as housewife	Low	21 - 29	44	73.33
	Medium	30 - 35	11	18.33
	High	36 - 41	5	8.33
Achievement motivation	Low	46 - 60	19	31.67
	Medium	61 - 70	20	33.33
	High	71 - 80	21	35.00
Extent of entrepreneurship	Low	50 - 66	16	26.67
	Medium	66 - 78	29	48.33
	High	78 - 90	15	25.00

Age: Majority of the respondents were above 50 years of age (46.66%). The mean age was 47.9 having a range 25-67 which suggests that respondents on an average belonged to the middle aged category. The coefficient of variance (16.91) was very low which suggests that the sample was highly homogeneous with regard to age. The table reveals that entry of young women (35 years and below) into the field of agro-entrepreneurship is less.

Education: Majority of respondents had a good educational background with 76.66 per cent having either a higher secondary or graduation degree.

Family type: A majority (66.67%) hailed from nucleous families.

Total annual income of the family: Majority of the respondents (41.67%) belonged to the higher income

group with annual income ranging from Rs. 1,70,000 to Rs. 2,10,000. The mean total annual income of the family was Rs. 1,37,700 having a range of Rs. 50,000 to Rs. 2,10,000 which suggests that the families of the respondents on an average belonged to the middle income group. The high coefficient of variance (41.67) suggests that the sample was heterogeneous with regard to total annual income of the family.

Place of residence: 91.67 per cent of the respondents belonged to urban areas.

Source of finance: A majority (80.00%) of women entrepreneurs did not go in for outside source of finance. In other words they had to put in their own finance for establishing their enterprises.

Source of labour: A majority (53.33%) did not hire any labour from outside, though a closely followed 46.67 per cent did engage hired labour which is a desirous feature for turning the enterprise from cottage type to a full scale commercial venture.

Job involvement: Majority of respondents (58.34%) had medium level of job involvement. The mean job involvement score was 50.13 having a range of 32-66. The coefficient of variance was low (18.05), which suggests that the sample was homogeneous with regard to job involvement.

Role conflict as entrepreneur: Majority of respondents (55.00%) faced little conflict in their role as an entrepreneur. The mean role conflict as entrepreneur was 29.13 having a range of 21-41 which suggests that respondents on an average faced little role conflict. The coefficient of variance value was low (19.05) which suggests that the sample was homogeneous.

Role conflict as housewife: Majority of respondents (73.33%) faced low conflict in their role as a housewife. The mean was found to be 27.21 having a range of 21.41. The coefficient of variance (16.50) was low which suggests that the sample was homogeneous.

Achievement motivation: Majority of respondents had a great extent of achievement motivation with 68.33 per cent falling in the high and medium categories of achievement motivation. The mean achievement motivation was 61.85 having a range of 46.80, which suggests that respondents on an average had a medium extent of achievement motivation. The coefficient of variance was low (12.19), which indicates that the sample was highly homogeneous.

Extent of entrepreneurship: Although a majority of entrepreneurs had a great extent of entrepreneurship (73.33% under high and medium categories), it is a matter of concern that a good many women scored quite low on the extent of entrepreneurship (26.57%). The mean was 70.60 having a range of 50-90, which indicates that the respondents on an average had medium extent of entrepreneurship. The coefficient of variance was low (12.96) which suggests that the sample was highly homogeneous.

Profile of 'high' and 'low' group entrepreneurs

Fisher's 't' was used to test the significance of the mean difference in the extent of entrepreneurship between 'HIGH' and 'LOW' group respondents (table 3).

Table 3: Testing for significance of mean difference of extent of entrepreneurship

Group	Mean value	't'
HIGH (n_1 = 15)	224.46	15.75**
LOW (n_2 = 15)	159.40	

** = Significant at 1 per cent and 5 per cent level of probability

As the calculated value of 't' (15.75) was much higher than the table value with 28 degrees of freedom at 5 per cent and 1 per cent probability level, it can be said that the mean values of the extent of entrepreneurship in both the groups differed significantly with each other.

To test the significance of differences in mean, if any, for the various socio-economic and psychological characteristics (age, education, total annual income of the family, job involvement, role conflict as an entrepreneur and a housewife, achievement motivation) between the HIGH and LOW groups of entrepreneurs, Fisher's 't' test was used (table 4).

Table 4: Testing for significance of mean differences of selected characteristics

Variable	Mean values		't'
	HIGH Gr. (n_1 = 15)	LOW Gr. (n_2 = 15)	
Age	50.00	45.90	1.117
Education	4.20	4.00	0.550
Total Annual Income of the family	171.60	95.60	6.84 **
Job Involvement	56.20	44.07	4.48 **
Role conflict as an entrepreneur	24.50	32.60	3.879**
Role conflict as a housewife	23.40	27.40	3.549**
Achievement motivation	71.00	58.50	6.439**

** Significant at 1 per cent and 5 per cent probability levels

On the basis of 't' values, it was found that the respondents did not differ in the extent of entrepreneurship because of differences in age and education as their mean age and mean education values did not differ significantly (t = 1.117 and t = 0.50, respectively). The variables role conflict as an entrepreneur and as a housewife had significant differences in mean values (t = 3.879 and t = 3.549, respectively). On the basis of mean values, it can be interpreted that entrepreneurs low on the extent of entrepreneurship faced more conflicts in their roles as an entrepreneur and as housewife. The variables achievement motivation, total annual income of the family and job involvement also might have caused the differences in the extent of entrepreneurship as their mean differences were significant (t = 6.439, t = 6.84 and t = 4.48, respectively). On the basis of mean values, it can be interpreted that entrepreneurs with high achievement motivation, high job involvement and high family annual income showed a high extent of entrepreneurship.

Entrepreneurs with high achievement motivation, high job involvement and high family annual income showed a high extent of entrepreneurship.

For the other characteristics, viz., family type, place of residence, source of finance and source of labour, simple frequency distribution of HIGH and LOW group respondents was done based on the characteristics (table 5).

It was found that with 60.00 per cent of HIGH group respondents having a joint family system and all the LOW group respondents belonging to nucleous families, joint family system definitely has a positive affect on the extent of entrepreneurship probably due to more responsibility sharing among members, more available family labour and more economic and social security.

Joint family system definitely has a positive affect on the extent of entrepreneurship probably due to more responsibility sharing among members, more available family labour and more economic and social security.

With 53.33 per cent of HIGH group respondents approaching the banks and other financial institutions for finance while none of the LOW group respondents doing so, it can be said that the determination to run their businesses truly on commercial lines is more with respondents having high extent of entrepreneurship. Thus, searching for finance from institutional sources makes a lot of difference in the extent of entrepreneurship.

With 93.33 per cent of HIGH group respondents and 100.00 per cent of LOW group respondents concentrated in urban areas only, it can safely be said that the very word 'entrepreneurship' has some significant association with urban areas or cities where, probably, presence of certain factors makes enterprises under study to flourish there only but, with the sample (n = 60) having only 8.3 per cent respondents from rural areas, it is difficult to interpret the effect of place of residence on the extent of entrepreneurship, whether high or low.

The fact of 100.00 per cent of HIGH group respondents going in for hired labour as against only 6.67 per cent of LOW group respondents suggests that in spite

Table 5: Distribution of respondents of high and low groups according to their family type, source of finance, place of residence and source of labour

Variable	Categories/Sources	Frequency		Percentage	
		HIGH Gr.	LOW Gr.	HIGH Gr.	LOW Gr.
Family type	Nuclear	6	15	40.00	100.00
	Joint	9	0	60.00	0
Source of finance	Banks and other financial institutions	8	0	53.33	0
	Friends and relatives	0	0	0	0
	No outside source	7	15	46.67	100.00
Place of residence	Urban	14	15	93.33	100.00
	Rural	1	0	6.67	0
Source of labour	Hired	15	1	100.00	6.67
	Not hired	0	14	0	93.33

of living in joint families (60.00% in case of HIGH group respondents), where available family labour is more, the HIGH group respondents have gone in for hired labour which shows that these respondents had expanded businesses being run on truly commercial tracks.

Summary & Conclusion

It was found that the majority of respondents were above 50 years of age, had a good educational background, belonged to higher income group families having Rs. 1,70,000 to Rs. 2,10,000 as annual income, were concentrated in urban areas, used or invested their own source of finance, were more keen on using own and family labour, were involved in their jobs to a great extent (80.00% in medium and high categories), faced less conflict as entrepreneurs and as housewives, had achievement motivation to a great extent (68.33% in medium and high categories) and possessed a great extent of entrepreneurship (73.33% in medium and high categories).

Further, it was found that women entrepreneurs with high extent of entrepreneurship had greater achievement motivation, greater job involvement and higher family annual income (ranging from Rs. 1,70,000 to Rs. 2,10,000 annually) when compared with women having low extent of entrepreneurship. At the same time, respondents with high extent of entrepreneurship faced less conflict in their roles as an entrepreneur and housewife whereas respondents with low extent of entrepreneurship faced more conflict. Moreover, comparatively more number of women in HIGH group belonged to joint families, approached institutions for financing their enterprises and hired labour from outside than those having low extent of entrepreneurship.

The study has three major action implications for the government and non-government organisations responsible for promoting and developing entrepreneurship amongst women. Firstly, they should come forward with awareness programmes exclusively for young women and make efforts to diffuse information on prospects of entrepreneurship among the less educated women as high or low extent of entrepreneurship does not depend upon age and education. Secondly, they should look out for realistic and adequate financial schemes being guaranteed on softer terms so that the adverse effect of low family annual income on the extent of entrepreneurship is minimized. Thirdly, wide and extensive campaigning should be done by these organisations, particularly the non-government ones, for involving rural women in agricultural entrepreneurship. Lastly, the support system should streamline and reorient their programmes and policies in a direction leading to higher job involvement, higher achievement motivation and lesser role conflict among women entrepreneurs as their extent of entrepreneurship seemed to depend on these factors. To reduce an entrepreneur's conflict in her roles, the support system must play an active role in making the socio-sphere system of the entrepreneur aware about their role in manipulating the factors that reduce role conflict. At the same time active policy intervention for better infrastructure, adequate finance, better market etc. shall increase their achievement motivation and involvement in job, thus leading to higher extent of entrepreneurship.

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Feature

Bovine Stock in Maharashtra: Changing Structure of Draught Power

Deepak Shah

Mechanisation of irrigation has taken place at much faster rate than mechanisation of tillage in the state of Maharashtra. Thus, the combined effect of mechanisation on displacement of work animals is very low. While the adult male bovine population in this state remained stable over the period of three decades, the adult females bovine population has shown a significant growth. The slowing down in the growth of work animals has facilitated the expansion of milch animals. The cattle population was observed to be in the process of erosion and being replaced by buffaloes in the state.

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For ages, man has been husbanding livestock with the aim of improving their quality and making them more useful. Cattle not only provides valuable animal protein but are also the source of power supply for the cultivation of crops. The contribution of power supply by livestock has been recognised even in some of the industrially developed countries. In most of the developing countries, the bulk of the agricultural operations is done by the use of animal power. In India, draught animals constitute roughly about 30 per cent of the total bovine population and are considered the mainstay of draught power (Nair & Dhas, 1987). Though recently mechanisation of agriculture has attracted the attention of many farmers, because of the time and labour saving devices and the quicker and more efficient output of work, yet due to a number of limitations such as small size of farms, Indian agriculture will have to depend mainly upon bullock power for a long period to come. However, it has also been noticed that in certain parts of the country the level of mechanisation has reached such a stage where it has gradually started displacing work animals. A section of researchers has also put forward the argument that the growth in mechanisation has met the additional draught power requirement of the green revolution in agriculture by supplementing the work animal population (Mishra & Sharma, 1990; Nair & Dhas, 1990).

As a matter of fact, the issue of demand of draught animals arising out of technological and institutional changes in agriculture coupled with their supply has received very scanty attention in the past. However, the works of Sharma (1981, 1989), Binswanger (1978) and Vaidyanathan (1982) provide good insight into this important aspect of the livestock economy and its linkages with agriculture.

Technological changes in agriculture associated with the green revolution have brought about significant changes in the size and composition of animal draught power in several areas of the country. The state of Maharashtra is not an exception to this phenomenon.

During the last three decades, the bovine economy of the state witnessed a number of changes in terms of its size, composition and productivity. The size of bovine herd increased from about 17 million in the mid-fifties to 21.7 million in the late eighties. While the sex composition of bovine has shifted in favour of females, its breed composition has shifted considerably in favour of crossbreeds. Contrary to many studies which showed a decline in work animal population in some of the regions of the country, the draught animal population of Maharashtra has shown a slight increase over time. The issue of economic viability alongwith socio-economic acceptability of species and breeds will become more pertinent under the changed situation in the state. Therefore, an insight into the changes in size, compositive and availability of draught animal power in relation to mechanical power will be helpful in understanding the extent of mechanisation of agriculture in the state Maharashtra. And assessment of factors that have facilitated the process of diffusion and adoption of advanced technology will provide useful insights into the future prospects for the development of livestock sector in the state.

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Draught Animals & Mechanical Power

The effect of agricultural mechanisation has been seen in the successive reduction of the growing requirement of bullock power and an increase in the production of livestock products (Bergmann, 1978; Myrdal, 1968; Venkatappiah, 1972). As a matter of fact, a reduction in the demand for work animals has two major consequences: a proportionate release of animal feed; and a change in the composition of livestock population in favour of milch stock and of females in all age groups. Either of the consequences or both may in turn, lead to an increase in milk and meat production. Draught animals are used mainly for land preparations, sowing, manuring, threshing and irrigation. However, these operations can also be performed by mechanical means. Draught animals can be displaced by tractors in land preparations, sowing, manuring and threshing and electrical pumpsets and oil engines can displace animals in irrigation. In consequence, the requirement of draught power may increase for other operations. Because of such differential impact of mechanisation of all agricultural activity on draught animal stock, it is necessary to examine the impact of these two categories of mechanical equipment on the draught animal stock in the state of Maharashtra.

Reduction in the demand for work animals has two major consequences: a proportionate release of animal feed; and a change in the composition of livestock population in favour of milch stock.

Draught animal population

Slow growth in the stock of draught animals was observed in the state of Maharashtra[1]. During the period between 1956 and 1987, the draught animal population increased only by 0.43 per cent per annum. Even this growth came through rise in draught cattle population since the stock of draught buffaloes remained constant over the last three decades in this state (table 1). Pune showed declining trend in the total stock of draught animals due to fall in its draught cattle population. The growth in draught animal population was higher during the period 1956-1972 compared to the period 1972-1987. The decline in draught animal population in Pune region and its slow growth in other regions of the state might be due to interaction of a number of factors[2], some of which are decline in the average size of cultivated holdings, shift in cropping pattern and increase in the cost of rearing work animals. As human population pressure on land increases, the size of land holding tends to decline. Because of the indivisibility of work animals, the density of work animal population per unit of cultivated area tends to increase. However, beyond a point when the average size of cultivated holding falls below the critical minimum needed to maintain a pair of work animals, there will be a tendency to do away with the work animals and to cling to milch animals

1. There are six major economic regions in Maharashtra. The districts in each region are Konkan Region: Greater Bombay, Thane, Raigad, Ratnagiri and Sindhudurg, Nashik Region: Nashik, Dhule, Jalgaon and Ahmednagar, Pune Region: Pune, Satara, Sangli, Solapur and Kolhapur, Aurangabad Region: Aurangabad, Jalna, Parbhani, Beed, Nanded, Latur and Osmanabad, Amravati Region: Buldana, Akola, Amravati and Yavatmal, Nagpur Region: Wardha, Nagpur, Bhandara, Chandrapur and Gadchiroli.

2. Nair (1981), Dolberg (1982) and Jabbar and Green (1983) discussed the role played by size of land holding on draught animal population. While Grewal and Kahlon (1973) and Rao (1975) argued that mechanisation has led to a decline in the utilisation of draught power, Sharma (1981) and Vaidyanathan (1982) argued that the increase in the mechanical power has not resulted in any reduction in the draught animal population.

Table 1: Draught Animal Population in Maharashtra

Region	Year	Draught animal population (10^6)			CGR	NSA (10^6 Hectares)	DDA
		Cattle	Buffalo	Total			
Konkan	1956	0.66	0.11	0.77	–	0.86	0.90
	1972	0.74	0.11	0.85	0.62	0.77	1.10
	1987	0.81	0.14	0.95	0.74	0.79	1.20
Nashik	1956	1.08	0.02	1.10	–	3.65	0.30
	1972	1.20	0.02	1.22	0.65	3.35	0.36
	1987	1.24	0.03	1.27	0.27	3.59	0.35
Pune	1956	0.09	0.06	0.96	–	3.84	0.25
	1972	0.92	0.06	0.98	0.13	2.83	0.35
	1987	0.84	0.05	0.89	–0.64	3.68	0.24
Aurangabad	1956	1.26	0.01	1.27	–	4.79	0.27
	1972	1.35	0.01	1.36	0.43	4.08	0.33
	1987	1.46	0.01	1.47	0.52	4.78	0.31
Amravati	1956	0.84	0.01	0.85	–	2.79	0.30
	1972	0.85	0.01	0.86	0.07	3.00	0.29
	1987	0.94	0.01	0.95	0.67	3.07	0.31
Nagpur	1956	0.09	0.06	0.96	–	1.78	0.54
	1972	1.05	0.08	1.13	1.02	2.02	0.56
	1987	1.14	0.08	1.22	0.51	1.97	0.62
Maharashtra	1956	5.64	0.27	5.91	–	17.71	0.33
	1972	6.11	0.29	6.40	0.05	16.05	0.40
	1987	6.43	0.32	6.75	0.36	17.88	0.38

Source: Statistical Abstracts of Maharashtra State (various years)

Note: CGR = Compound Growth Rate; NSA = Net Sown Area; DDA = Density of Draught Animal
Net sown area figures used are three-year average centered around the respective years in the table.

(Vaidyanathan et al, 1982). The density of work animals per hectare of net sown area was observed to be almost constant over a period of three decades, with only some moderate fluctuations. This was because of the fact that while total net sown area showed falling trend in most of the regions, the stock of draught animals increased over time. Consequently, the density of work animals per hectare of net sown area remained by and large constant during this period.

Mechanisation of irrigation

The growth of mechanisation of irrigation has contributed significantly to the increase in the availability of draught power in agriculture. A rapid increase in the number of electric pumpsets and oil engines was seen during the last three decades (table 2). The number of electric pumpsets and oil engines, which stood at only 0.3 lakh during 1956, increased to some 7.5 lakhs by 1987. The bulk of the increase was contributed by electric pumpsets. A major increase in electric pumpsets was noticed during the period 1972-1987. On the other hand, after registering an annual increment of nearly 12 per cent between 1956 and 1972, oil engines showed an annual decline of about one per cent between 1972 and 1987. This was mainly because of considerable fall in the number of oil engines in Nashik and Aurangabad regions of the state. Interestingly, while the number of oil engines declined drastically (a fall of about 45 per cent) in Nashik and Aurangabad regions during the period 1972-1987, a substantial rise, on the other hand, was also noticed in electric pumpsets in these regions of the state. The decline in oil engines was, therefore, more than compensated by the considerable increase in electric pumpsets. Consequently, the overall growth in mechanised sources of irrigation did not get affected. Further, as the net sown area remained more or less constant over the last three decades in the

Table 2: Number of Electric Pumpsets and Oil Engines in Maharashtra

Region	Year	Electric Pumpsets and Oil Engines (10^4)						Density of electric pumpsets and oil engines per 100 hectares of NSA
		Pumpsets		Oil Engines		Total		
		Number	CGR	Number	CGR	Number	CGR	
Konkan	1956	0.01	–	0.09	–	0.10	–	0.12
	1972	0.38	25.53	0.20	5.12	0.58	11.61	0.75
	1987	0.50	1.85	1.18	-0.70	0.68	1.07	0.86
Nashik	1956	0.02	–	0.90	–	0.92	–	0.25
	1972	6.04	42.89	6.04	12.64	12.08	17.04	3.61
	1987	17.12	7.19	3.56	-3.46	20.68	3.65	5.76
Pune	1956	0.02	–	1.11	–	1.13	–	0.29
	1972	3.95	39.15	6.04	11.17	9.99	14.59	3.53
	1987	12.98	8.25	5.84	-0.22	18.82	4.31	5.11
Aurangabad	1956	0.01	–	0.27	–	0.28	–	0.06
	1972	2.90	42.53	3.81	17.99	6.71	21.96	1.64
	1987	16.24	12.57	1.99	-4.24	18.23	6.89	3.81
Amravati	1956	0.06	–	0.19	–	0.25	–	0.09
	1972	2.32	25.66	0.79	9.31	3.11	17.06	1.04
	1987	8.84	9.33	1.64	4.99	10.48	8.44	3.41
Nagpur	1956	0.10	–	–	0.11	–	0.21	0.12
	1972	1.39	17.88	0.50	9.93	1.89	14.72	0.94
	1987	4.87	8.72	1.09	5.33	5.96	7.96	3.03
Maharashtra	1956	0.22	–	2.67	–	2.89	–	0.16
	1972	16.98	31.21	17.38	12.42	34.36	16.73	2.14
	1987	60.55	8.85	14.30	-1.29	74.85	5.33	4.19

state, a rapid increase in electric pumpsets and oil engines has resulted in a considerable rise in the density of these mechanised sources of irrigation per 100 hectares of net sown area.

In Maharashtra, out of the total net irrigated area, 56 per cent was well irrigated in 1972-73 which marginally rose to 58 per cent in 1982-83[3]. The rising importance of well irrigation in the state implies that the requirement of various sources of draught power for lifting water has been increasing. However, the rise in the intensity of mechanisation of irrigation did not appear to have affected the draught animal population in the state. This is evident from the classification of districts according to the growth of mechanised irrigation and reduction in the draught stock during 1972 to 1987. In districts like Ahmednagar, Pune, Satara, Sholapur and Parbhani the increase in electric pumpsets and oil engines was more than 100 per cent, but in these districts the decline in the draught animal stock was less than 20 per cent. In majority of the districts, the draught animals' stock also increased with the increase in the stock of mechanised equipment in the above period. This was observed especially in districts like Buldana, Akola, Amravati, Yavatmal and Bhandara where the increase in electric pumpsets and oil engines was more than 200 per cent, but the increase in draught animal stock varied from 1 to 20 per cent. Interestingly, the increase in mechanised equipment was more than 400 per cent in Beed during the period 1972 to 1987, but the total stock of draught animal remained constant during this period.

Thus the installation of more electric pumpsets and oil engines has not had any significant influence on the

3. Out of the total net irrigated area of 1.28 million hectares in Maharashtra, the well irrigated area was 0.71 million hectares in 1972-73. By 1982-83, the total net irrigated area increased to 1.95 million hectares and well irrigated area to 1.12 million hectares. Surface irrigation was followed in the remaining area.

The rising importance of well irrigation in the state implies that the requirement of various sources of draught power for lifting water has been increasing. However, the rise in the intensity of mechanisation of irrigation did not appear to have affected the draught animals population in the state.

changes in the draught animals stock. Given the utilisation pattern of bullock, an increase in the intensity of mechanised irrigation would not have resulted in a reduction in the draught animal stock. Though it might contribute to the displacement of bullock labour from irrigation, this must have been more than compensated by the increase in the cropping intensity consequent to the increase in the intensity of mechanisation. It follows that if mechanisation of irrigation is followed by mechanisation of land preparation and other cultivation operations like harvesting and threshing, it would result in a reduction in the work animal stock. In this context, it is useful to examine the trend in availability of mechanical and draught animal power and the extent of tractorisation in the state.

Given the utilisation pattern of bullock, an increase in the intensity of mechanised irrigation would not have resulted in a reduction in the draught animal stock. Though it might contribute to the displacement of bullock labour from irrigation, this must have been more than compensated by the increase in the cropping intensity consequent to the increase in the intensity of mechanisation.

Farm power availability

A steady growth in pumpsets, oil engines and tractors has resulted in a significant increase in the availability of total farm power in Maharashtra (table 3). The estimated gross availability of farm power from animal and mechanised sources was about 2.6 million horse power (HP) units in the mid fifties and this increased to 4.4 million HP in the early seventies. By the late eighties, it is estimated to have increased to 7.3 million units. Bulk of the increase in total farm power availability over time was contributed by regions like Nashik, Pune and Aurangabad. The contribution of these regions together to total farm power was 58 per cent in mid fifties which sharply increased to nearly 67 per cent in early seventies and by late eighties the share of these regions was estimated to be about 70 per cent in the total draught power availability of the state.

The composition of farm power has also undergone a marked change. While the share of power from mechanised sources in total farm power availability has shown a rising trend in the last three decades, a declining trend was noticed in the case of draught animal power, though in absolute terms, the draught animal power remained almost constant over the last three decades. The share of animal power declined to 37 per cent by 1987 which was about 92 per cent in 1956. Konkan and Nagpur regions of the state presented a slightly different scenario from the general trend obtaining in other regions in terms of draught power availability. Though draught animal power in these two regions has been declining over time, the dependence on it was found to be higher even in late eighties, when about 90 per cent of the total farm power in Konkan region and nearly 60 per cent in Nagpur region was found to be contributed by work animals. Thus, the extent of farm mechanisation in these two regions was found to be very low compared to the other regions of the state.

A cursory look at table 3 further revealed that the share of irrigation equipment in total farm power availability increased from 6 per cent to 51 per cent and that of tractors from 2 per cent to 12 per cent between 1956 and 1987. Around 80 per cent of the mechanised power in Maharashtra's agriculture was estimated to be derived from oil engines and electric pumpsets and the latter has been increasing at a faster rate in recent years. Consequently, the consumption of electric power per hectare of cultivated land has increased rapidly[4].

Tractorisation

One of the crucial aspects of farm mechanisation is the effect of the growth of tractorisation on draught animals holding. Tractors can displace animal drawn techniques in preparatory tillage, sowing, manuring and interculture, threshing and transport. Obviously, one

4. According to Raj (1973) the faster diffusion of mechanisation in irrigation was due to the following reasons: "The use of animal and manual labour for lifting water from wells often poses problems, even in areas where adequate supplies of groundwater are available. Moreover, when the storage capacity of tanks is small, the supplies of water may not last for more than a few months following the rainy season. That an improved technique of irrigation should more rapidly gain acceptance in areas of heavy dependence on ordinary wells and storage tanks is therefore understandable".

Table 3: Availability of Mechanical and Draught Animal Power (HP) in Maharashtra

Region	Year	Mechanical Power (MP) (10^4 HP)				DAP (10^4 HP)	TEP (10^4 HP)	Share of MP in TFP (%)	Share of DAP in TFP (%)	Share of Pumpsets and Oil Engines in TFP (%)
		Pumpsets	Oil Engines	Tractors	Total					
Konkan	1956	0.05	0.45	0.06	0.56	30.80	31.36	1.79	98.21	1.59
	1972	1.90	1.00	0.30	3.20	34.00	37.20	8.60	91.40	7.80
	1987	2.50	0.90	0.41	3.81	38.00	41.81	9.11	90.89	8.13
Nashik	1956	0.10	4.50	1.36	5.96	44.00	49.96	11.93	88.07	9.21
	1972	30.20	30.20	4.12	64.52	48.80	113.32	56.94	43.06	53.30
	1987	85.60	17.80	33.93	137.33	50.80	188.13	73.00	27.00	54.96
Pune	1956	0.10	5.25	1.21	6.86	38.40	45.26	15.16	84.84	12.48
	1972	19.75	30.20	4.75	54.70	39.20	93.90	58.25	41.75	53.19
	1987	64.90	29.20	28.24	122.34	35.60	157.94	77.46	22.54	59.58
Aurangabad	1956	0.05	1.35	1.36	2.26	50.80	53.56	5.15	94.85	2.61
	1972	14.50	19.05	3.82	37.37	54.40	91.77	40.72	59.28	36.56
	1987	81.20	9.95	10.35	101.50	58.80	160.30	63.32	36.68	56.86
Amravati	1956	0.30	0.95	1.09	2.34	34.00	36.34	6.44	93.56	3.44
	1972	11.60	3.95	1.58	17.13	34.40	51.53	33.24	66.76	30.18
	1987	44.20	8.20	7.07	59.47	38.80	98.27	60.52	39.48	53.32
Nagpur	1956	0.50	0.55	0.74	1.79	38.40	40.19	4.45	95.55	2.61
	1972	6.95	2.50	0.93	10.38	45.20	55.58	18.68	81.32	17.00
	1987	24.35	5.45	4.30	34.10	48.80	82.90	41.13	58.87	35.95
Maharashtra	1956	1.10	13.35	5.82	20.27	236.40	256.67	7.90	92.10	5.63
	1972	84.90	86.90	15.50	187.30	256.00	443.30	42.25	57.75	38.75
	1987	302.75	71.50	84.30	458.55	270.00	728.55	62.94	37.06	51.37

Note: DAP = Draught Animal Power; TFP = Total Farm Power; HP = Horse Power

It is assumed that one animal is equivalent to 0.4 HP, Oil engines/pumpsets 5 HP and tractor to 25 HP.

Around 80 per cent of the mechanised power in Maharashtra's agriculture was estimated to be derived from oil engines and electric pumpsets and the latter has been increasing at a faster rate in recent years. Consequently, the consumption of electric power per hectare of cultivated land has increased rapidly.

might expect a decline in draught animal population with an increase in the intensity of tractorisation. A study conducted in Tamil Nadu showed a decline in draught animal population over a period of 30 years due to increase in farm mechanisation (Dhas, 1987). On the other hand, another study conducted by Sharma (1981) on the draught power situation in Haryana had shown that even after introduction of tractors on farms, the farmers continued to maintain their bullocks because of a variety of reasons like fear of sudden break-down of tractors, large number of fragments, etc. The focus of this study was on the supplementary role of tractor power for the draught animals power in the state.

In the state of Maharashtra, tractorisation has taken place at a faster rate from the early seventies onwards. This is evident from the very high growth rate in tractor population in the period 1972-1987 compared to the period 1956-1972 (table 4). In the mid fifties there were only 2319 tractors in the state, but by 1987 its strength had increased to 33719. Bulk of the increase was observed in Nashik and Pune; together contributing about 75 per cent of the total tractor population of the state in 1987.

Table 4: Number of Tractors and its Share in Total Draught Power in Maharashtra

Region	Year	Tractors	CGR (%)	Share of tractor power in TFP in (%)	Density of tractor per 100 hectares of NSA
Konkan	1956	23	–	0.19	Neg.
	1972	119	10.82	0.81	0.02
	1987	162	2.08	0.98	0.02
Nashik	1956	544	–	2.72	0.01
	1972	1649	7.18	3.64	0.05
	1987	13573	13.07	18.04	0.38
Pune	1956	484	–	2.67	0.01
	1972	1898	8.92	5.06	0.07
	1987	11296	10.88	17.88	0.31
Aurangabad	1956	539	–	2.54	0.01
	1972	1530	6.74	4.16	0.04
	1987	4138	14.68	6.46	0.09
Amravati	1956	435	–	3.00	0.02
	1972	631	2.35	3.07	0.02
	1987	2829	10.52	7.19	0.09
Nagpur	1956	294	–	1.84	0.02
	1972	372	1.48	1.67	0.02
	1987	1719	10.74	5.19	0.09
Maharashtra	1956	2319	–	2.27	0.01
	1972	6199	6.34	3.50	0.04
	1987	33717	11.95	11.57	0.19

Neg.: Negligible.

There has also been a significant increase in the number of tractors per 100 hectares of net sown area. However, its availability is still very low: about two tractors per 1000 hectares by the late eighties. Our estimate for the late eighties shows that the tractors have contributed about 12 per cent of the total draught power availability in the state.

In order to examine the displacement of draught animals population due to the growth in tractorisation, the districts of Maharashtra were classified according to the percentage increase in tractors and the percentage change in draught animal stock during the period 1972 to 1987. It was noticed that in districts where the percentage increase in tractors was higher, either there was increase in the draught animal stock or a low decline in the stock of work animals. For instance, while the increase in the tractor population was more than 700 per cent in Nashik, Dhule, Jalgaon and Buldana districts of Maharashtra, the decrease in draught animal population was less than 20 per cent. In districts like Pune, Sangli, Sholapur, Kolhapur and Parbhani, the increase in tractor population was around 500 per cent, but decline in draught animal stock was less than 15 per cent. Interestingly, in Beed district the increase in tractor population was around 1600 per cent, but the draught animal stock remained unchanged during the period 1972 to 1987. This indicates that the growth in tractors has not contributed to the reduction in the draught animal stock.

The foregoing analysis indicates that the intensity and spread of mechanisation have progressed rapidly in Maharashtra. However, even now it is operating at a low level. Therefore, its impact on displacement of work animals is likely to be low. The incidence of displacement is likely to be more in the large and medium farms where the intensity of tractorisation is higher. Further, mechanisation of irrigation has taken place at much faster rate than mechanisation of tillage in Maharashtra. Thus, the combined effect of mechanisation on displacement of work animals is likely to be low in this state.

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Trends in Compositional Changes

The growth of different livestock species and breeds depends upon the crop economics, land utilisation pattern, farmers' preference for different livestock products and technological advancement. These changes also reflect the future trend and demand situations for a particular type of livestock and its product. A study of such changes is extremely crucial for policy planning. Therefore, an attempt has been made to evaluate the changes in the composition of bovine population over time in different regions of Maharashtra. Apart from this, the study also places onus on analysing the growth of breedable female population in relation to total stocks of animals in the state. In order to have a general idea about the six economic regions, some basic information on the human population, bovine (cattle + buffalo) population and gross cultivated area alongwith some relevant ratios are given in Appendix.

Bovine population trends

The bovine population in the state has been showing a rising trend over time. It increased by about 30 per cent during the three decades between 1956 and 1987. The increase during 1972-87 was substantially higher compared to 1956-72 (table 5). Though cattle population in the state constituted about 80 per cent of the total bovine stock, the rise in buffalo population was much higher. While cattle population grew only by 4 per cent between 1956 and 1972 and by 15 per cent between 1972 and 1987, the growth in buffalo population was 21 per cent and 44 per cent respectively. The increasing trend in buffalo population was mainly due to rise in female population. Between 1956 and 1987, the stock of adult female buffaloes had almost doubled, whereas, male buffalo population remained more or less constant. In the case of cattle, though male population showed a rising trend, the female population remained constant between 1956 and 1972. Substantial increase in stocks of female cattle was noticed between 1972 and 1987. Regions did not differ significantly and fell in line with the overall compositional changes in bovines over time in the state. However, Pune region showed a high proportion of buffalo population compared to other regions of the state.

A notable feature of the foregoing analysis was that while the adult male bovine population remained stable over the period of three decades, the adult female bovine population has shown significant growth. Consequently, the sex ratio of adult bovine has shifted rapidly in favour of females. In case of young stock, no discernible trend was observed. Another important observation was the declining proportion of cattle population in relation to total stock of bovines. It came down from 84 per cent in 1956 to 78 per cent by 1987. On the other hand, the proportion of buffalo population increased during the same period. It has also been noticed that about 96 per cent of the total adult male bovine population in Maharashtra was used for draught purposes (table 1 and 5). However, the growth of adult male bovine population over time has been very slow. This was perhaps due to the increasing farm mechanisation in the state. Further, the adult male bovine population was higher than female population till 1972. But, thereafter, the female population has outnumbered the male.

While the adult male bovine population remained stable over the period of three decades, the adult female bovine population has shown significant growth. Consequently, the sex ratio of adult bovine has shifted rapidly in favour of females.

Growth rates in bovines

The growth in buffalo population[5] was much faster than cattle population in Maharashtra state. Though Aurangabad region possessed the largest bovine population, it ranked 5th in terms of overall growth (1956-87) in buffalo population and 4th in cattle population (table 6). The growth of cattle appeared to be very slow in majority of regions. In regions like Pune and Amravati, cattle population was found to

5. Annual compound Growth Rates (CGR) were calculated using the following formula:

$$CGR = \left[\left(\frac{P_n}{P_o}\right)^{1/n} - 1\right] \times 100$$

Where, P_n = Population in Current Period

P_o = Population in Base Period

n = Number of years

Table 5: Changing Composition of Bovine Population in Maharashtra

Region	Year	Cattle				Buffalo				Bovine			
		Adult		Young stock	Total cattle	Adult		Young stock	Total buffalo	Adult		Young stock	Total bovine
		M	F			M	F			M	F		
Konkan	1956	0.69	0.47	0.39	1.55 (78.28)	0.12	0.22	0.90	0.43 (21.72)	0.81	0.69	0.48	1.98
	1972	0.75	0.49	0.41	1.65 (77.83)	0.12	0.25	0.10	0.47 (22.17)	0.87	0.74	0.51	2.12
	1987	0.85	0.57	0.47	1.89 (73.26)	0.15	0.36	0.18	0.69 (26.74)	1.00	0.93	0.65	2.58
Nashik	1956	1.10	0.74	0.68	2.52 (87.80)	0.02	0.20	0.13	0.35 (12.20)	1.12	0.94	0.81	2.87
	1972	1.22	0.85	0.69	2.76 (86.25)	0.02	0.26	0.16	0.44 (13.75)	1.24	1.11	0.85	3.20
	1987	1.31	1.14	0.86	3.31 (81.73)	0.03	0.45	0.26	0.74 (18.27)	1.34	1.59	1.12	4.05
Pune	1956	0.91	0.66	0.58	2.15 (73.38)	0.06	0.44	0.28	0.78 (26.62)	0.97	1.10	0.86	2.93
	1972	0.93	0.65	0.49	2.07 (66.13)	0.06	0.64	0.36	1.06 (33.87)	0.99	1.29	2.43	3.13
	1987	0.87	0.84	0.60	2.31 (60.79)	0.06	0.96	0.47	1.49 (39.21)	0.93	1.80	1.07	3.80
Aurangabad	1956	1.29	0.95	0.98	3.22 (85.19)	0.02	0.32	0.22	0.56 (14.81)	1.31	1.27	1.20	3.78
	1972	1.37	1.00	0.89	3.26 (83.38)	0.01	0.37	0.27	0.65 (16.62)	1.38	1.37	1.16	3.91
	1987	1.52	1.23	1.02	3.77 (80.73)	0.02	0.53	0.35	0.90 (19.27)	1.54	1.76	1.37	4.67
Amravati	19.56	0.88	0.77	0.68	2.33 (88.26)	0.01	0.18	0.12	0.31 (11.74)	0.89	0.95	0.80	2.64
	1972	0.87	0.74	0.65	2.65 (87.26)	0.01	0.20	0.12	0.33 (12.74)	0.88	0.94	0.77	2.59
	1987	0.97	0.91	0.69	2.57 (84.82)	0.01	0.29	0.16	0.46 (15.18)	0.98	1.20	0.85	3.03
Nagpur	1956	0.96	0.74	0.64	2.34 (88.97)	0.07	0.13	0.09	0.29 (11.03)	1.03	0.87	0.73	2.63
	1972	1.07	0.85	0.79	2.71. (88.85)	0.08	0.15	0.11	0.34 (11.15)	1.15	1.00	0.90	3.05
	1987	1.17	1.05	0.91	3.13 (86.94)	0.08	0.23	0.16	0.47 (13.06)	1.25	1.28	1.07	3.60
Maharashtra	1956	5.83	4.33	3.95	14.11 (83.84)	0.30	1.49	0.93	2.72 (16.16)	6.13	5.82	4.88	16.83
	1972	6.21	4.58	3.92	14.71 (81.72)	0.30	1.87	1.12	3.29 (18.28)	6.51	6.45	5.04	18.00
	1987	6.69	5.74	4.55	16.98 (78.41)	0.35	2.82	1.58	4.75 (21.86)	7.04	8.56	6.13	21.73

Figures in parentheses indicate percentages to the total bovine population.

Table 6: Compound Growth Rates of Cattle and Buffalo between Census Years

(per cent per annum)

Region	Period	Total population			Breedable female population		
		Cattle	Buffalo	Total	Cattle	Buffalo	Total
Konkan	1956-72	0.40	0.59	0.44	0.31	0.86	0.49
	1972-87	0.90	2.63	1.32	0.98	2.57	1.55
	1956-87	0.65	1.57	0.87	0.63	1.69	1.00
Nashik	1956-72	0.57	1.38	0.67	0.89	1.79	1.09
	1972-87	1.21	3.49	4.84	1.93	3.56	2.35
	1956-87	0.88	2.39	2.67	1.39	2.64	1.70
Pune	1956-72	–0.23	1.94	0.42	–0.09	2.41	1.02
	1972-87	0.71	2.29	1.28	1.68	2.74	2.23
	1956-87	0.22	2.11	0.84	0.76	2.57	1.60
Aurangabad	1956-72	0.04	0.97	0.19	0.28	0.92	0.45
	1972-87	1.00	2.18	1.21	1.44	2.45	1.73
	1956-87	0.51	1.55	0.68	0.84	1.65	1.06
Amravati	1956-72	–0.16	0.28	–0.11	–0.21	0.57	–0.05
	1972-87	0.83	2.22	1.02	1.34	2.47	1.59
	1956-87	0.32	1.22	0.44	0.54	1.49	0.74
Nagpur	1956-72	0.91	1.22	0.95	0.89	1.28	0.94
	1972-87	0.99	1.97	1.11	1.42	2.61	1.62
	1956-87	0.95	1.58	1.03	1.14	1.92	1.27
Maharashtra	1956-72	0.26	1.21	0.42	0.36	1.49	0.67
	1972-87	0.96	2.45	1.26	1.50	2.75	1.88
	1956-87	0.06	1.58	0.83	0.91	2.10	1.25

decline between 1956 and 1972. However, its population showed considerable growth during 1972-87. In fact, the growth in both cattle and buffalo was quite appreciable between 1972 and 1987 in all the regions of the state. On the whole, Nashik region showed the highest growth in buffalo population and Nagpur region in cattle population during the last three decades (1956-87). For ascertaining the reasons for these changes in the growth rate population, planned survey is required. Several reasons viz., better demand for buffalo milk due to high fat percentage, higher average milk yield and higher price, etc. can be given for the increasing growth in the buffalo population in the state.

The data was further analysed for the growth rate of breedable cattle and buffalo for better understanding the reasons for slow growth in cattle population and increase in buffalo population. The growth rates in breedable female population showed similar trends, except some improvement in growth rates compared to total cattle and buffalo population in all the regions of the state. As in the case of total cattle population, a decline in breedable stocks of female cattle was noticed in Pune and Amravati regions during 1956-72. However, the growth in breedable female cattle was remarkable between 1972 and 1987 in these regions.

As a matter of fact, increase in buffalo population was mainly contributed by increase in stocks of breedable buffaloes. Its population increased in all the regions in all the periods thereby giving positive and substantially higher growth rate for the whole state. The highest growth in breedable female buffaloes was noticed in Nashik regions followed by Pune, Konkan, Nagpur, Amravati and Aurangabad during the period 1972-87. It is pertinent to mention that the growth rates in breedable buffalo population was higher than cattle in all the regions during the period 1956-87. This strongly suggests that the breedable cattle are being replaced by breedable buffaloes in the state.

Table 7: Number of Buffaloes Per Thousand Cattle and Number of Animals in Milk Per Thousand Milch Animals

Regions	Buffaloes per thousand cattle			Animals in milk per thousand milch animals								
				Cattle			Buffalo			Total		
	1956	1972	1987	1956	1972	1987	1956	1972	1987	1956	1972	1987
Konkan	460	503	636	361	303	428	655	632	650	460	413	515
Nashik	268	309	392	414	334	446	505	447	521	433	360	467
Pune	658	978	1143	497	459	557	644	548	633	555	467	598
Aurangabad	337	372	432	406	426	469	487	489	544	425	443	492
Amravati	235	266	315	446	366	380	593	510	486	474	397	405
Nagpur	170	181	215	294	370	360	550	441	471	331	381	380
Maharashtra	341	408	490	405	370	439	580	520	572	449	414	483

To understand it more clearly, number of buffalo per 1000 heads of cattle was worked out (table 7). It is observed that cattle population is in the process of erosion and being replaced by buffaloes in each region of the state. The highest replacement was noticed in Pune region; buffalo population has surpassed the cattle population in the region in 1978 and onwards. However, the replacement of cattle by buffaloes was observed to be very slow in Aurangabad, Amravati and Nagpur regions of the state.

Cattle population is in the process of erosion and being replaced by buffaloes in each region of the state.

Ratio of milk to milch animals

In the absence of enough improvement in the production potential of milch animals, one has to depend on the number of milch animals. The total production depends upon the proportion of animals in milk, apart from the type of milch animals. Higher proportion of animals in milk reflects high degree of breeding efficiency of the animals.

It was noticed that there was little variation in the percentage of animals in milk over time. On an average, more than 50 per cent of buffaloes were in milk in each period under study (table 7). The breeding efficiency of buffaloes appears to be higher compared to cattle which is reflected by the higher proportion of animals in milk. In the case of cattle Pune region has attained an optimal proportion of 55.7 per cent. Konkan region showed a remarkable proportion of 65.0 per cent of buffaloes in milk which is an achievement even for an organised sector of animals Husbandry. Such high proportion of buffaloes in milk strengthens the conclusion that the breeding efficiency of buffaloes as well as the management inputs are high in Maharashtra state.

Thus, the analysis revealed that the size and composition of bovine herd in the state have undergone significant changes. During the last three decades (1956-87), the size of the bovine population has shown steady growth. But, within the herd population, the importance of adult male has declined. At the same time, because of the increased demand for milch animals, the population of adult females has increased. It is interesting to note that the adult she-buffalo population increased at a faster rate as compared to that of cows, indicating the farmer's preference for she-buffaloes as milch stock. Higher proportion of buffaloes in milk compared to cows contradicts the usual hypothesis that cow is better than buffalo with respect to reproduction. In this context, a detailed study on the compositional changes in bovine stock in Uttar Pradesh has also shown a favourable growth rate of buffalo population and moderate growth in stocks of cattle (Singh et al, 1990). Thus, there is no doubt that the slowing down in the growth of work animals has facilitated the expansion of milch animal population in Maharashtra state which has grown by over 47 per cent between 1956 and 1987 compared to less than 15 per cent of work animals thereby facilitating a shift from cows to the buffaloes and also, very likely, a rise in milk yield. The tendency

The slowing down in the growth of work animals has facilitated the expansion of milch animal population in Maharashtra state which has grown by over 47 per cent between 1956 and 1987 compared to less than 15 per cent of work animals thereby facilitating a shift from cows to the buffaloes and also, very likely, a rise in milk yield.

for relatively faster growth of milch animals stock is nearly Universal; that of substitution of buffaloes for cows, however, is not. In West Bengal, Orissa and Kerala where the cow has always been the principal source of milk, the dominance of the cow has become more pronounced. In other states, the strength of the latter tendency varies a great deal, depending partly on the trends in feed supply for the animal and partly on ecology (Vaidyanathan, 1987).

Conclusion & Policy Implications

As the analysis reveals, there was an increase in the intensity of mechanisation, but this did not seem to have contributed to any significant displacement of work animals per hectare of net sown area. On judging the past trend, the growth in mechanical power appeared to have served largely as a supplementary source of animal power. The impact of tractorisation in respect of displacement of work animals was also very slow in the state. Since the rate of mechanisation of irrigation was faster than mechanisation of tillage, the overall effect of mechanisation in terms of displacement of work animals has been very slow. Further, the sex ratio of adult bovine has shifted rapidly in favour of female during the 30 year period. Finally, the cattle population was noticed to be in the process of erosion as it was being replaced by buffaloes in the state.

The growth in mechanical power appeared to have served largely as a supplementary source of animal power. The impact of tractorisation in respect of displacement of work animal was also very slow in the state. Since the rate of mechanisation of irrigation was faster than mechanisation of tillage, the overall effect of mechanisation in terms of displacement of work animals has been very slow.

The findings of this study have four major policy implications. Firstly, while draught animals are not displaced by other sources of farm power, there is a sharp increase in the stock of female bovine population. This trend is desirable in the light of the growing economic opportunity for increasing milk production and for undertaking dairying as a commercial proposition. Secondly, as buffalo population is increasing in proportion, the income generating capacity of milch animals will be higher because of higher productivity of buffaloes in terms of milk. As a matter of fact, at present, India is the second largest milk producer in the world.

Since the use of animals for draught purpose is showing no significant growth, farmers should resort to modern techniques of tilling to substitute animal power.

Now, India has emerged as an exporter of milk products in contrast to its import in the earlier years. With the increasing number of milch animals and milk production in rural settings, it may be possible for India to emerge in future as the largest producer and exporter of milk products in the world. Thirdly, since the use of animals for draught purpose is showing no significant growth, farmers should resort to modern techniques of tilling as substitute to animal power in the face of growing farming activities. This may in turn bring opportunities for improvement in land productivity and a still higher income generation from the farmers' scarce land the other resources. Finally, the increasing use of mechanical equipment for cultivation in lieu of additional animal power will progressively increase the rural demand for energy i.e., for electricity, diesel, etc. Therefore, there must be adequate investment in power sector in the future to accommodate this increasing rural demand for power.

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Appendix: Human (1991) and Bovine (1987) Population Gross Cultivated Area (1988-89) and their Ratios in Maharashtra State

Region	HP (10^{10})	BP (10^{6})	GCA (10^{6} Ha)	GCA/100 HP (Ha)	GCA/100 BP (Ha)	BP/100 HP
Konkan	19.38 (24.55)	2.58 (11.58)	0.88 (4.49)	4.54	34.11	13.31
Nashik	12.95 (16.40)	4.05 (18.65)	3.92 (19.99)	30.27	96.76	31.27
Pune	16.41 (20.79)	3.79 (17.45)	4.06 (20.70)	24.74	107.12	23.10
Aurangabad	12.80 (16.21)	4.68 (21.55)	5.26 (26.82)	41.09	112.39	36.56
Amravati	8.38 (10.62)	3.02 (13.90)	3.24 (16.52)	38.66	107.28	36.04
Nagpur	9.02 (11.43)	3.60 (16.57)	2.25 (11.48)	24.94	62.50	39.91
Maharashtra	78.94	21.72	19.61	24.84	90.29	27.51

Note: HP = Human population; BP = Bovine population; GCA = Gross Cultivated Area

Figures in parentheses indicate percentage of state population/area. □

Feature

Socio-economic Constraints in Rice Production

T.R. Shanmugam & C. Ramasamy

Rice in Southern India is characterised by low yield in a substantial area. The article identifies the socio-economic constraints which operate to keep rice yields significantly below their potential. Labour scarcity during peak season is a major constraint faced by farmers of Southern India. Selective mechanisation can be recommended to rice farming activities like ploughing, transplantation, harvesting and thrashing in order to minimise labour scarcity problems during peak season, conclude the authors.

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Rice is the staple food for most of Indian population. There has been a giant leap in rice productivity and production in 60's and 70's after the introduction of high yielding, short duration and photoinsensitive varieties. Increase in the area of rice cultivation, generation of improved rice production technologies and enthusiasm of rice farmers in adopting improved production technologies were the major influencing factors behind these increases in rice production which has matched the demand from the growing population.

However, the trend in rice production in India over the recent years indicates that the scenario is changing. India, with the current population growth rate of 2.1 per cent a year would be the most populous country in the world in 2030. The current growth rate in production does not keep pace with that in population. Apparently, rice production has come to a stagnation in recent years due to many constraints. With almost no scope for increasing the area under rice production, the only way for production increment is to increase the productivity of rice lands in future. Though rice yield in India has levelled off in certain regions, still it is characterised by low yields in substantial areas. The World Rice Statistics published by IRRI (1987) reveals that there has been no significant upward trend in yield in many states of India even after introduction of modern varieties; considerable yield variation also exists due to the differential levels of adoption of new rice technologies, varying degrees of water control, imbalances in infrastructural development and a host of other factors. The average rice yield per hectare ranges from as low as 1.69 tonnes

With almost no scope for increasing the area under rice production, the only way for production increment is to increase the productivity of rice lands in future.

in Bihar to 4.80 tonnes in Punjab. A recent study conducted by Tamil Nadu Agricultural University in collaboration with the International Rice Research Institute revealed that the average per hectare yield levels of rice varied from 3.2 tonnes to 6.8 tonnes across different rice production environments (Ramasamy, et al, 1992).

Hence there is a strong case to identify the socio-economic constraints which keep rice yields significantly below their maximum potential and to channelise efforts to increase yield by solving the constraints particularly in the 'low yield' regions as well as in the farms with low yield within given regions.

Rice Production in Southern India

Southern peninsular India consists of four states—Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, and one Union Territory, Pondicherry. Rice is the major food crop in these states. Table 1 shows area under rice in each state. The share of rice area in gross cropped area in Southern India is 22.51 per cent. The proportion of rice area to total rice area at India level works out to 23.18 per cent.

Table 1: Share of Rice Area to Gross Cropped Area in Southern India

'000 Hectares (1989-90)

State	Rice Area	Gross Cropped Area
Andhra Pradesh	4218.00 (32.07)	3151.00 (100.00)
Karnataka	1047.60 (8.86)	11819.00 (100.00)
Kerala	577.60 (19.49)	2964.00 (100.00)
Tamil Nadu	1891.00 (29.16)	6451.00 (100.00)
Pondicherry	25.65 (62.56)	42.00 (100.00)
South India	7749.25 (22.51)	34426.00 (100.00)
All India	42177.70 (23.18)	182900.00 (100.00)

Figures in parentheses indicate percentage to total

Rice production in Southern India during the cropping year 1989-90 stood at 19.63 million tonnes which was 26.5 per cent of the total rice production in India. Rice production parameters—growth rates of area, production and productivity—over the period from 1971 to 1990 suggest that the variation in the total rice production in Southern India was more due to the large swings in the area under rice in different years rather than changes in the productivity of rice crop. This was particularly so in states like Kerala, Tamil Nadu and Union Territory of Pondicherry (table 2).

Table 2: Growth rates of Area, Production and Yield of Rice in South India

(1971 to 1990)

States	Area (%)	Production (%)	Yield (%)
Andhra Pradesh	0.83	4.06	3.23
Karnataka	0.74	1.32	0.58
Kerala	–2.11	–1.19	0.92
Tamil Nadu	–3.48	–0.82	1.66
Pondicherry	–0.94	–1.41	–0.47
South India	–2.30	–0.32	1.98
All India	0.63	2.56	1.93

Growth rates of area as well as production were negative during the reference period for Kerala, Tamil Nadu and Pondicherry. And productivity growth was only marginal and not enough to accelerate rice production in Kerala and Karnataka. In Andhra Pradesh and Karnataka, growth rate of area was either constant or negligible. This trend is clearly indicative of the need for new and more efforts on rice research and extension in order to increase rice production in Karnataka, Kerala, Tamil Nadu and Union Territory Pondicherry. Low productivity of rice in Kerala, Karnataka and Pondicherry was responsible for the low average rice productivity of Southern India.

In the case of Andhra Pradesh, there was a substantial growth in rice production and productivity. The state being the leading rice producer, whose surplus is critical to meet the rice demand in the deficit states, the present tempo of production and productivity need to be maintained. With the higher rice production, the annual per capita availability is also highest in the state with 170 kgs per capita (table 3).

Table 3: Per capita Availability of Rice in Southern States of India

States	Rice Production (000' tonnes)	Population (000' numbers)	Annual Per capital Availability (kgs)
Andhra Pradesh	10558.00	61759	170.95
Karnataka	2410.82	43497	55.42
Kerala	1013.68	29262	34.64
Tamil Nadu	5590.04	54759	102.08
Pondicherry	61.99	748	82.87
South India	19634.53	1900.25	103.33
All India	74100.00	811800	91.28

Estimation of Production Loss

In the present study, for each agroclimatic region–rice production environment–the absolute quantity of yield loss attributed to each constraint was estimated by knowledgeable scientists (table 4). They were also required to estimate the proportion of area affected by each constraint to the total rice area of the region. While identifying constraints in the region, the scientists were reminded to be specific to sub-production environments within the region. To be precise and authentic in the estimation of yield loss, they were requested to estimate yield loss due to the constraints which were relevant to their area of specialization. The total area affected by each constraint in each region was arrived at by summing up the areas affected in the different sub-production environments within a region. The scientists were asked to indicate average yield loss due to a particular constraint over the last five years. The average value was considered as the loss due to the constraint. The sum of the losses across the regions gave the total production foregone due to each constraint in each state.

Production foregone was then multiplied by the price of the current year prevailing in the state to obtain the value of foregone production due to each challenge in the state.

In order to crosscheck yield loss estimates due to production constraints, views of the extension personnel who had long field experience in rice production in that region were obtained. The same procedure adopted by the scientists was applied for the estimation of loss by the extension personnel also.

Socio-economic Constraints

Successful adoption of improved rice production technologies is a function of a number of socio-economic and institutional factors. The yield loss attributed to individual, social or economic constraints could be difficult to estimate. The reason is that though the damage caused to rice yields by the socio-economic constraints is substantial, it is largely indirect. Moreover, the nature and intensity of damage caused by each one of the socio-economic constraints are widely varying across regions. And the estimate of yield loss due to socio-economic constraints also suffers from perceptional differences. For instance, rice scientists view socio-economic constraints in the context of their interest on maximising production whereas rice farmers assess them with the view of maximising profitability.

The estimation of the cost of resolving socio-economic constraints pertaining to rice yield is limited to such a kind of subjective assessment of required research, and extension facilities. In order to be more accurate and realistic on the assessment of the severity due to socio-economic problems, it was decided to assess the number of farmholds affected by the problem instead of area affected. The assessment of yield loss in this case is also tricky and the respondents were asked to respond rather in a reverse way, i.e., they were asked to indicate the possible yield gain in the absence of such a problem.

Socio-economic constraints do not allow the farmers to adopt the full package of practices. People in traditional rice growing areas suffer most from both environmental and socio-economic constraints. Every year they face natural calamities like flood, drought etc. Inspite of having a good amount of water to grow rice, the farmers in these areas are not in a position to invest on critical inputs like HYV seeds, fertilizers, insecticides or weedicides etc. due to the lack of investment resources. The nature and intensity of socio-economic constraints on higher rice yields vary by production environments. We have identified some major socio-economic constraints prevailing in different rice production environments of all four southern states:

* Labour scarcity during peak seasons
* High cost of fertilizers
* High cost of plant protection chemicals
* Shortage of water and electricity
* Inadequacy of credit
* Poor technical extension
* Unremunerative paddy prices
* Inadequate supply of quality seeds

The results are presented in table 4.

Labour scarcity

Contrary to the general contention that there is an excess supply of agricultural labour in the country, scarcity of labour, especially during peak rice growing seasons has been faced by most of the rice farmers. This problem is more acute in well irrigated production environment than canal irrigated and dry-upland environments. This observation is not to disprove the general contention of excess farm labour supply. The demand for labour in rice farming is seasonal and in peak operational season, demand exceeds supply. Moreover, migration of rural labour force to the neighbouring urban/industrial towns where higher wages prevail is a major factor contributing to labour scarcity.

Table 4: Production loss due to socio-economic problems in Southern India

Constraints	Andhra Pradesh	Karnataka	Kerala	Tamil Nadu	South India
Socio-economic					
Labour Scarcity	47.66	25.02	14.55	31.49	118.72
High cost of fertiliser	21.49	25.86	13.71	17.41	78.47
High cost of PPC	19.13	19.25	11.23	9.83	59.44
Low paddy prices	12.31	17.72	9.26	8.21	47.50
Poor tech exten	13.37	18.81	9.66	13.75	55.59
Inadequate supply of quality seeds	12.36	11.24	5.29	8.04	36.93
Lack of credit	15.28	17.99	8.74	14.48	56.49
Shortage of power and water	12.13	15.51	7.41	10.99	46.04
Total	153.73	151.40	79.85	114.20	499.18

Development of small and medium scale industries especially in the well irrigated and canal cum well irrigated environments leads to the migration of labour to non-farm jobs. The industrial development paves the way for the growth of service sector which is, mostly, labour intensive in nature. Ultimately, the movement of labour into industrial and service sector cuts down the labour supply to agriculture. This problem ranks first in Andhra Pradesh, Kerala and Tamil Nadu and second in Karnataka.

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High cost of fertilizers/plant protection chemicals

The cost of inputs, particularly of fertilizer, is one of the major concerns of farmers in all production environments. With the introduction of short duration and high yielding rice varieties, the food grain production grew rapidly, which in turn, increased the demand for plant nutrients. Since the plant nutrients supplied through manures were far inadequate to meet the huge demand the use of chemical fertilizers has steadily increased over the years. At the same time the manufacturing cost of fertilizers remained high. As a strategy to promote food production, the government subsidised the fertilizers. Over the years, the growing burden of subsidy made the government remove the subsidies in a phased manner. This means, that the fertilizers price again increased and the farmers' terms of trade worsened. In the course of the present survey, substantial interaction was effected with scientists, extension officers, and selected farmers. This exercise brought forth the view that the present level of prices are so high as to act as disincentive for increasing rice yields. This problem ranks first in Karnataka, second in Andhra Pradesh, Kerala and Tamil Nadu.

The high cost of plant protection chemicals was also invariably reported both by researchers and agricultural development personnel. In response to the higher cost of pesticides, the scientists have introduced IPM (Integrated Pest Management) practice which is being increasingly advocated by the extension workers. Evidently, the use of chemicals is still inevitable. The problem, however, is that the price of pesticides and fungicides has been consistently bullish over the years, thus squeezing the profitability in rice production. In other words, improving the terms of trade in favour of farmers will help boost rice yields. This problem ranks third in Andhra Pradesh, Karnataka and Kerala.

Improving the terms of trade in favour of farmers will help boost rice yields.

Shortage of water and electricity

Water is the most crucial factor in determining rice yield. Different rice production environments are determined based upon the water availability to the rice crop. The irrigated area under rice has increased

from 9.8 to 17.8 m. ha during the last four decades. Apparently, irrigation is playing a key role in expanding the rice area. An examination of the sources of the growth of rice production indicates that irrigation contributed to 25 per cent increase in rice production in Tamil Nadu (Hazell & Ramasamy, 1992).

Wastage of irrigation water due to poor control particularly during the wet season (Kharif) leads to little availability (drought conditions) during the dry season. Fluctuation in rainfall aggravates this problem. Improving water management and introducing drought tolerant varieties may help minimise yield losses. However, lesser degree of water control in unfavourable rice production environments is, at present, a major constraint. In well irrigated environments, electric power is the main source of energy used to lift water from open wells or tube wells. The shortage of electricity is also a major constraint faced by the farmers. Inconsistent and untimely power supply is another dimension of the problem. In such conditions, farmers find it hard to irrigate the crop at crucial stages leading to yield reduction.

Inconsistent and untimely power supply is another dimension of the problem.

Inadequacy of credit

The demand for credit has increased substantially with the introduction of modern rice varieties which require higher levels of fertilizers, pesticides, and labour-both machine/animal and human. Besides, the seasonality of crop production makes the rice farmers run out of liquidity. Thus credit becomes crucial for enhancing rice output at the farm level. One of the socio-economic constraints invariably reported across rice regions has been the inadequacy of credit supply. Institutional credit system is also reported to be handicapped due to many factors like untimely credit, tiring procedures and formalities, non-repayment of loans, and political intervention causing slow flow of credit to rice production.

Poor extension service

Extension service is critical in translating research results into realities. The major proportion of the extension service in the Southern states is being carried out by the respective State Departments of Agriculture. They command a massive machinery to carry out the task of Transfer of Technology (TOT) from the research end to the farm end. In 1980s, Training and Visit system was introduced in order to enhance the productivity of extension efforts. Only a sub-set of farmers realised the benefits of the whole set of production technologies. In many rice villages, the farmers complained about the lack of extension services. In villages, where the extension net work has reached, the efforts were truncated; and the set of farmers who have social and economic power were more benefitted.

Paddy prices

Most scientists and personnel of extension agencies consider the paddy prices received by producers unremunerative. The prices are not high enough to induce farmers to apply additional increments of modern inputs. Unremunerative paddy price has always been the main concern of the farmers, irrespective of the production environment. Evidently, the present level of support and procurement prices needs to be remunerative in order to induce stepped up rice production. Increasing producer prices will shift the economic optimum of input application. It has been historically viewed that price incentives are basic for the adoption of new technologies and investing on yield increasing inputs.

The present level of support and procurement prices needs to be remunerative in order to induce stepped up rice production.

Inadequate supply of quality seeds

Assuring adequate supply of quality seeds to all rice farmers during the peak sowing season is a challenging task faced by the extension and input agencies. This problem is particularly acute in canal irrigated environment where the sowing period is determined by the release of water in the canal. Most of the farmers in the command area solely depend on the canal for irrigation and hence there is always a heavy rush for seeds at the sowing time. Both public and private sector seed agencies do not live upto requirements in terms of provision of adequate quality seeds. Poor quality of seeds causes considerable yield loss, another dimension of the problem. Little supply of seeds of recommended varieties, especially new varieties, is an oft-repeated problem. The magnitude of the problem is less observed in other rice production environments such as well and tank irrigated, because the farmers there can make minor adjustments in raising nurseries, depending upon seed availability as they are able to control the irrigation system. Nevertheless, the constraint with respect to the

The constraint with respect to the availability of quality seeds of recommended varieties persists in all the rice growing environments.

availability of quality seeds of recommended varieties persists in all the rice growing environments.

Conclusion

The total losses due to socio-economic problems in absolute terms are highest in Andhra Pradesh since this state leads in rice acreage and production. Labour scarcity is the first important problem realised in Southern India. It tops the list of constraints causing maximum loss in Andhra Pradesh, Kerala and Tamil Nadu. This calls for selective mechanisation in rice farming at appropriate time.

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Feature

Challenges in Silk Reeling Industry

D.V. Gopalappa

Though India stands second in the sericulture enterprise in the world, due to poor reeling technology, the country imports rawsilk from China to export finished silk products. A study was undertaken to understand the problems involved in the industry. The paper highlights that unskilled labour, reelers' reluctance to adopt improved technology and improper credit facilities are the major constraints in the development of silk reeling industry.

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India is the second largest producer of rawsilk in the world next to China. However, India imports most of the rawsilk for exporting finished silk products since the local rawsilk is of inferior quality (Shekar & Sinha, 1992). Though mulberry cultivation and silkworm rearing (cocoon production) are well developed in five states viz. Karnataka, Andhra Pradesh (AP), Tamil Nadu (TN), West Bengal (WB) and Jammu & Kashmir (J&K), silk reeling technology has not made much headway. Karnataka can claim of some progress in reeling activity but not other potential states including AP.

Though mulberry cultivation and silkworm rearing (cocoon production) are well developed, silk reeling technology has not made much headway.

In Andhra Pradesh, although mulberry cultivation and silkworm rearing have been practised since 1960, silk reeling gained momentum only in the late 70s. While AP produces a large quantum of cocoons next only to Karnataka, it lags behind in the cocoon processing technology. However, since the raw material is available in plenty, there exists a promising potential to develop silk reeling industry. Accordingly, the Department of Sericulture, AP, initiated a number of measures to encourage the growth of silk reeling in the state. However, it has not made much of a dent as the existing reeling technology is indigenous (charka reeling) and the required number of reeling basins is almost twice the current available strength (table 1). Studies by Venkatanarasaiah (1992) and Gopalappa (1994) highlighted the problems and prospects of silk reeling at the macro level. This study examines the various constraints in the development of silk reeling industry.

Methodology

In AP, silk reeling is largely concentrated in Anantapur and Chittoor districts, with the former ranking first. As Hindupur town of Anantapur district has the most

Table 1: Reeling Units in Andhra Pradesh (1992-93)

Type of Reeling Technology	Required Basins	Existing Basins	Persons Employed
Charka	–	3043	3803
Cottage Basin	–	2345	5862
Total	10668	5388	9665

Source: Department of Sericulture AP., Hyderabad.

number of reeling units (Department of Sericulture, AP) it was chosen as the study area. Both qualitative and quantitative methods were followed for the present study. Since participant observation is also included in the methodology, one out of the seven localities called Rehmatpur in Hindupur where, 40.3 per cent of the 343 reeling units are located, was covered for the study. The study covered the entire 140 households consisting of 63 manual charka, 74 power operated charka and three cottage basin reeling entrepreneurs.

Profile of the Existing Reeling Technology

Three types of technologies are available for silk reeling in AP. Hand operated charka which is the most common is made out of wood and costs about Rs. 500 per charka. Two labourers – one to reel the cocoons and the other to run the charka – are required to operate it. Another system is driven either by electric motor or kerosene generator (it can also be manually operated) costs about Rs. 6,500 per unit[1]. Three labourers are required to run the unit – 2 being engaged in reeling and the third acting as helper. The third type is Cottage basin which is driven by electric motor/generator/hand. The technology is largely imported from the neighbouring Karnataka state. This costs about Rs. 80,000 per unit[2]. Fifteen labourers, six for reeling, three for cooking the cocoons, two as helpers, one for re-reeling, two for sorting and stifling and one supervisor for overall charge are required to run a unit[3].

Influencing Factors

Though many factors are responsible for the development of silk reeling the three most important availability of skilled labourers, technology and credit.

Skilled Labour

In Hindupur, the reeling industry is operated by family labour, hired labour and sometimes both. However, when the scale of operation increases, the family labour involvement decreases[4]. In single and twin charka units, family and hired labour constitute 52 per cent and 48 per cent respectively of the total labour force, whereas in four charka units, the corresponding figures are 39 and 61 per cent. In units with more than four charkas, the participation of family labour is as low as 24 per cent and that of hired labour 76 per cent. Of the total labour force, men form 25 per cent, women 14 per cent and children as much as 61 per cent (Gopalappa, 1995[5]).

Reeling industry in Hindupur started in the late seventies with a few migrant reelers from Karnataka. Over the years, quite a few local people took it up. Of the entrepreneurs, migrants from Karnataka constitute 42.5 per cent, 41.8 per cent from Hindupur itself and the remaining 15.6 per cent is from other parts of Anantapur district (Acharya et al., 1992). The industry cannot get the required skilled labour force from Karnataka and has to depend on the unskilled local labour. This has resulted in the establishment of only charka reeling technology which is easier to operate. The labourers get equal wages on piece rate basis but not on the basis of skill, i.e., both skilled and unskilled labourers receive the same amount of wage for their work.

In case of cottage basin reeling, a flat rate of Rs. 20 per day is paid as wage. In charka reeling, labourers get Rs. 5 per gani[6] of cocoons. A labourer can reel 6 to 7 ganies of cocoons and earn Rs. 30 to Rs. 35 per day. There is no incentive for labourers to master cottage basin reeling technology where better skill is required as it offers lower wages. A labourer who works on cottage basin is better skilled but earns less than an unskilled labourer and hence labourers are unwilling to shift from charka reeling to cottage basin reeling. The cottage basin entrepreneurs are forced to recruit new labourers who do not have skill and the silk they produce can command only a low price. This is the vicious circle which results in the poor performance of improved technology.

Technological factors

In AP in general and in Hindupur in particular, the charka technology is used to a greater extent. Many factors influence the adoption of charka reeling rather than other technologies: little space required to run the unit; low capital investment; abundant supply of skilled

1. Unit consists of two charkas (two basins).
2. Unit consists of six ends (six basins).
3. Other two important improved technologies like filature (multi end machine) and semi-automatic machines are found only in Karnataka state.
4. Only rich reelers can increase the scale, they feel that employing their own family labour is inferior.
5. Due to be published in Manpower Journal.
6. One gani constitutes two kgs. of cocoons Rs. 5 is paid as the wage for reeling one gani.

labour force; suitability of the water and less negative impact of price fluctuation. These factors adversely affect the cottage basin reeling.

Many factors influence the adoption of charka reeling rather than other technologies: little space required to run the unit; low capital investment; abundant supply of skilled labour force; suitability of the water and less negative impact of price fluctuation.

To establish one charka unit-consisting of two basins, 400 Sq. feet space is required, whereas a cottage basin unit needs 1500 Sq. Feet. This is mainly due to the fact that re-reeling of silk has to be done after reeling in the cottage basin technology and it requires the cocoons to be stifled and cooked in separate places whereas in the charka, the cooking basin is attached to the reeling machine itself. The cost of a twin charka unit (power operated) is Rs. 6,500 and the cost of a cottage basin unit is Rs. 80,000 (Department of Sericulture, AP). The working capital requirement for charka is low (in thousands) whereas it is quite high (in lakhs) for cottage basin reeling.

The requirement of skilled labour force is an important factor of production in the improved technology. As mentioned, labourers prefer charka reeling to cottage basin reeling since the remuneration is high in the former. Moreover, the existing labourers are used to the charka and can not master the cottage basin technology which results in high wastage. A few entrepreneurs had tried to get skilled labour from Karnataka, but could not cope with their demand of high amount of advances ranging from Rs. 5000 to Rs. 8,000 which amounts to Rs. 75,000 to Rs. 1,20,000 totally. On the other hand a unit with six charka basins may have to pay a maximum advance of Rs. 9.000 only for all the labourers.

In most parts of AP, the water is hard and not suitable for reeling. The reelers have to use oxipan[7] and citric acid to soften the water so as to get a better quality silk. However, even after treating the water, it is not totally fit for cottage basin reeling.

Whenever there is fluctuation in the prices of cocoons and also rawsilk, the reelers who have cottage basin units close down their units due to heavy losses. However, charka units transaction is bi-weekly and such fluctuations do not affect them much as the volume of the business is modest. Hence, they can withstand the price fluctuations.

Even the profitability of reeling does not favour cottage basin reeling technology. The data reveals that hand driven charka is the most profitable technology followed by power driven charka and cottage basins. Monthly net returns per basin of hand driven charka vary from minus Rs. 2419 to Rs. 5332 per month amounting to an annual net profit of Rs. 15,514 (table 2). The table shows that the owners of charka get the highest returns (Rs. 4694) in January and incur the heaviest loss (Rs. 2419) in May. Since May falls in peak summer, the quality of the cocoons is low due to the high intensity of diseases[8] for the silkworms which spin the cocoons.

In case of the power driven charka, the monthly net returns per basin (in the table the profitability is worked out for two basins) range from minus Rs. 2117 to Rs. 4544 per month with an annual net returns of Rs. 13,329 per basin (table 3). The table also reveals that the highest returns is in November and heaviest loss in May as in the case of manually operated charka.

Cottage basin reeling shows the lowest returns among the three technologies – the monthly net returns vary between minus Rs. 2546 and Rs. 4674 per basin (in the table, the profitability is worked out for six basins). And the net income per annum is Rs. 6954 per basin (table 4). The table shows that the cottage basin entrepreneurs incur the heaviest loss in September and get more returns in November. However, Hanumappa and Erappa (1985) present the opposite view. According to them in Karnataka state, the cottage basin fares better than charka since the labour productivity is much higher in the former than in the latter. They state that even the renditta[9] favours this technology. This may be due to the availability of suitable water, quality of cocoons and skilled labourers in Karnataka which are lacking in AP.

A modern system of production with better quality product facing stiff competition from the traditional system of production with inferior quality product is the peculiar problem of silk industry.

7. Oxipan is a chemical used to soften the water which in the study area is hard and not fit for reeling activity.

8. Mascardine and Pebrine are the two major diseases which cause severe loss to the silkworm rearers in summer.

9. The ratio of cocoons to produce a kg of rawsilk.

Table 2: Returns of Manually Operated Charka Technology (One Basin)

Particulars	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
Days worked	25	24	23	17	13	13	15	17	20	24	26	26	243
Avg. Cocoon Price/kg.	84.45	88.50	83.40	90.42	104.35	127.30	123.90	120.65	143.35	160.60	170.95	99.70	–
Number of Ganies/Day	8	8	8	6	6	6	6	6	6	8	8	8	84
Cocoons Handled	400	384	368	204	156	156	180	204	240	3384	416	416	3508
Cocoon Cost	33780	33984	30691	18446	16279	19859	22302	24613	34404	61670	71115	41475	408617
Market Fee	338	340	307	184	163	199	223	246	344	617	711	415	4086
Transport Cost													
Wages	1875	1800	1725	1020	780	780	900	1020	1200	1800	1950	1950	16800
Fuel/Electricity	700	672	644	357	273	440	422	405	224	172	172	198	4679
Total Working Capital	36693	36796	33367	20007	17494	21277	23847	26284	36172	64259	73947	44038	434183
Interest on Working Cptl	826	828	751	450	394	479	537	591	814	1446	1664	991	9769
Interest on Fixed Cptl	15	15	15	15	15	15	15	15	15	15	15	15	182
Depreciation/Fixed Cptl	14	14	14	14	14	14	14	14	14	14	14	14	170
Total Cost	37548	37653	34147	20487	17917	21785	24413	26904	37016	65734	75641	45058	444304
Silk Produced	50.00	48.00	46.00	25.50	19.50	19.50	22.50	25.50	30.00	48.00	52.00	52.00	438.50
Avg. Silk Price (local)	712	727	696	805	1010	1183	1157	1257	1313	1460	1459	913	–
Total Silk Value	35600	34896	32016	20528	19695	23069	26033	32054	39390	70090	75868	47476	456713
Jute Produced Value	333	320	307	170	130	130	150	170	200	320	347	347	2923
Pupae Sold Value	19	18	17	13	10	10	11	13	15	18	20	20	182
Gross Returns	35952	35234	32340	20710	19835	23208	26194	32236	39605	70428	76234	47842	459818
Net Returns	–1596	–2419	–1807	224	1917	1423	1780	5332	2589	4694	593	2784	15514

Notes: Type of unit: Manually operated charka (single basin) producing "medium' grade silk
Workers include one reeler (family) and one turner (hired)
Wages are worked out based on actual rates prevailing at the time of study. Opportunity cost of family labour included.
Fixed capital: Cost of machine = Rs. 850 (life 5 years for calculation of depreciation). Interest rate on fixed Capital = 13.5% per annum
Interest on working capital is taken as 9% per month
The turn over for realisation of value taken as one week
Days worked based on actuals
Renditta: 8 kgs of cocoons
Actual monthly average cocoon prices at Hindupur market (April 1991 to March 1992)
Market fee: @ 1% advelorem
Fuel charge taken @ 1.00 to 1.10 rupees per kg. of cocoon, varying across seasons; based average of actuals
Silk prices: Monthly average local silk prices computed on average of actual data (for the period April 1991 to March 1992), which should be Rs. 50 to to Rs. 75 below the Bangalore Silk Exchange prices
Jute produced at the rate of 1 kg. of jute for every 30 kg of cocoons sold at the rate of Rs. 25 per kg of jute
Pupae sold: Calculated @ 0.75 rupee per basin per day

Source: Acharya, J., Shashikala & D.V. Gopalappa.

Table 3: Returns of Power Operated Charka Technology (Two Basins)

Particulars	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
Days worked	22	20	15	14	13	13	14	15	20	22	24	24	216
Avg. Cocoon Price/kg.	84.45	88.50	83.40	90.42	104.35	127.30	123.90	120.65	143.35	160.60	170.95	99.70	–
Number of Ganies/Day	16	16	12	12	12	12	12	12	16	16	16	16	168
Cocoons Handled	704	640	360	336	312	312	336	360	640	704	768	768	6240
Cocoon Cost	59453	56640	30024	30381	32557	39718	41630	43434	91744	113062	131290	76570	746503
Market Fee	595	566	300	304	326	397	416	434	917	1131	1313	766	7465
Transport Cost	430	420	395	390	385	385	390	395	420	430	440	440	4920
Wages	3080	2800	1425	1330	1235	1235	1330	1425	2400	3080	3360	3360	26060
Fuel/Electricity	974	898	811	766	721	721	766	811	1314	974	1050	1050	10854
Total Working Capital	64531	61324	32955	33171	35224	42456	44533	46499	96795	118677	137452	82185	795801
Interest on Working Cptl	1452	1380	742	746	793	955	1002	1046	2178	2670	3093	1849	17906
Interest on Fixed Cptl	158	158	158	158	158	158	158	158	158	158	158	158	1890
Depreciation/ Fixed Cptl	96	96	96	96	96	96	96	96	96	96	96	96	1150
Total Cost	66236	62958	33950	34170	36270	43664	45788	47798	99227	121600	140798	84287	816747
Silk Produced	88	80	45	42	39	39	42	45	80	88	96	96	780
Avg. Silk Price (local)	712	727	696	805	1010	1183	1157	1257	1313	1460	1459	913	–
Total Silk Value	62656	58160	31320	33810	39390	46137	48594	56565	105040	128498	140064	87648	837882
Jute Produced Value	587	533	300	280	260	260	280	300	533	587	640	640	5200
Pupae Sold Value	33	30	23	21	20	20	21	23	30	33	36	36	324
Gross Returns	63276	58723	31643	34111	39669	46417	48895	56888	105603	129117	140740	88324	843406
Net Returns	–2961	–4234	–2307	–59	3400	2752	3107	9089	6377	7517	–58	4037	26659

Notes: Type of unit: Power operated charka (two basins) producing "medium' grade silk

Workers include two reelers (one family, the other hired), one helper (hired)

Wages are worked out based on actual rates prevailing at the time of study. Opportunity cost of family labour included. Also costs on purchasing and transporting of cocoons.

Fixed capital: Cost of machine, motor, stand-by generator = Rs. 11500 (life span is 10 years for calculation of depreciation).

Interest on working Capital is taken as @9% per month

The turn over for realisation of value taken as one week

Days worked based on actuals

Renditta: 8 kgs of cocoons

Actual monthly average cocoon prices at Hindupur market (April 1991 to March 1992)

Market fee: @ 1% advelorem

Fuel charge taken @ 1.00 to 1.10 rupees per kg. of cocoon, varying across seasons; based average of actuals plus cost of 1 litre of kerosene per day, plus Rs. 140 flat-rate electricity charges per month

Silk prices: Monthly average local silk prices computed on average of actual data (for the period April 1991 to March 1992), which should be Rs. 50 to to Rs. 75 below the Bangalore Silk Exchange prices

Jute produced at the rate of 1 kg. for every 30 kgs of cocoons, sold at the rate of Rs. 25 per kg of jute

Pupae sold: Calculated @ 0.75 rupee per basin per day

Source: Same as for table 2

Table 4: Returns of Cottage Basin Reeling Technology (Six Basins)

Particulars	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
Days worked	22	18	17	17	16	14	14	15	17	22	22	22	216
Avg. Cocoon Price/kg.	83.40	80.30	71.60	87.90	100.10	129.30	123.15	115.50	124.85	148.90	166.25	106.80	–
Cocoons Processed/basin/kgs.	12.18	12.76	12.76	12.76	13.34	13.34	13.34	13.34	13.34	12.18	12.18	12.18	153.70
Cocoons Handled/kgs.	1608	1378	1302	1302	1281	1121	1121	1201	1361	1608	1608	1608	16495
Cocoon Cost	134087	110660	93189	114404	128192	144888	137997	138669	169881	239395	267290	171709	1850361
Market Fee	1341	1107	932	1144	1282	1449	1380	1387	1699	2394	2673	1717	18504
Transport Cost	892	820	802	802	784	748	748	766	802	892	892	892	9840
Wages	7832	6408	6052	6052	5696	4984	4984	5340	6052	7832	7832	7832	76896
Fuel/Electricity	1631	1385	1324	1324	1262	1140	1140	1201	1324	1631	1631	1631	16622
Total Working Capital	145783	120380	102299	123725	137126	153209	146249	147363	179756	252144	280318	183781	1972223
Interest on Working Cptl	505	417	354	428	475	530	506	510	622	873	970	636	6827
Interest on Fixed Cptl	3797	3797	3797	3797	3797	3797	3797	3797	3797	3797	3797	3797	45563
Depreciation on Fixed Cptl	601	601	601	601	601	601	601	601	601	601	601	601	7212
Total Cost	150685	125194	107050	128552	142089	158137	151153	152271	184778	257415	285686	188815	2031825
Silk Produced	153	125	118	118	111	97	97	104	118	153	153	153	1503
Avg. Silk Price (local)	953	949	985	1068	1243	1435	1501	1696	1672	1751	1765	1197	–
Total Silk Value	145923	118891	116545	126366	138420	139826	146257	177062	197831	268212	270257	183285	202887
Jute Produced Value	2345	2010	1898	1898	1868	1634	1634	1751	1984	2345	2345	2345	24056
Pupae Sold Value	2010	1723	1627	1627	1601	1401	1401	1501	1701	2010	2010	2010	20619
Gross Returns	150278	122623	120070	129891	141889	142681	149292	180314	201516	272567	274644	187639	2073551
Net Returns	–408	–2571	13020	1339	–200	–15276	–1860	28043	16739	15152	–11075	–1176	41726

Notes:

Type of unit: Cottage basin (Ramanagaram type) with six basins producing 18-20 denier silk

Workers are 15, including reelers, helper sorters, cooks etc.

Wage is Worked out based on actual rates prevailing at the time of study. Also included are the expenses on purchasing and transporting of cocoons and costs on marketing of silk at Bangalore.

Fixed capital: Includes cost of land (1500 sq.ft.): Rs. 13,000: Cost of shed construction: Rs. 1,48,500; Cost of reeling and re-reeling machinery: Rs. 70,000; Advance paid to workers: Rs. 1,06000

Interest is 13.5 per cent has been considered on fixed cost and 18 per cent on working capital. Depreciation has been worked out only on shed and machines taking the life of shed as 40 years and that of machinery as 20 years.

The turn over for realisation of value taken as one week

Days worked based on actuals

Renditta: 10.5 kgs of cocoons during January-April; 11 kgs during May-July; 11.5 during August-December

Cocoon price: actual monthly average cocoon prices at Hindupur market (April 1991 to March 1992)

Silk produced per reeler per day: Average 1.16 kg of silk. (Estimation based on average of actual data)

Market fee 1 per cent advelorem

Fuel charge taken as 4 bags per day at the cost of Rs. 15 per bag of ground-nut husk, plus two liters of kerosene per day for the generator, plus fixed electricity charges of Rs. 280 per month.

Silk prices: Monthly average silk prices at Bangalore silk Exchange (average of actual data (for the period April 1991 to March 1992) Jute produced at the rate of 1 kg. for every 24 kgs of cocoons, sold at the rate of Rs. 35 per kg

Pupae sold: Calculated at 800 gm per kg of cocoon, sold at the rate of Rs. 1 per kg

Source: Same as for table 2

The returns per rupee investment is worked out to be Rs. 1.04 and Rs. 1.03 for hand driven and power operated charka technology and Rs. 1.02 in the case of cottage basin reeling technology. Even though the difference in the profit margin among the different technologies is minimum, the reeler has to take more risk in the case of cottage basin reeling technology. Srikantaradhya (1985), while referring to Karnataka's silk reeling development, observes that a modern system of production with better quality product facing stiff competition from the traditional system of production with inferior quality product is the peculiar problem of silk industry. However, in the later stages, the better quality product stabilises and gets its own market.

Financial Problems

For the growth and development of silk industry, capital plays an important role. It is one among the major constraints in the development of silk reeling in AP. The reelers avail financial assistance from three important sources viz., formal credit, informal credit and advances from silk traders.

Formal credit (banking institutions)

As a part of the government's initiative, financial assistance is provided to new reelers through commercial banks and other financial institutions. The project cost to establish a two charka unit and cottage basin unit is estimated to be Rs. 29,000 and Rs. 3,10,000 respectively. Upto 1991-92, altogether 799 beneficiaries availed the loan and 543 units including three cottage basin reeling units were established. The loans carry 20 per cent subsidy and a margin money of Rs. 5,000 and 20,000 is provided by the Minority Commission. Although five years time has been given to repay the loan, this programme has failed due to lack of skilled labourers, the demand for exorbitant amounts as advance wages by the few available skilled labourers from Karnataka; inadequate working capital and lack of suitable quality of cocoons for cottage basin reeling. It was found that out of the 543 units established around 340 charka units and the three cottage basin units are functioning.

True entrepreneurship spirit and the desire to run a successful business were not the motives for many people who availed the loans. The main reason for getting the loan was found to be the lure of the subsidy and the margin money which need not be repaid. Many reelers considered this itself as profit and they did not bother if the banks confiscated the building and machinery. Even the bank officials seem to be having some percentage in the subsidy. It has not been a development oriented investment and such programmes should not be focussed towards just meeting the targets as the reelers' interest has been to avail the subsidy but not to take up reeling (Gopalappa, 1994, p. 35).

The main reason for getting the loan was found to be the lure of the subsidy and the margin money which need not be repaid.

Moreover, there is no cordial relationship between the bankers and the beneficiaries, particularly after the disbursement of credit. In reality, there should be a close interaction between reelers and bankers to get loans for working capital, but the banks do not lend even a rupee other than the sponsored money which is a handicap for further development. It is, as the bank officials say, due to the poor repayment behaviour of the reelers.

Informal credit (non banking institutions)

The informal sources of credit are the money lenders and chit funds. These are opted for by the reelers due to easy access, less formalities, prompt disbursement and the credit being extended for a variety of purposes. Though the interest rate is exorbitant (108 per cent per year) and repayment has to be made within a short period of time ranging from one week to 3 months, there is a great demand for informal credit. But the disadvantage of informal credit is that since the repayment period is very short, this cannot be used for asset creation and is used only for short term transactionary purposes.

If comparison is made between formal and informal credit, the former is far better than the latter. In the formal credit arrangement, the interest rate is low (13.5 per cent per annum) and the repayment period is quite long (5 years). Hence, there is every opportunity to stabilise the business and pay back the loan. But unfortunately corruption, redtapism and the bureaucratic nature of the officials force the beneficiaries to go in for informal credit. In private lending, repayment is assured and there are no hazards in the transactions.

Advances from silk traders

Financial needs are met by silk traders[10] also. By and large, silk traders advance the money for (non interest bearing advance) future purchases. Money given as an advance at surface appears as interest free but there

10. Silk traders are those who buy silk from small reelers and hoard it to gain the advantage of price fluctuation.

is an implicit interest in it. The reeler is under obligation to sell silk to the creditor and most of the time the silk is valued at lower than the market rate. Though the reelers are always the losers, they still prefer advances rather than credit since the interest rate is higher than what they lose from the price of silk.

Summary & Suggestions

Lack of skilled labour is one of the major constraints to the development of silk reeling in AP. It is due to the equal wage rates prevailing for similar work, irrespective of age, gender and lack of training to the labourers on modern technology like cottage basin reeling. The department can take the initiative to organise training programmes for labourers in the operation of cottage basin reeling technology and may provide some incentives during the training period. Moreover, the trainees have to be educated to join private units instead of waiting for government jobs. Even though the department has initiated training programme under schemes like Indo-Swiss Programme, Training Rural Youth for Self-Employment and Andhra Pradesh Self-Employment Training, the programmes are not effective in the creation of skilled labour force since the number of persons trained is low.

The department can select a suitable place and declare it as silk reelers colony and the property may be given to reelers after satisfying the rules and regulations of the revenue authorities. Before formulating such a project, a techno-economic feasibility study should be carried out for a specified area.

The present study showed that charka reeling technology is more profitable than cottage basin reeling. However, cottage basin technique can be profitable provided there exist the necessary inputs like skilled labour and suitable water as noted in Karnataka (Hanumappa & Erappa, 1985). Rajapurohit and Govindaraju (1981) reveal that the cottage basin technique absorbs more labour per unit of capital and is also capable of producing high value-added per unit of labour. They suggest that to augment employment and income, the cottage basin technique has to be preferred as it provides higher level of employment and income. Nonetheless, for the balanced development of reeling industry, in the state of AP, both charka and cottage basin technologies may be encouraged.

The cottage basin technique has to be preferred as it provides higher level of employment and income.

Most of the reelers borrow from the bank for cottage basin units exclusively to avail the subsidy and the margin money and ultimately become defaulters. Hence, some modifications in the scheme can be made. The subsidy may be removed and strict action may be taken on the defaulters. Against subsidy, inducement price can be given on production of rawsilk from cottage basin technology till the infant industry develops and is able to compete in the general market. This system is better than subsidy since production of rawsilk is assured and the reelers are also benefitted.

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Feature

Spices in North Eastern Region: Present Status & Future Strategies

Ram Chandra & U.C. Sharma

The North Eastern Region, comprising the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagland and Tripura, has a tremendous potential for the production of spices. Ginger, turmeric, chillies, tejpata, garlic, coriander and large cardamom are the major spice crops having good potential in the region. The availability and export potential of spices are analysed in the paper and methods suggested for enhancing the productivity and production of spices in the region. Future research strategies to achieve the maximum potential have also been enumerated.

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India has been known as the 'land of spices' from time immemorial and is the leading country in the world as far as the production, consumption and export of spices are concerned. Spices can be categorised into six groups based on the parts of the plant from which they are obtained, namely, rhizomes and roots, bark, flowers, leaves, fruits and seeds. Among 63 existing spices, the major ones are; cardamom, ginger, turmeric, chillies, garlic, coriander, cumin, fennel, fenugreek, celery, saffron, clove, nutmeg and cinnamon.

The North Eastern Region, comprising the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura, and having a geographical area of 255,090 sq km, has tremendous potential for the cultivation of spices due to its moderate climate (Sharma, 1993). The climate of the region varies from near tropical to temperate with the altitude varying from 73m to more than 6000m above mean sea level. The rainfall is low to heavy and the region also has some rain shadow areas. These extreme variations in climate and altitudes in the region could be exploited for the production of spices on commercial scale. This would enhance the income of the otherwise poor farmers of the area. The state and Central Government have already realised this and many schemes on the production of spices are under way.

Area, Production & Productivity

The total area under spice crops in North Eastern States is 69.51 thousand ha with a production of 217.24 thousand tonnes with an average yield of 3.12 t/ha (table 1). Maximum area under spices is in Assam (57.3%) followed by Meghalaya (21.8%), Manipur (6.8%) Mizoram (5.3%) Tripura (4.7%), Arunachal Pradesh (3.3%) and Nagaland (0.6%).

About 66.4 per cent of the total production of spices is in Assam followed by Meghalaya (21.1%) while

Nagaland has the lowest share. The highest yield per hectare of spices has also been recorded in Assam (3.62 t/ha) and lowest in Tripura (1.06 t/ha).

Table 1: State-Wise Area, Production & Productivity of Spices in North Eastern Region (1990-91)

State	Area (000'ha)	Production (000'tonnes)	Productivity (t/ha)
Assam	39.89	144.35	3.61
Arunachal Pradesh	2.29	5.91	2.58
Manipur	4.70	6.53	1.38
Meghalaya	15.20	45.85	3.01
Mizoram	3.72	9.91	2.66
Nagaland	0.41	1.19	2.90
Tripura	3.30	3.50	1.03
Total	69.51	217.24	3.12

Table 2: Crop-Wise Area, Production and Productivity of Spices in North Eastern Region (1990-91)

Spices	Area (000'ha)	Production (000'tonnes)	Productivity (t/ha)	
			N.E	National
Ginger	14.48	143.36	9.90	2.79
Turmeric	12.01	11.82	0.98	2.96
Chillies	23.02	17.67	0.77	0.80
Tejpata	5.23	13.31	2.55	–
Large cardamom	0.43	0.05	0.12	–
Pepper	0.58	0.35	0.60	0.28
Coriander	5.30	7.36	1.39	0.63
Garlic	8.39	23.26	2.77	–
Cumin	0.10	0.05	0.45	0.55

Ginger, turmeric, chillies, tejpata, garlic coriander and large cardamom are the major spice crops of the region. Chillies and ginger have the distinction of having the highest area and production, respectively, while cumin has the lowest area and production in North Eastern Region (table 2). Productivity of ginger in North Eastern Region (9.90 t/ha) is 3.5 times higher than that of the country as a whole (2.79 t/ha), whereas the yield of all other spices in the region is relatively low. It appears from the data given in table 2. that it would be advisable to concentrate on ginger, turmeric, garlic and tejpata in the region. Commercial production needs to be attempted by launching schemes and giving incentives to the growers for higher benefits.

It would be advisable to concentrate on ginger, turmeric, garlic and tejpata in the region.

Per Capita Availability

Per capita annual availability of ginger during 1980-81 and 1990-91 was highest in Meghalaya (16.3 and 16.8 kg) and lowest in Manipur (0.070 and 0.591 kg, respectively). In case of turmeric, however, maximum per capita availability was in Meghalaya and lowest in Nagaland (table 3). Analysing the production trends, it is expected that by 2000-01, Mizoram would be leading in per capita availability of ginger (20.45 kg/annum) and Meghalaya in per capita availability of turmeric (1.40 kg/annum). Per capita availability of ginger in the region is about 25 times more than in the country while in the case of turmeric it is only about 83 per cent of the availability in the country. Thus ginger is one of the most

Table 3: Per Capita Annual Availability of Ginger and Turmeric in North Eastern States Vis-a-Vis Country (Kg/Capita/Annum)

States	Ginger			Turmeric		
	1980-81	1990-91	2000-01 Expected	1980-81	1990-91	2000-01 Expected
Arunachal Pradesh	1.424	4.918	6.750	0.474	0.847	1.130
Assam	3.140	4.536	5.520	0.271	0.266	0.275
Manipur	0.070	0.591	0.705	0.705	0.821	0.905
Meghalaya	16.317	16.802	18.600	1.347	1.022	1.400
Mizoram	3.448	15.350	20.450	0.646	0.272	0.350
Nagaland	0.645	0.822	0.950	0.040	0.045	0.050
Tripura	0.389	0.495	0.525	0.682	0.582	0.600
N.E. Region	3.038	4.566	5.110	0.352	0.344	0.394
All India	0.120	0.175	0.265	0.316	0.411	0.512

promising spice crops in the region, particularly in Meghalaya, Mizoram and Arunachal Pradesh.

Thus ginger is one of the most promising spice crops in the region, particularly in Meghalaya, Mizoram and Arunachal Pradesh.

Annual Compound Growth Rate

Annual CGR of 10.5%, 6.5%, 6.4% and 5.9% in area, 22.2%, 17.7%, 12.8% and 6.4% in production and 12.2%, 12.9%, 14.5% and 0.9% in productivity was registered in Arunachal Pradesh, Manipur, Mizoram and Tripura, respectively, in ginger area, production and productivity between 1980-81 and 1992-1993 (table 4). For turmeric, annual CGR in case of area, production and yield was 11.6% and 3.7%, 13.4% and 5.3% and 0.9% and 2.0% in Arunachal Pradesh and Tripura, respectively. Area under ginger has gone down in Nagaland and productivity of turmeric has shown a slight decline in Meghalaya. The area under chillies has also decreased in Mizoram and Nagaland. The States registering a major increase in area (8.4% and 3.4%, ACGR) and production (10.3% and 7.7% ACGR) in Chillies are Arunachal Pradesh and Tripura, respectively. Overall productivity of chillies increased in Mizoram (5.9% ACGR), Nagaland (5.5% ACGR), Arunachal Pradesh (4.2% ACGR) and Tripura (3.2% ACGR). Compared to All India Annual CGR in area, production and productivity thereby that there is a great scope for bringing more area in the region under spices as well as enhancing their production and productivity.

Export Potential

Of the estimated world production of about 16 million tonnes, India's share is slightly over two million tonnes from an area of 2 million ha. The total export potential of spices in the country is around 5.73 million tonnes (table 5). At present, India exports about 124,405 tonnes of spices valued at rupees 3774.4 million, but with exploitation of total potential, the export will touch rupees 193,667 million mark (table 5). Individually, export of the pepper accounted for the maximum value (22.1%), followed by dry chillies (18.0%), coriander (5.3%), ginger and turmeric (4.1% each). The total production of spices in NE States is about 217.24 thousand tonnes. Data presented in table 6 gives an overall picture of the production, consumption, and value of the major spices which could be spared for export. Ginger, turmeric, dry chillies, tejpata, garlic and coriander are the major spices which can bring prosperity to NE Region, if exploited properly. Of these, ginger and turmeric have the maximum potential. Among states Meghalaya has got the highest potential for export of spices.

At the present level of production and consumption, the surplus produce of spices can be valued at Rs. 65.9, Rs. 226.9 (except ginger), Rs. 62.0, Rs. 554.0 and Rs. 202.9 million rupees in Arunachal Pradesh, Assam, Manipur, Meghalaya and Mizoram, respectively, while Nagaland and Tripura appear to be deficit with spices valued at Rs. 68.7 and Rs. 130.1 millions, respectively. Among spices, dry chillies could be exported to the tune of 9097 tonnes valued at Rs. 363.8 million followed by ginger (Rs. 299.0 million, ginger status of Assam not included). Tejpata has a good potential for export from Meghalaya and garlic from Assam. The expected value of whole produces of

Table 4: Annual Compound Growth Rates (%) of Various Spices in North Eastern States

State	Ginger			Turmeric			Chillies		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
Arunachal Pradesh	10.5	22.2	12.2	11.6	13.4	0.9	8.8	10.3	4.2
Assam	6.0	–	–	0.10	0.3	0.3	1.3	2.3	0.9
Manipur	6.5	17.7	12.9	–	–	–	1.5	1.9	0.2
Meghalaya	1.0	4.2	3.2	0.6	0.2	–0.1	1.6	0.9	–0.6
Mizoram	6.4	12.8	14.5	0.00	5.9	4.7	–1.8	5.6	5.9
Nagaland	–8.7	4.1	1.1	–	–	–	–14.4	–7.7	5.5
Tripura	5.9	6.4	0.9	3.7	52.3	2.0	3.4	7.0	3.2
Total	2.5	7.8	2.7	0.7	2.7	2.6	0.9	2.7	1.8
All India	3.1	7.2	4.0	1.9	5.1	3.1	0.8	3.6	2.7

Table 5: Export of Spices from India (1992-93) and Total Export Potential

Spices	Quantity (tonnes)	Value (Million rupees)	Per cent share	Total potential (million tonnes)	Value (M. rupees)
Pepper	25,480	831.7	22.1	0.490	18888
Cardamom (small)	175	67.9	1.8	0.043	17451
Cardamom (large)	1270	80.3	2.1	0.812	773
Dry Chillies	16850	678.6	18.0	1.476	15263
Ginger	8220	156.9	4.1	1.066	13417
Turmeric	18950	156.9	4.1	0.428	88276
Coriander	13555	199.1	5.3	0.727	11097
Cumin	2080	117.6	3.1	0.182	8899
Celery	2750	41.8	1.1	0.010	164
Fennel	2550	63.5	1.7	0.028	665
Fenugreek	4850	52.1	1.3	0.038	558
Garlic	7700	71.6	1.9	1.191	14477
Other spices	13700	216.6	5.8	0.020	316
Spice products	6075	1039.8	27.6	0.020	3423
Total	124,405	3774.4	100.0	5.731	193667

surplus spices in the region is valued at Rs. 912.9 million which is estimated to increase to Rs. 1374.3 million by 2000-01.

This shows that with adequate and appropriate efforts the spices productivity and production could be enhanced and the region can highly benefit from these crops. Some constraints in the spice industry like inconsistent quality of the produce, adulterants, microbial contamination, bird excreta, pesticidal residues and aflatoxins are serious problems. Consumer packs and value added forms would solve the problem.

Constraints

Some of the constraints experienced in enhancing the production of spices are the prevalence of shifting cultivation in the region, land tenure system, size of holding, non-availability of good seed, high rainfall, lack of funds, lack of improved technology and management practices. In shifting cultivation, the agricultural crops are sown in intimate mixture and the yields are very poor. Spice crops generally do not find any place in this system. Further, shifting cultivation has caused large scale deforestation, soil degradation and depletion of resource base. For boosting the productivity of spices, settled cultivation is necessary like other crops. The productivity is low also due to the land and tenure system prevailing in the region because the farmers do not feel any sense of belonging to the land and do not undertake adequate management practices. Lack of availability of good seed of spice crops is also a problem in the region. A good seed distribution system would be helpful for higher productivity. The high rainfall received in the region causes heavy infestation of the crops with weeds, pests and diseases.

Some of the constraints experienced in enhancing the production of spices are the prevalence of shifting cultivation in the region, land tenure system, size of holding, non-availability of good seed, high rainfall, lack of funds, lack of improved technology and management practices.

Unless suitable measures are adopted, yield reductions occur. Inputs such as seed, fertilizers etc. required for spice crops, need handsome financing back-up. The overall financial condition of the farmers being poor, lack of finance is a constraint raising the productivity of spices.

Future Strategies

The following measures are suggested for improving the yield and production of spices in the region:

Management is an important aspect for enhancing the productivity/production of spices in North Eastern States. At present, the production of spices in the

Total 6: Approximate Export Value of Spices – Spices which could be Exported from NEH States and their Export Value (in Million Rupees) (1990-91)

Spices	Item	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Tripura	Total
Ginger	Production*	4029.0	–	400.0	29,300.0	6,492.0	800.0	1200.0	42221.0
	Consumption*	2522.0	–	5334.0	5,142.0	1,997.0	3550.0	8015.0	26560.0
	Balance*	1507.0	–	–4934.0	24,158.0	4,495.0	–2750.0	–6815.0	15661.0
	Exp.Value	28.7	–	–94.1	461.1	85.8	–52.5	–130.0	299.0
Turmeric	Production	732.0	5950.0	1500.0	1800.0	186.0	55.0	1600.0	11,823.0
	Consumption	315.0	8137.0	666.0	643.0	250.0	444.0	1002.0	11,457.0
	Balance	417.0	–2187.0	834.0	1157.0	–64.0	–389.0	598.0	366.0
	Exp.Value	8.3	–43.7	–6.7	23.1	–1.3	–7.7	11.9	7.3
Dry Chillies	Production	998.0	7470.0	4000.0	1100.0	3209.0	200.0	700.0	17677.0
	Consumption	228.0	6102.0	498.0	482.0	187.0	333.0	750.0	8580.0
	Balance	770.0	1368.0	3502.0	618.0	3022.0	–133.0	–50.0	9097.0
	Exp.Value	30.8	54.7	140.0	24.7	120.9	–5.3	–2.0	363.8
Tejpata	Production	10.0	–	–	13,300.0	–	–	–	13310.0
	Consumption	–	–	–	3000.0	–	–	–	3000.0
	Balance	–	–	–	10,300.0	–	–	–	10310.0
	Exp.Value	–	–	–	51.5	–	–	–	51.5
Garlic	Production	125.0	22,884.0	130.0	20.0	–	120.0	–	23259.0
	Consumption	315.0	8137.0	666.0	663.0	250.0	444.0	1002.0	11457.0
	Balance	–190.0	14741.0	–536.0	–643.0	–250.0	–324.0	–1002.0	11802.0
	Exp.Value	–1.9	147.4	–5.4	–6.4	–2.5	–3.2	–10.0	118.0
Coriander	Production	–	6865.0	500.0	–	–	–	–	7365.0
	Consumption	–	2295.0	182.0	–	–	–	–	2477.0
	Balance	–	4570.0	318.0	–	–	–	–	4888.0
	Exp.Value	–	68.5	4.8	–	–	–	–	73.3
	Total Value	65.9	226.9	62.0	554.0	202.9	–68.7	–130.1	912.9
Expected Value in 2000-01 (Million Rs)		92.9	276.5	75.5	782.0	286.2	–48.7	–90.1	1374.3

* in tonnes

region is not given a preferential treatment like that of food crops. The spice crops are not grown on commercial scale and still, come under the category of backyard crops. Proper nutrition of crops with macro and micro nutrients, proper timing in planting, interculturing, timely weeding and plant protection measures are necessary for enhancing yields. Use of organic manures in acidic soils (@ 15 t/ha) helps in increasing productivity and maintenance of soil health.

Spices have to be given their due share of land, water and inputs if their production is to be made a commercial venture in the region. Settled cultivation and right of ownership of land of the farmers are necessary for judicious management of land and crop.

Provision of financial facilities for the purchase of costly seed and other inputs for spice production is necessary. There should be a scheme to provide soft loans to the farmers.

The state departments of agriculture need to arrange good quality seeds for different spices since these are not easily available to the farmers. Unless good quality seed is used, productivity cannot be enhanced.

Spices in Different Farming Systems

Since more area may not be available for the cultivation of spices on large scale as also for getting higher returns per unit of area, it would be appropriate to include spices in different farming systems. There are some spices like ginger, turmeric, cardamom, coriander etc. which can be grown very well under partial to moderate shade conditions. The gestation period of perennial woody trees can be utilized to generate subsistence

income by including such spices. In the humid tropics and subtropics, higher efficiency of land, solar radiation and water can be achieved by adopting intensive cropping systems. There is ample scope in sub-temperate to temperate regions also for improving the efficacy of soil and water resources by including spices in the cropping system.

Fruit trees and spices: Generally fruit trees are planted at wide spacing (5 to 10 m apart), the gap remaining unutilized. Different spices have been tried in orchards and have proved remunerative particularly in pre bearing stage. Growing of ginger in mandarin orchards in Meghalaya has been highly profitable with a net return of Rs. 7819 per hectare than rice (Anonymous, 1987). In another study under slopy land condition, ginger and turmeric recorded higher net return without affecting the growth of orange trees (Anonymous, 1989). Guava takes 3-4 years to come into full bearing stage and this gestation period could be utilized properly. Intercropping with ginger and turmeric in guava orchard gave a net return of Rs. 7930 and Rs. 4335 per hectare, respectively (Anonymous, 1988). Chandra and Prasad (1994) evaluated different inter crops including turmeric in 2 and 3 year old guava orchard. Turmeric recorded maximum cost benefit ratio (1:2-1) in a 2-year old orchard but in a 3-year old orchard, except for pineapple, no other intercrops were remunerative. Turmeric, was found to be a highly exhaustive crop as its yield reduced to a great extent in the following year. Different intercrops in papaya and banana were tried, chilli and coriander were found to be most suitable in papaya orchards but they did not perform well with banana (Chandra et al, 1981). Rhizomatous crops can suitably be planted in peach orchard as the growth of peach is not affected by them.

Plantation crops and spices: Coconut gardens with wide spacing of 7.5×7.5 m utilize only 50 per cent of solar radiation. Ginger and turmeric can be profitably grown both in the young and old gardens (Rethinam, 1993). Intercropping with chilli, ginger, turmeric, cinnamon, clove and nutmeg in coconut resulted in the increase of nut yields of coconut (Liyanage et al, 1994). Some of the other obvious advantages of inter cropping include better and more intensive utilisation of land, more income and generation of more employment. Arecanut with 2.6 × 2.7 m spacing permits 40 per cent of solar radiation and 70 per cent of space for other crops. Ginger, cardamom (small), turmeric are beneficial to grow as intercrops in arecanut gardens. However, pepper and tree spices are common in arecanut plantations of west coast and western ghats. The farmers of coffee and tea plantations in the country have now started growing black pepper on shade providing tree to improve incomes. The benefit of this technology can be extended in NE Region for better utilization of land and inputs for higher net returns.

Forest trees and spices: Forest ecosystem has better avenue to grow different types of spices though taking of crops in forest plantations is not very common. However, there are some reports where spices have been grown in forest plantations and the results have been quite encouraging. Large cardamom is grown with different forest species (*Alnus nepalensis, Schima wallichii, Ficus* sp) in Sikkim (Singh *et al.* 1989). Dhyani and Chauhan (1989) found higher yield of ginger and turmeric under the partial shade of *Pinus Khasia* (pine) compared to open condition. Lahari (1972) has proposed that in initial stages of teak (*Tectona grandis*) and sal (*Shorea robusta*) plantation, agricultural crops are suitable while turmeric can be grown in older plantations.

Mixed plantations and spices: Coconut cocoa, pineapple are successful in multistoreyed cropping. The productivity of these crops could be enhanced even at one third fertilizer schedule prescribed for individual crops. Pineapple with black pepper and arecanut resulted in highest net return of Rs.42,500/-ha/year after 6 years of plantation of trees while arecanut with black pepper would give about Rs. 31,500 per hectare per year (Chauhan & Dhyani, 1989). Tree species (clove, nutmeg, cinnamon) could prove to be an excellent choice for introducing in the forest ecosystems of North Eastern Region. Such high density systems improve the productivity of the crops, control soil erosion, suppress weeds, recycle soil nutrition and conserve moisture. For optimum utilization of land covered by fruit tree crops and forest species that continue for years together, suitable spices can be tried for increasing production. Such systems cater to the needs of the local markets and money returns are always better. Small and marginal farmers may be more benefitted with these systems particularly in humid climates.

Vegetables/Agriculture crops and spices: Spices are not commonly grown in vegetable and agriculture based cropping systems. However, in some pockets of our country such systems are followed to some extent. Chillies, fennel, coriander, kalajeera, cumin showed promise as intercrop with vegetables and agricultural crops. In north eastern region particularly in Meghalaya, some cereals (millets, maize, paddy), horticultural crops (ash gourd, chilli, tapioca, colocasia, brinjal etc.) and other crops (sesamum, cotton) are grown with ginger on jhum lands in Garo hill districts while in Khasi hill districts, ginger is grown mainly on buns (raised beds) including colocasia/sweet potato/chilli/cucumber/brinjal, bottle gourd etc or mixture of those. A peculiar system related to ginger cultivation in Meghalaya is that old

rhizomes are removed after about 60 days of planting (Chandra, 1994).

Marketing & Infrastructural Facilities

The North Eastern Region has generally faced problems regarding the proper disposal of its surplus produce. So creation of marketing and infrastructural facilities is a pre-requisite before undertaking the production of spices on commercial scale.

Future Research Needs

The following are the priority areas where more intensive research are needed so that the overall scenario of horticultural productivity can be increased in the region with sustainable production system.

- Survey, diagnosis and design
  - Evaluation of existing spice based land use systems
  - Survey and diagnosis of land for suitable spices
  - Development of area specific farming system models.
- Introduction, evaluation and improvement
  - Introduction of indigenous and exotic strains of spices for suitable areas
  - Breeding varieties in spices for high yield and better quality with emphasis on biotic and abiotic stresses.
- System management research
  - Rapid mass multiplication (micropropagation and other propagation methods), seed germination and efficient nursery raising techniques
  - Studies of plant stress factors and their effect on production behaviour
  - Use of biofertilisers
  - Manipulation of plant canopy for efficient productivity
  - Exploitation of biological pest management or cheap chemical control measures or integrated pest management
  - Development of simulation models for predication of crop yield
  - Studies on plant ecosystem, recycling of nutrients, soil erosion and soil fertility build up under different farming systems
  - Organic farming
  - Evaluation of modern irrigation techniques (sprinkler, drip).
- Post harvest technology
  - Processing and preservation for value added products
  - Quality control
  - Packing techniques
- Economics and technology transfer
  - Evaluation of cost benefit analysis of different farming systems, socio-economic impact study and analysis of existing systems on marketing of plant products.
  - Research methods in extension and training.

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Capital Productivity in Indian Manufacturing (1973-94)

NPC Research Division

In our earlier study on Productivity in Indian Economy, we arrived at labour and capital productivity ratios for broad economic sectors of the economy during 1951-1994 (Productivity Vol. 37 (1), 1996). Yet another study attempted to estimate labour productivity and labour intensity ratios in 46 Indian Manufacturing industries for the period 1973-92 (Productivity, Vol. 36 (1), 1995). In the present study we arrive at capital productivity for 46 industry groups separately and for the total manufacturing sector during 1973-74 – 1993-94. The capital productivity has been defined as a ratio of Gross Value Added to Gross Fixed Capital Stock. The industrial groups have been chosen keeping in view their significance in terms of contributions to the 'Gross Value Added' generated in the manufacturing sector.

Gross value added (net value added plus depreciation) is the increment to the value of goods and services that is contributed by manufacturing and is obtained by deducting the value of total inputs from the gross value of output. Gross value added has been deflated with industry group specific price indices with 1981-82 as the base year.

Capital has been estimated as Gross Fixed Capital Stock deflated by machinery and machine tools price index with 1981-82 as the base year. Fixed capital represents the depreciated value of fixed assets owned by the factory as on the closing day of the accounting year. Fixed assets are those which have a normal productive life of more than one year. Fixed capital covers all types of assets, new or used, or own constructed, deployed for production, transportation, living or recreational facilities, hospitals, schools etc., for manufacturing personnel. It includes the fixed assets of the head office allocable to the factory and also the full value of assets taken on hire purchase basis (whether fully paid or not) excluding interest element. It excludes intangible assets and assets solely used for post manufacturing activities such as sale, storage, distribution, etc.

Depreciation is consumption of fixed capital due to wear and tear and obsolescence during the accounting year and is taken as provided by the factory owner or is estimated on the basis of cost of installation and working life of the fixed assets.

Capital stock has been estimated based on the following methodology. We define Fixed Capital Stock (K_T) in year T as

$$K_T = K_o + \sum_{t=1}^{T} (I_t - DS_t),$$

where K_T is Fixed Capital Stock in year T

K_o is base year capital stock

I_t is Gross Investment (at the base year prices) in fixed assets in year t

DS_t is the amount of Fixed Assets (at the base year prices) discarded during year t

I_t is further defined as

$$I_t = (B_t - B_{t-1} + D_t)/P_t$$

Where B_t is the book value of Fixed Assets at the end of year t,

D_t is the amount of depreciation allowances made during year t

P_t is the capital goods price deflator.

About the time pattern of discarding, it has been assumed that assets discarded during a year is a constant fraction of the previous year's capital stock,

$$DS_t = \delta K_{t-1} \qquad (3)$$

The choice of δ is made by an iterative procedure. For ASI sector 2 percent has been assumed. For further details on the model, see Goldar, B.N. "Productivity Growth in Indian Industry", 1986, Allied Publishers, New Delhi.

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Table 1: Capital Productivity in Manufacturing Industries

Years	Food Products (20-21)			Refining of Sugar (206)			Hydrogenated Oils, Vanaspathi (210)			Beverages Tobacco & Tobacco Products (22)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	1.24	64865	13509	0.86	19150	261	1.96	4270	65	2.81	18538	2357
1974-75	1.08	79457	13454	0.60	19239	251	1.03	3109	71	2.99	29449	2080
1975-76	0.94	88362	14126	0.60	24929	243	0.83	3173	75	1.51	21188	2880
1976-77	0.86	99555	15306	0.53	26976	261	1.10	4733	79	1.91	32130	6398
1977-78	0.82	122338	15783	0.42	29291	288	1.31	5994	69	1.30	23983	7307
1978-79	0.77	140729	16310	0.43	37072	286	1.14	6171	69	1.48	31451	8240
1979-80	0.57	119006	16840	0.33	32399	293	1.13	7214	83	1.18	28084	9629
1980-81	0.36	81051	17067	0.21	22499	304	1.03	7948	82	0.95	25413	8901
1981-82	0.44	108782	18351	0.31	35972	296	0.75	5966	76	0.92	26923	9568
1982-83	0.50	139769	17111	0.46	58355	308	0.75	7185	90	0.94	27886	8486
1983-84	0.52	174551	17523	0.47	65280	318	0.50	6035	109	1.31	54005	8188
1984-85	0.46	167285	17459	0.35	56249	318	0.48	6056	102	1.05	44590	7093
1985-86	0.45	176292	17725	0.31	52397	323	0.63	9230	88	0.71	40174	8457
1986-87	0.41	175820	17299	0.33	60113	328	0.52	8928	97	0.77	48353	7163
1987-88	0.39	186740	18333	0.34	68921	349	0.46	9046	99	0.65	48625	7951
1988-89	0.42	225748	18581	0.46	102478	336	0.36	7484	104	0.60	54684	7723
1989-90	0.43	277839	19342	0.40	107853	361	0.33	7815	123	0.58	54605	9088
1990-91	0.35	252427	19760	0.28	88182	356	0.26	7094	103	0.54	57350	8448
1991-92	0.32	251538	19721	0.29	93315	352	0.24	7625	119	0.56	65346	8831
1992-93	0.29	254178	21397	0.28	101232	395	0.17	6188	203	0.49	66803	8350
1993-94	0.32	313468	21491	0.29	112512	399	0.18	7062	339	0.50	73598	5764

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Cotton Textiles (23)			Wool, Silk & Manmade fibre textiles (24)			Jute, Hemp & Mesta textiles (25)			Textiles Products (26)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	2.47	132405	5719	1.46	24276	2413	2.38	18125	429	3.91	11355	1642
1974-75	1.68	127571	5560	0.89	24967	2368	1.99	17791	322	2.64	10058	1652
1975-76	1.28	117562	5968	0.88	27807	2743	2.16	22692	184	2.03	11363	1979
1976-77	1.09	117618	6213	0.76	28692	3090	1.84	20196	201	1.75	12441	2192
1977-78	0.97	124413	6508	0.73	38024	3112	1.56	20194	223	1.54	13922	2347
1978-79	1.02	156605	6701	0.76	44387	3216	1.22	19115	247	1.26	15718	2577
1979-80	0.93	163936	7207	0.63	43261	3455	1.41	24402	257	0.84	12126	2907
1980-81	0.76	155598	7189	0.52	46072	3743	1.37	27590	265	0.84	12876	2889
1981-82	0.59	134151	7141	0.52	57102	4100	1.08	22984	297	0.92	15619	2943
1982-83	0.47	126498	6569	0.42	59376	3267	0.87	21056	219	0.89	17402	2491
1983-84	0.51	159517	6731	0.41	73233	3532	0.62	15878	236	0.80	18195	2621
1984-85	0.41	142615	6760	0.41	79119	2955	0.50	16461	215	0.91	23775	3063
1985-86	0.39	148905	7073	0.44	90691	3236	0.44	14593	204	0.65	19169	2835
1986-87	0.42	167503	6981	0.43	97889	2986	0.74	23734	184	0.70	22394	2821
1987-88	0.36	149208	6844	0.37	103433	3142	0.53	19633	236	0.57	27305	3141
1988-89	0.33	153001	6801	0.37	102861	3250	0.40	20949	187	0.67	33712	3159
1989-90	0.38	189967	7021	0.42	145342	3325	0.35	18152	327	0.75	44631	3186
1990-91	0.37	201716	7218	0.44	175903	3368	0.31	17852	326	0.74	50445	3537
1991-92	0.29	164533	7252	0.33	152019	3236	0.32	19645	352	0.80	62291	3772
1992-93	0.26	167584	8896	0.33	172042	3400	0.37	20912	420	0.80	69557	4104
1993-94	0.25	181190	8539	0.37	228563	3720	0.32	19105	422	0.98	117021	5333

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Wood & Wood products furniture & fixture (27)			Paper & Paper Prdts, Printing etc. (28)			Pulp, Paper & Paper board (280)			Leather, Leather & Fur Prdts (29)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	3.26	8517	2932	1.58	48813	3779	1.16	21576	560	3.92	5878	594
1974-75	1.87	8008	3158	1.15	50875	3820	0.98	29057	490	2.65	7472	667
1975-76	1.53	7645	3431	0.89	48728	3936	0.71	26253	424	1.57	4629	670
1976-77	1.38	8505	3573	0.74	49745	4506	0.52	23635	449	1.43	7901	727
1977-78	1.21	9165	3676	0.67	53699	4439	0.47	26123	538	1.09	8066	762
1978-79	1.08	9143	3788	0.60	52334	4901	0.42	25877	500	0.85	8374	797
1979-80	0.96	9455	3978	0.51	54252	4743	0.36	27000	587	0.69	8418	862
1980-81	0.69	7907	4033	0.40	54568	4798	0.27	27179	585	0.56	7413	886
1981-82	0.65	7947	4094	0.38	60820	4890	0.24	28425	672	0.56	8282	899
1982-83	0.55	7651	3618	0.28	53434	4571	0.14	19497	637	0.55	9500	880
1983-84	0.47	9677	3591	0.25	58808	4710	0.14	24432	734	0.60	11752	942
1984-85	0.52	9402	3847	0.25	69107	4808	0.16	33122	696	0.64	13573	929
1985-86	0.41	7551	3580	0.23	56645	4870	0.14	25121	802	0.48	11789	999
1986-87	0.39	8011	3873	0.22	65452	4921	0.15	31992	779	0.45	11469	976
1987-88	0.38	9107	3407	0.21	67790	5096	0.13	28313	899	0.54	15382	1074
1988-89	0.38	10774	3355	0.19	69617	4960	0.12	32982	808	0.44	15297	1195
1989-90	0.34	10223	3521	0.22	80854	5098	0.17	45443	842	0.49	19012	1238
1990-91	0.44	13774	3419	0.21	91678	5299	0.17	52345	895	0.45	22352	1398
1991-92	0.42	13318	3421	0.19	87136	5222	0.14	45410	839	0.49	26302	1545
1992-93	0.22	7589	3608	0.17	82208	5565	0.12	40341	927	0.49	29562	1581
1993-94	0.19	8628	3548	0.18	98951	5863	0.11	41164	1005	0.65	44569	1950

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Rubber, Plastic, Petroleum & Coal prdts (30)			Chemicals & Chemical Prdts (31)			Basic & Industrial Chemicals & Gases (310)			Fertilizers & Pesticides (311)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	1.54	50115	1794	1.13	152300	3043	1.38	34014	389	0.49	31163	335
1974-75	1.26	57711	1952	0.74	144044	3221	1.11	28221	543	0.30	30008	344
1975-76	0.92	59317	2496	0.52	143486	3732	0.73	27446	639	0.19	28099	378
1976-77	0.70	78549	2831	0.54	163153	4152	0.64	30448	701	0.21	33417	440
1977-78	0.67	88703	2881	0.50	183492	4674	0.72	38864	764	0.18	37661	469
1978-79	0.44	72824	2350	0.51	223558	4881	0.68	40223	874	0.22	52512	493
1979-80	0.42	74978	3302	0.39	218760	5328	0.50	36172	883	0.18	57196	503
1980-81	0.46	70623	3498	0.31	198261	5479	0.31	40402	917	0.14	46270	447
1981-82	0.36	69693	3864	0.31	215721	6834	0.35	44706	1223	0.16	56988	618
1982-83	0.42	98653	3514	0.33	240969	5350	0.31	47146	934	0.20	69245	442
1983-84	0.25	72974	3778	0.34	294416	5824	0.25	45135	978	0.18	76294	495
1984-85	0.32	104583	3900	0.31	290183	6032	0.24	50299	1320	0.23	92901	469
1985-86	0.46	174061	3958	0.29	305132	6402	0.22	54456	1040	0.18	84606	546
1986-87	0.41	170313	4097	0.26	305242	6335	0.24	67414	1017	0.16	78700	474
1987-88	0.39	184214	4412	0.28	358108	6578	0.24	68815	1049	0.18	98281	515
1988-89	0.35	204527	4660	0.29	406272	6946	0.28	85178	1119	0.21	128071	594
1989-90	0.36	218688	5047	0.29	483453	6631	0.21	72294	1264	0.21	152441	556
1990-91	0.37	261235	5289	0.28	528586	6914	0.21	86002	1377	0.23	171758	569
1991-92	0.30	229890	5627	0.26	537021	7251	0.21	92500	1405	0.21	176261	509
1992-93	0.38	328386	5971	0.30	689902	7886	0.18	82967	1444	0.24	210064	633
1993-94	0.38	387719	6162	0.29	752081	8537	0.19	98014	1522	0.20	184134	652

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Paints & Varnishes (312)			Drugs & Medicines (313)			Non-metallic Mineral Prdts (32)			Structural Clay Prdts (320)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	2.28	15151	388	1.72	22568	674	1.34	43418	3757	2.43	9400	1182
1974-75	1.57	13738	372	1.39	24380	682	1.00	39716	3890	1.29	8364	1223
1975-76	1.30	10904	368	1.40	29812	800	0.82	41875	4820	1.20	8925	1533
1976-77	1.13	12051	403	1.21	30577	865	0.76	45596	5309	1.05	9135	1641
1977-78	0.98	13079	496	1.09	32801	918	0.81	54431	5558	1.06	10005	1666
1978-79	1.05	20025	498	0.94	34110	958	0.62	52551	5639	0.96	11218	1727
1979-80	0.93	19733	551	0.89	38697	1070	0.52	50301	6083	0.88	11289	1899
1980-81	0.61	15671	568	0.81	40111	1121	0.44	52435	6440	0.71	10994	2159
1981-82	0.51	14134	773	0.69	40651	1434	0.38	56087	7694	0.64	11450	3048
1982-83	0.47	14180	476	0.76	48874	1131	0.41	73651	6667	0.55	11418	2495
1983-84	0.55	18774	547	0.87	63331	1187	0.33	78886	7618	0.35	10475	3117
1984-85	0.48	17762	515	0.68	56932	1265	0.33	87539	7841	0.35	11921	3146
1985-86	0.40	15266	555	0.66	60382	1358	0.28	98847	8515	0.31	12712	3421
1986-87	0.46	19155	592	0.64	63585	1374	0.22	91704	8267	0.28	11974	3247
1987-88	0.43	20348	739	0.66	75479	1479	0.22	103980	8706	0.30	15581	3445
1988-89	0.32	17055	722	0.64	82106	1554	0.20	115043	9025	0.27	15270	3486
1989-90	0.46	27341	820	0.65	94588	1699	0.22	132448	9038	0.24	14285	3515
1990-91	0.42	28261	853	0.58	97866	1794	0.24	156634	9441	0.24	16468	3674
1991-92	0.54	42725	939	0.64	124253	1886	0.25	187328	9919	0.22	16752	3976
1992-93	0.36	32155	1021	0.64	143440	2112	0.19	150471	10365	0.20	16894	4072
1993-94	0.29	34311	1105	0.69	177487	2352	0.06	55957	10826	0.21	20075	4261

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Glass & Glass Prdts (321)			Cement, Lime & Plaster (324)			Basic metal & Alloys Industries (33)			Iron & Steel in Primary/Self Finished forms (330)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	1.80	7364	391	0.71	11225	126	0.89	130408	4132	0.82	76235	942
1974-75	1.08	6400	932	0.53	10118	126	0.93	145500	4215	0.94	85720	1114
1975-76	0.82	5362	414	0.55	13604	205	0.46	149623	4562	0.41	93526	1150
1976-77	0.73	6124	448	0.51	14287	226	0.43	163855	4988	0.37	99743	1143
1977-78	0.85	7283	483	0.58	18538	247	0.35	151411	5054	0.31	94830	1299
1978-79	0.73	7592	560	0.41	15696	232	0.36	178852	5259	0.32	110158	1332
1979-80	0.62	6380	573	0.31	14585	271	0.27	162160	5538	0.22	98860	1471
1980-81	0.56	6265	590	0.24	15206	261	0.27	182018	5779	0.24	120244	1546
1981-82	0.55	7835	674	0.19	14896	276	0.26	203968	6013	0.24	140088	1714
1982-83	0.44	8188	607	0.34	33472	276	0.23	200457	5509	0.20	134727	1474
1983-84	0.43	8045	601	0.26	35693	328	0.22	219254	5888	0.20	146092	1686
1984-85	0.45	8992	567	0.28	41276	366	0.18	201703	5901	0.17	143837	1657
1985-86	0.55	12963	571	0.22	49054	468	0.18	208700	6077	0.16	146792	1764
1986-87	0.41	9984	556	0.17	47489	448	0.15	191410	6191	0.14	129810	1822
1987-88	0.37	10271	570	0.17	53828	517	0.16	223339	6184	0.15	145282	1754
1988-89	0.35	12037	596	0.16	61379	558	0.20	298515	6203	0.19	203618	1829
1989-90	0.39	18808	626	0.17	69732	551	0.17	277413	5853	0.14	162944	1597
1990-91	0.36	15328	598	0.21	93507	612	0.16	343431	6014	0.15	245047	1674
1991-92	0.42	24575	628	0.25	117567	616	0.11	264347	6097	0.09	168035	1682
1992-93	0.31	19259	590	0.16	83280	687	0.13	361106	6247	0.12	239633	1910
1993-94	0.24	21179	667	0.13	72521	745	0.24	713880	6447	0.12	271051	1799

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Foundry for Casting & Forging (331)			Ferro Alloys (332)			Copper Manufacturing (333)			Aluminium Manufacturing (335)			Zinc Manufacturing (336)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	1.43	42181	2440	1.32	2817	49	0.61	2820	92	0.69	9784	161	0.58	837	29
1974-75	1.93	41591	2519	1.36	2778	21	0.28	3543	74	0.40	10031	141	2.38	2672	11
1975-76	0.92	38940	2737	1.07	2777	42	0.17	2254	111	0.30	10098	200	0.65	1608	11
1976-77	0.72	38555	3094	1.21	3294	70	0.44	6153	116	0.34	12936	183	0.40	1849	12
1977-78	0.65	36260	2973	0.61	2981	43	0.16	1822	117	0.25	10579	232	0.37	3879	19
1978-79	0.73	48891	3121	0.64	3559	49	0.26	3077	96	0.27	12590	253	0.23	2592	20
1979-80	0.63	47807	3173	0.42	2691	49	0.35	4272	119	0.22	8970	280	0.26	3178	23
1980-81	0.63	53285	3293	0.59	4638	53	0.19	2444	141	0.10	5937	308	0.25	3092	24
1981-82	0.51	46294	3307	0.33	3232	60	0.17	2220	164	0.10	6143	317	0.17	2059	25
1982-83	0.43	44880	3126	0.21	2546	35	0.28	3741	149	0.15	9476	318	0.16	2250	21
1983-84	0.41	50024	3208	0.20	3759	65	0.27	3936	143	0.13	8708	364	0.31	4767	22
1984-85	0.30	39553	3313	0.15	2908	53	0.12	2193	129	0.16	11024	335	0.12	1805	21
1985-86	0.31	45136	3337	0.25	4856	54	0.12	2139	144	0.13	9337	331	0.09	1562	46
1986-87	0.29	44984	3365	0.26	6537	64	0.03	559	167	0.10	7150	328	0.19	3449	33
1987-88	0.28	46364	3313	0.30	7833	80	0.14	2622	175	0.11	17628	335	0.18	3504	43
1988-89	0.27	50246	3236	0.27	7424	76	0.08	1820	193	0.19	36282	395	0.14	2838	45
1989-90	0.16	30364	1442	0.25	6989	77	0.18	4047	187	0.21	41105	342	0.17	3648	29
1990-91	0.17	32718	1543	0.17	5380	87	0.19	4722	163	0.17	28250	288	0.14	3137	37
1991-92	0.14	29887	1326	0.11	7053	100	0.18	4795	166	0.17	35290	319	0.11	5227	44
1992-93	0.12	33285	1382	0.16	9297	96	0.03	980	144	0.17	42611	368	0.17	8455	34
1993-94	0.14	35262	1468	0.04	2314	95	0.02	662	224	0.14	34319	421	0.05	2364	40

Table 1: Capital Productivity in Manufacturing Industries (Contd.) 1981-82 = 100

Years	Metal Products & Parts (34)			Machine Tool & Parts (35)			Agriculture Machinery (350)			Prime Movers, Boilers (352)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	2.62	33558	4434	1.94	74403	4713	1.54	5852	799	3.14	19867	623
1974-75	1.86	31149	4412	1.41	84075	4808	0.99	5813	707	2.57	23151	689
1975-76	1.45	30539	5260	1.06	81427	5449	1.03	6822	637	1.59	20220	732
1976-77	1.27	34413	5590	1.09	98563	5881	1.04	10211	621	1.64	24935	776
1977-78	1.17	35740	5657	0.96	104004	6203	0.81	8652	718	1.60	24420	757
1978-79	1.09	35422	5818	0.90	106371	6387	0.80	10146	703	1.03	18841	719
1979-80	1.03	41621	6230	0.75	105018	6826	0.68	10198	789	0.83	17885	782
1980-81	0.81	39291	6457	0.73	109309	7011	0.72	11987	786	0.71	17671	800
1981-82	0.77	39794	6563	0.66	115713	7876	0.64	11347	797	0.71	21387	1097
1982-83	0.68	39823	5884	0.64	128824	7207	0.53	11304	717	0.63	21585	822
1983-84	0.62	44955	6054	0.61	148297	7138	0.50	12037	794	0.49	24139	838
1984-85	0.58	44369	6078	0.63	167784	7168	0.54	13967	734	0.70	32873	942
1985-86	0.54	44340	6307	0.53	171961	7648	0.58	15558	802	0.68	39920	940
1986-87	0.49	42953	5978	0.49	153781	7524	0.51	14018	700	0.41	21980	871
1987-88	0.54	58335	6390	0.49	169201	7584	0.60	17372	830	0.42	25359	956
1988-89	0.49	65072	6335	0.42	161931	7711	0.51	17113	775	0.38	27091	902
1989-90	0.40	53436	6683	0.45	191866	7753	0.54	18783	859	0.37	26504	770
1990-91	0.32	53130	6964	0.43	203093	7738	0.66	26521	824	0.30	21621	759
1991-92	0.33	58998	6890	0.60	447798	12771	0.53	22040	739	0.27	20618	797
1992-93	0.28	56922	7038	0.53	478818	13434	0.49	23173	802	0.22	17411	734
1993-94	0.29	70182	7496	0.49	478110	13854	0.44	20972	801	0.18	14823	878

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Industrial Machinery for Food & Textiles (353)			Industrial Machinery other than for Food & Textiles (354)			Refrigeration & AC (355)			Machine Tools & Parts (357)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	2.97	15268	1003	1.29	7533	402	2.18	2701	128	0.90	5512	590
1974-75	2.33	15690	977	0.82	7330	541	1,56	2760	161	0.86	7810	586
1975-76	1.65	14957	1028	0.75	10559	437	0.93	2030	121	0.79	8916	827
1976-77	1.66	17710	1130	0.75	11953	499	1.05	3057	130	0.75	9630	847
1977-78	1.52	20508	1250	0.40	8784	642	1.56	4459	151	0.61	9650	934
1978-79	1.38	21523	1289	0.56	10560	656	1.31	4380	155	0.59	10244	910
1979-80	1.11	19911	1375	0.56	12672	740	0.74	3942	162	0.54	11090	949
1980-81	0.91	18901	1359	0.53	9888	737	1.00	4826	200	0.47	10753	1009
1981-82	0.70	16275	1565	0.51	12510	768	1.11	5938	259	0.61	15380	1011
1982-83	0.63	18110	1250	0.56	13222	718	1.21	7130	164	0.57	16627	1166
1983-84	0.61	20583	1448	0.65	16996	725	0.93	6333	167	0.65	21358	1075
1984-85	0.52	19659	1266	0.59	16629	715	0.69	5418	165	0.60	23813	1027
1985-86	0.31	18077	1296	0.47	14431	829	0.89	7869	159	0.46	21229	1076
1986-87	0.44	18287	1240	0.49	16527	835	0.63	6161	173	0.40	18886	1032
1987-88	0.44	20650	1206	0.49	18097	940	0.59	6913	199	0.34	15634	975
1988-89	0.41	21935	1272	0.37	16628	995	0.41	5558	190	0.24	11921	1051
1989-90	0.51	27757	1217	0.39	18258	1158	0.64	13817	155	0.23	12829	1039
1990-91	0.51	30112	1241	0.32	17486	1121	0.56	15349	196	0.19	11732	985
1991-92	0.49	31817	1289	0.30	17528	1073	0.53	16158	212	0.19	11174	935
1992-93	0.42	33161	1336	0.33	20754	1234	0.55	16092	212	0.19	13570	1017
1993-94	0.39	32604	1341	0.37	24042	1271	0.39	18010	247	0.15	10210	1087

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Electrical Machinery (36)			Electrical Indl. Machinery (360)			Transport Equipment (37)			Locomotive Parts (371)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	1.91	65974	2380	1.96	33635	1141	2.17	84985	1600	1.27	6645	25
1974-75	1.05	59465	2340	0.95	28662	998	1.65	84208	1680	1.00	5538	23
1975-76	1.00	64422	2390	1.01	33336	843	1.28	77820	2752	0.95	5728	24
1976-77	0.95	70737	2596	0.97	35113	837	1.15	91559	2204	0.96	5272	16
1977-78	0.90	76811	2740	0.88	37541	915	1.04	94746	2348	1.33	7509	19
1978-79	0.83	80012	2882	0.80	37463	955	0.55	115497	2528	0.17	18102	24
1979-80	0.74	83917	3277	0.70	36333	1036	0.48	112462	2867	0.16	17001	36
1980-81	0.75	95901	3406	0.77	44230	1046	0.45	113386	2815	0.15	15694	41
1981-82	0.70	97728	4229	0.70	44290	1062	0.46	126909	3339	0.09	8980	44
1982-83	0.77	129540	3641	0.77	56697	1138	0.47	143375	2816	0.14	14006	37
1983-84	0.71	137333	3661	0.76	55782	1105	0.46	151152	2815	0.13	13339	37
1984-85	0.79	171532	3831	0.94	85410	1148	0.41	159701	3041	0.16	18969	42
1985-86	0.59	140827	4066	0.61	54679	1129	0.35	143460	3267	0.03	3328	36
1986-87	0.57	149615	3888	0.58	54709	1071	0.36	164457	3120	0.14	14136	42
1987-88	0.60	191107	4241	0.67	74471	1304	0.33	164462	3318	0.08	8301	62
1988-89	0.53	202811	4496	0.53	69010	1378	0.34	182283	3345	0.08	7819	54
1989-90	0.56	232321	4790	0.64	84576	1556	0.34	192937	3637	0.08	7336	45
1990-91	0.52	250783	4995	0.71	107366	1655	0.37	225737	3625	0.05	4331	39
1991-92	*	*	*	0.62	97614	1739	0.32	211788	3704	0.05	5614	46
1992-93	*	*	*	0.60	102121	1863	0.30	222043	3758	0.06	6245	43
1993-94	*	*	*	0.49	91322	1841	0.31	245434	4180	0.05	4817	60

*Included in Industry Group 35

Table 1: Capital Productivity in Manufacturing Industries (Contd.)

Years	Railway Wagons (372)			Motor Vehicles (374)			Motorcycle, Scooter (375)			Bicycle Parts (376)		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	3.69	16203	109	2.18	42149	523	1.34	2793	114	1.98	3170	464
1974-75	2.99	15535	110	1.54	42209	569	1.19	3207	147	1.60	3001	498
1975-76	3.06	14471	102	1.12	41888	990	0.56	2211	110	1.12	3061	581
1976-77	3.40	14333	101	1.20	52296	1021	0.82	5318	146	1.10	3119	600
1977-78	2.98	12865	139	1.09	53901	1023	0.61	5540	201	1.04	3667	598
1978-79	2.59	14338	137	0.96	57868	1113	0.60	6089	215	0.77	2916	643
1979-80	1.95	17749	173	0.69	51804	1205	0.51	6300	270	0.99	4371	694
1980-81	1.65	17473	145	0.63	53354	1297	0.50	6767	235	0.81	3719	676
1981-82	1.50	18248	187	0.68	68561	1565	0.56	8848	293	0.96	5385	748
1982-83	1.22	17962	153	0.65	79116	1334	0.43	6789	255	0.84	5335	638
1983-84	0.90	15609	153	0.59	78453	1302	0.53	12074	257	0.80	6292	669
1984-85	0.76	15082	149	0.53	81353	1529	0.38	12700	287	0.68	6023	658
1985-86	0.85	18886	146	0.46	84906	1594	0.32	14264	295	0.47	4655	673
1986-87	0.85	19598	134	0.46	95778	1567	0.27	14855	348	0.44	5120	627
1987-88	0.75	24815	160	0.40	86573	1463	0.24	17908	432	0.59	7417	687
1988-89	0.43	17878	145	0.42	103621	1498	0.24	20431	460	0.48	7770	691
1989-90	0.60	23467	174	0.50	104474	1569	0.23	22002	550	0.45	7043	693
1990-91	0.59	23878	204	0.54	122142	1609	0.34	34558	481	0.59	12064	696
1991-92	0.50	18769	220	0.50	116468	1586	0.31	33770	518	0.46	9052	724
1992-93	0.32	19576	202	0.46	118380	1654	0.28	32183	488	0.48	10445	753
1993-94	0.34	17675	207	0.50	133339	1020	0.31	39471	545	0.51	12871	817

Table 1: Capital Productivity in Manufacturing Industries

Years	Other Manufacturing Industry (38)			All Industries		
	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)	Capital Productivity Ratio	Gross Value Added (Rs. lakhs)	Factories Covered (Nos.)
1973-74	1.72	9451	1662	0.91	1047922	64133
1974-75	1.69	8077	1566	0.76	1108634	64217
1975-76	1.13	8662	1473	0.62	1160294	71705
1976-77	1.22	11389	1871	0.56	1294316	81277
1977-78	0.97	11267	1897	0.48	1410273	84924
1978-79	0.82	11415	1799	0.46	1662998	88077
1979-80	0.77	12609	2047	0.37	1572656	95126
1980-81	0.73	14069	1956	0.31	1456139	96503
1981-82	0.63	13824	2383	0.32	1672346	105037
1982-83	0.76	17783	1475	0.31	1849393	93166
1983-84	0.77	22064	1871	0.31	2142121	96706
1984-85	0.80	26967	1509	0.28	2122691	96947
1985-86	1.14	41660	1725	0.27	2222249	101016
1986-87	0.74	31492	1573	0.26	2337392	97957
1987-88	0.68	34163	1742	0.24	2497170	102596
1988-89	0.60	34646	1792	0.25	2765595	104077
1989-90	0.66	45224	1795	0.25	3086409	107992
1990-91	0.59	43513	1758	0.23	3368574	110179
1991-92	0.71	58785	1843	0.21	3253088	112286
1992-93	0.66	66042	1870	0.22	3799157	119494
1993-94	0.99	119205	1820	0.22	4312873	121594

□

Book Reviews

Handbook for Personal Productivity by *Henry E. Liebling*, Productivity Press of (I) Pvt. Ltd. Madras, Indian Edition 1994, Revised Edition 1995, 122 p, Rs. 50.

This is a pocket size handbook having 5 chapters. Each chapter deals with a different topic like Personal Productivity, Team Achievement, Quality Customer Service, Health Achievement, Work-shops and Seminars. All these chapters are inter-linked, ultimately helping an individual to improve his productivity.

In the beginning the author has given a small note on 'getting started'. He suggests that the reader must make an action plan for his development with few strategies like having a mission and following it through by reviewing the progress at intervals, handling setbacks and motivating oneself.

Chapter 1 which is titled 'Personal Productivity' is the longest one and deals with very useful topics like self-esteem, goal setting, plan of action, visualisation, time management, communication, etc. Each of these has been dealt with in a simple way. There are many affirmations by reading which the reader could easily verify whether he has in himself positive or negative thought process. There are also many statements given under the sub-title "Ban Negative Thinking". This would also help in verifying and overcoming the negative thought process. A mere reading of this can provide guidance on overcoming some of the personal guidance on deficiencies.

There are also 'Challenge Yourself' exercises listed throughout the book. These exercises are simple questions to direct and examine the needed change process in an individual. One would benefit a lot by taking them seriously and answering them sincerely.

Many readers are probably aware of the importance of setting goals and having a follow-up plan of action etc. In this book instead of elaborately explaining these aspects the reader is directed to answer simple questions whereby he would go through the process of doing, rather than just reading, the concepts. This is perhaps the speciality of this small book. It is like a guide for a workshop on topics like setting goals, plan of action, visualisation, time management, communication etc.

While dealing on 'Team Achievement', the author drives across the message that a person needs to be a good team member as by having the skills of team building, a person achieves much more than what is otherwise possible as an individual. The concept of team productivity is elaborated quite well. Some of the qualities that are required in an individual for effective team work, problem solving etc. are listed down whereby the reader could easily examine himself as to whether he is good as a team worker or as a team builder.

The author goes on to emphasise the need to have improved quality of service, for both internal as well as external customers. How to handle customers effectively in different situations is brought out well. As usual there are Challenge Yourself exercises which would make the reader aware of his own style at present and what is the direction of improvement required. Even simple things like the importance of listening to customers or clients have been discussed.

There is an exclusive chapter on Health Achievement where the author identifies the different dimensions of health namely mental, physical, spiritual, social, financial and family. Simple guidelines have been presented to improve ones conviction in each one of these aspects.

Then the author deals with workshops and seminars a person might attend, emphasizing the need to have the right attitude towards learning and self improvement.

In the end are few appendices which include sales affirmation, life planning, pre-retirement planning, etc. which are also helpful.

On the whole the entire book has very useful topics which are of interest to everyone. There could be many who are already familiar with these topics. However, what is good about the book is that they are made to introspect to what extent they are capable of putting into practice what they know. It takes the reader from the knowledge plane to the understanding plane and to some extent, even to the action plane. It certainly helps the interested reader to improve his own effectiveness. At Rs. 50/- it is definitely worth buying and is strongly recommended for all types of readers.

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Economic Development and Change: South Asia and the Third World, Editors *R.N. Ghosh, Y.M. Melotte, M.A.B. Siddique*, International Institute for Development Studies (IIDS), Calcutta; Western Australia in collaboration with New Age International Limited, Publishers, New Delhi, 1996, 328 p, (Price not listed), Hard cover.

The book under review is an offshoot of an international seminar organised by IIDS at Perth in December 1993. Most of the papers included had been originally presented in that seminar. The papers discuss the general processes of development in under-developed countries and address country-specific issues with special emphasis on the South Asian countries—India, Bangladesh, Pakistan and Sri Lanka. The book provides a rare collection of 19 articles covering a wide range of subjects from both developing and developed nations.

Despite the diversity of the papers included in this volume, there is a common theme underlying viz, how do we view the process of economic change? Would economic liberalisation and structural change lead to poverty alleviation and sustainable development in developing countries? In the recent years, one country after another in South Asia and Sub-Saharan Africa has been forced by the compulsion of the economic circumstances to move away from the long cherished path of socialism. How far have the new policies of freeing the market helped such countries?

The book starts with interesting interpretations offered by Alan Duhs on the W.A. Lewis model of economic development with unlimited supplies of labour. He interprets the model in three different ways to accommodate what would otherwise appear to be dissimilar views of the complex development process. Peter Longton in his article explains many obscure and competing theories that have relevance to the social transformation in contemporary Southeast Asian societies by way of modification of social structure. Cal Clark and Roy in their paper challenge the basic assumptions underlying the traditional neo-classical argument revolving around GDP. They develop the alternative human capital approach and examine the role of human capital in Development.

Clem Tisdell looks at the question of development of the African continent. Despite many attempts to introduce the IMF and the World Bank—imposed structural adjustment processes, few countries, if any, of Sub-Saharan Africa have been able to achieve significant headway towards economic development. Quaddus and Siddique examine the techniques of multiple criteria decision making as planning tools which offer sophisticated and practical approaches to support the decision making activities of development planners. Jim Longmire draws lessons for Australia from the competitive international environment and cautions that Australian exporters would be left behind unless they go for speedy micro and macro economic reforms.

Samanta has produced a very competent paper on the failure of structural adjustment programmes in sub-saharan Africa, with special reference to Kenya. Like Samanta, Amir Mohamood looks at the impact of the IMF and the World Bank—prescribed structural reform package in Pakistan and concludes that it did not generate conditions for sustainable economic growth and human resources development.

A. Hossain while analysing the experience of Bangladesh, finds evidence that structural reforms have led to some improvements in the quality of life of people. Ahmed and Siddique examine the complex issue of linkages between economic changes and reduction in poverty with special reference to Bangladesh. The issue of poverty reduction is the focus of M. Hossain's paper which discusses how the World Bank approach towards poverty reduction by stimulating national growth is less effective than the SAARC approach which focusses on grass roots development.

Ray and Ghosh in their paper caution that the present euphoria about India's economic achievement could soon disappear without fundamental reforms of the administrative system. Dutta in his paper draws attention to the negative aspects of governmental control over the Indian economy with regard to foreign investment. The paper by Tisdell, Roy and Gannon discusses the very important question of sustainability of tribal villages in West Bengal in the context of technological and environmental changes that are currently taking place at the village level.

Dunham and Kelegama examine the complexity of the economic liberalisation process in the context of Sri Lanka for the period 1977-92 and warn the policy makers of the third world countries on the dangers of too strictly adhering to conventional lines of thinking.

Bandaralage and Nguyen's paper is on the importance of South Asia as Australia's future trading partner. Smith analyses Australia's export performance in the ASEAN region in detail and argues that it falls far short of the potential based on her comparative advantage. Quang's article deals with the exploitations of labour by capital in the sugar plantations of La Reunion and evaluates how the nature of this exploitation has changed over time.

Some of the papers in the volume are theoretical, dealing with the process of economic change whilst others are more applied and country specific, dealing with the experience of several developing countries in south Asia, ASEAN, and Africa. The general message conveyed is that structural adjustments and economic liberalisation processes by themselves do not hold the key to development in Third Word countries. They must go hand-in-hand with other changes in the social structure including institutions such as the government and judiciary. The papers indicate that economic liberalisation and structural reform must be seen as only the first step in the right direction for change.

This volume will be of immense use to policy makers in the developing countries who are dealing with liberalisation and structural adjustment programmes. This book also provides better understanding and insight to researchers on the impact of the recent liberalisation and structural adjustment programmes under implementation in many developing countries in Asia and Africa.

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Role Plays by *David Turner,* Vinod Vasishtha Viva Books Private Limited, New Delhi, 1995, 386 p, Rs. 550.

A role play, used for training purposes, is a simulation in which trainees are required to act out the role of an individual in a situation or in circumstances that are relevant to them. The scenario can be an imaginary one or a real situation that the trainee is shortly to face. In practice, most role plays take the form of a one-act, unscripted playlet involving two or more participants taking the parts of different people. Role playing is a valuable technique for the trainer. It can provide participation, involvement and the opportunity for action learning. Participants act out (or practise) real life situations in a protected environment. Their behaviour, speech and feelings during the playlet form the basis for self appraisal and feedback from others who have been observing; from this they will learn which behaviour, words and approaches are effective. Mistakes can be made and learned from in a risk-free way. Role playing during training permits participants to receive objective feedback about their performance from their peers and from the trainer. Trainees can discover the impact their attitudes and behaviour have, in terms of how effective they are perceived to be by others. This opportunity to receive feedback rarely, if ever, occurs in normal circumstances back at work. Role playing provides a mirror for participants to see themselves as others see them. This encourages insight into their own behaviour and sensitivity to others' attitudes and needs. The benefits of a change in behaviour or attitude can readily be demonstrated and thus any desired change encouraged.

The book has been divided into Nine Chapters. Part I, the first 3 Chapters, is intended as a reminder of the principal characteristics of role playing, its use and the skills involved for trainers and trainees alike. It contains a certain amount of practical guidance for those unfamiliar with the necessary techniques. This part also includes some copiable notes and checklists for trainers and players for use with any or all the role play scenarios.

Chapter 3 contains some thoughts about how trainers might extend the use of role plays and use them in more unusual ways. It deals with the techniques involved in writing their own situations; here trainers should find some tips on producing effective role plays for themselves.

Part II contains groups of scenarios focusing on particular skill areas that are suitably addressed by the medium of role plays. The role plays are set in a variety of environments and the skill areas covered are: negotiation; appraisal; discipline; grievance; and managing people at work.

The role plays in Chapters 4 to 8 are longer ones requiring between 1 and 3 hours to play out. There are some 40 scenarios of this type in the book which are intended for use as major items in training events. With every role play, there are some basic notes for the trainer and specific briefing notes for each participant, which are intended to be photo-copied. Each role player should receive only their own brief and any other general papers: they should not be told what is in other

briefs. The trainer's notes give an indication of the numbers of participants involved, the time required and the equipment needed. They also describe the range of learning points that should emerge, and skills practised, and some suggestions for questions that could be answered in the review phase.

Chapter 9 is different, in that it has a range of very simple pen pictures of familiar situations which can be played out very quickly and reviewed like their longer and more complex cousins in the other Chapters. These are intended for inclusion in training events, for small subsidiary groups to play out among themselves, or for use on the spur of the moment, if a situation arises in which the trainer would like to see some activity tried out. They can also be used very effectively to familiarise people with role playing and to remove anxieties that they may have about it.

This book is designed to be a sourcebook of role play scenarios for busy trainers. The situations and scenarios included describe aspects of communication and face-to-face communication in particular. It is in this area of inter-personal communication skills that role playing can be amazingly successful in changing both behaviour and attitudes. The book is written with a wide range of potential users in mind.

It is intended as a resource offering relevant situations and scenarios to use to explore the effectiveness of different types of behaviour by people at work, particularly by those who manage others.

This stimulating and involving book will be of particular relevance to trainers in management and supervisory skills, interpersonal skills in a work context, management and staff development, and business training in colleges and business schools. It also gives clear guidance on how to get the best out of role playing and a wide range of exercises that can be used as written, or modified to suit the circumstances of the organisation.

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World Development Experience by *Sharanjit Singh*, B.R. Publishing Corpn., New Delhi, 1995, 268 p, Rs. 300.

In this work the author has tried to look at the economic development process as a process of quantitative and qualitative change. In quantitative measurement of economic development usual indicators such as GDP, per capita income and demographic changes have been considered. For qualitative measurement indicators like Quality of Life Index, Education and Structural change are used. The basic objective of the study is to examine the relationship of economic development with structural and demographic changes in the light of experiences of different countries. The study is a cross section study of 100 countries. The two time points chosen are 1965 and 1986.

The author has considered 37 variables for the 100 countries under study. Using such a large number of variables to understand the development process of different countries is risky in the sense that when considered for different countries, these variables must give contradictory results, as they behave differently in different social, economic, legal and political structures. Had the author used few variables, the diversity of super structure and similarities of the development process could have been better highlighted.

The author looks at various theories which relate the various variables with economic development and structural change. He contends that none of the studies is comprehensive. However, each reviewed study was conducted to understand the development process with reference to a particular variable or set of variables. In other words, if the considered variable/variables change, various measures of development considered in various studies are likely to change. The chapter has surveyed perhaps all the important studies on development and structural change.

Then, the author discusses the methodology and the data sources to be used in analysing the relationship between economic development and structural change. The author picks up the methodologies used in various studies and indicates how he is going to relate the variables (on the basis of which he is exploring) with development process and structural change. The data used are from secondary sources (U.N. Publications and Country Publications).

The author then explores the relationship of per capita income with the structural shift from agriculture to industry. For measuring structural change he uses sectoral shares in GDP. Apart from these variables he compares average annual growth rate of shares of industry and agriculture in GDP. Thereafter he tries to corroborate the earlier findings. It could not be understood if sectoral shares have already been considered, how far the growth rates of sectors will be a different route to substantiate the findings. The comparison of growth rate of the two sectoral shares reflects only the comparable rate of change occurring in the two sectors.

Next the relationship between per capita income and demographic change has been explored. The author has found evidences of the theory of demographic transition. The study also indicates that there is no immediate relationship between the rate of growth of GDP and the growth rate of population. He also finds a positive correlation between per capita income and percentage of population and on this basis, the author asserts that the proportion of children in working population becomes more. This kind of inference can not be understood; it rather reflects more on technology (the productivity per capita) rather than the increase in proportion of children in total employment. Moreover correlation does not imply any causality, it only tells that the two series are moving together.

The author has also explored the relationship between structural and demographic indicators. He finds that the distribution in the three sectors moved together with the distribution of labour force in these sectors. He also concludes that low productivity in agriculture, particularly in low and middle income countries resulted in low growth rate in their economies and so is responsible for their low level of development.

The author then consolidates the findings relating the rate of growth with the level of development and for the countries considered in the study. Here the author concludes that developed countries follow the balanced growth path and asserts that a country, if it passes a particular level of development, tries to adopt a balanced growth policy.

The author tries to rank countries on the basis of three indices – Per capita Income based on exchange rate (PCI (ER)), Per capita Income based on Purchasing Power Parity (PCI (PPP)) and Physical Quality of Life Index (PQLI) and finds that the development level rankings change with the use of the index. He then tries to develop a composite index on the basis of twenty one variables with weights based on the first principal component. He prepares two indices – Composite Index I and Composite Index II by using per capita Income (ER) and per capita Income (PPP). When he uses rank correlation to rank the countries under study on the basis of these indices, he finds that ranking changes within a group and not across groups and concludes that this change of ranking indicates the multidimensional aspect of economic development.

It is really surprising to read such a comment. When the measures have changed the ranking of countries is bound to change because each index is framed in a particular way and therefore will result in the change of ranking. This is because the Indices prepared do not have congruent weights for similar variables. Had the author ranked the countries on the basis of the surveyed studies, which he says are not comprehensive and only took one or two aspects, he would have found different ranking. Moreover on the basis of this change in ranking he asserts on the multidimensional character of development process. This aspect is already indicated by the various studies that he has surveyed in the review of studies.

In the end of the book, apart from summarising and concluding the study, the author also gives policy implications of the study and suggests that structural and demographic changes can not be treated in isolation. He seems to suggest that unbalanced theory, if applied will retard the rate of growth. However, he has not compared any where in the book the performance of the countries following unbalanced and balanced growth paths. He also suggests that the benefits of development will not automatically percolate down to the poor and specific policies are needed to reduce inequalities. He concludes by saying that the difference between the per capita income of rich and poor countries reduces if one shifts from PCI (ER) to PCI (PPP). This change of index changes the ranking of the countries as well. When he concludes that per capita income and structural and demographic changes are significantly associated, it is not clear what test of significance has been used to make such a statement.

However, inspite of some shortcomings, the study is important for the reason that an attempt has been made in the right direction to expose the validity of measuring economic development with one index. Since the ranking of the countries drastically change if one switches from PCI (ER) to PCI (PPP), purposefully a country can be placed at a disadvantageous situation by choosing a particular index. These two indices are in use at world forums to measure development to decide aid and other benefits to developing countries. The study is also important for the students and researchers of development economics. The survey of the studies and the methodology chapters are particularly relevant.

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Public Policy Analysis and Design by *Vivek K. Agnihotri* (Ed.), Concept Publishing Co., New Delhi, Ed. 1995, 482 p, Rs. 700.

The present work under review is an outcome of the proceedings and papers discussed in the seminar on

public policy analysis and design organised under the leadership of the Editor of the book and also Joint Director of LBS National Academy of Administration, Mussoorie. Professor A.M. Khusro, a highly respectable economist of the country, in his foreword has highlighted the need of greater awareness as to how policies are framed, policy makers solved some of the problems, impact of weak private industrial sector, commercial sector and social sector in context to influencing policy decisions, and emerging NGO. Resistance to change was from prime ministers in terms of freedom from excessive controls and positive response to the suggestions of Commerce and Industry. Professor has also indicated that leadership plays vital role in policy initiative and combating vested interest. Recent changes in Economic Policy has proved it.

Mr. Agnihotri in his editorial note clarifies the concept of term 'public policy' which is loosely used with reference to Govt. programmes, schemes etc. He also outlines the public policy making process and approaches in general and in particular in India covering structure and unstructured approaches, institutional framework for policy making at Central Government level, use of standing committees, export committee or panel for structured policy making process etc. Besides, efforts have been made to bring out the role of political system in making the process 'polyarchal' through election manifesto. The subject of policy methodologies was also discussed.

The reviewer observes that the book covers mainly two themes. The first one covers sectorial policies incorporating 16 papers in the public policy areas of Agriculture, Forestry, Environment, Industry, Population, Health, Urban Sector, Education, Science and technology, Energy and Computers. The second theme concentrates on appropriate methodologies for public policy analysis and design. This part presents 9 papers (17 to 25) covering Idea Writing, Nominal Group Technique, Structural Modelling, Option Field and Option Profile Methodologies, Fuzzy Set Evaluation Technique, Systems Dynamics, DELPHI, Viable System Modelling, Flexible Systems Methodology, Logical Framework Approach etc.

A cursory look at the list of participants and contributors indicates that people with long and vast experience have made reasonably good attempt to share their views on such vital issues. Most of the contributors are senior bureaucrats who were practically involved in the policy making process in their different capacities and in different areas. Therefore reviewer confirms that readers get first hand and useful information from these contributions. The editor deserves appreciation for making addition to the scanty literature on this developing subject particularly in Indian context. The reviewer feels that the book would be of interest to researchers, academicians and experts in the area of public policy. However, this high priced book is targeted at libraries only.

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Panchayats and their Finance by *M.A. Oommen & Abhijit Datta*, Institute of Social Sciences, 76 p, Rs. 150.

Panchayat Finance issues relating to Inter-Governmental Transfers and Finance Commission and Restructuring of Panchayat Finances are the two papers which form the present book. Both are revised versions of the papers originally presented at the Workshop on the theme of Panchayat Finances and State Finance Commission held at Vigyan Bhawan in New Delhi during October 28-29, 1994.

The subject matter of the first paper has been divided into five sub-headings: An Integrated Approach: A Constitutional Imperative; The Structure of Panchayat Finance: A Broad Picture; Functional Financial and Planning Decentralisation; A Critique of Conformity Acts; Inter-governmental Transfers; Some Conceptual and Operational Issues and Conclusion.

Under the first part of the paper, the author gives the information about the constitutional provisions regarding Panchayati Raj and their usual criticisms such as—centralised planning being a hurdle, subjects like education, rural electrification in the concurrent list not falling in the exclusive domain of States. Local area development scheme being self-deception to decentralised planning, the role of Planning Commission and the district. Planning Committee in the development of the local areas duplicating and triplicating State and Central Government administrative functions, etc.

Under the second part, the author has provided data about the 13 states of the first two decades of Panchayati Raj Institutions—solely based on the National Institute of Rural Development report and Ashok Mehta Committee report. The main features of this part are: a picture of the finances of Gram Panchayats in 13 states and Panchayat Samities in ten states, field studies on Panchayat Finance in Himachal Pradesh, Karnataka and UP and an outline of Zilla-Parishad finances based on data from selected Parishads in Maharashtra, West Bengal and Uttar Pradesh.

The author says that Conformity Acts are only a continuation of existing functions with more development works and poverty alleviation. Distribution of function, between various tiers of Panchayat Raj Institutions, has been done without administrative, financial and technical support. In most conformity Acts, the traditional distinction between obligatory and discretionary functions is missing. The author suggests that in order to ensure clarity, efficiency and proper accountability, a differentiation of functions into essential, assigned and urgency categories would have been useful.

Then the author reviews the tasks of state financial commission vis-a-vis Union Financial Commission, some conceptual and operational issues arising from the explicit tasks required of SFCs by constitution.

The author says that after the 73rd amendment, not much serious efforts are being put in by UFC and the Planning Commission. Only traditional gap filling approach has been pursued by UFC. He recommends that an integrated view of panchayat finance is needed. Distinction between plan and non-plan outlay should not be pushed too far. However though the 10th Financial Commission disapproved of artificial classification of plan/non-plan allocation, the non plan expenditure continues to get low priority. The distinction between revenue and capital account must be clearly mentioned. Grants should be such as to assure equality in distribution and access of minimum basic services to all anywhere in India. Resource based fiscal management rather than expenditure based budgeting, should be the key to fiscal autonomy and discipline. Fiscal autonomy cannot be built in a regime of Grants-in-aid. Functions of Panchayat Raj Institutions should be local development and self rule. In Inter governmental fiscal transfers, predictability, transparency and tax coordination are essential so that receiving units may do proper planning and budgeting.

Conformity Acts have a list of 26 taxes – but all have a poor base and are accompanied by the indifference of Panchayat Raj Institutions in imposing taxes. The author says that there is a great potential for raising non tax payment by assigning more land to Panchayats. Income from agriculture is a legitimate tax source. The author indicates that Panchayat Finance Corporations in Bihar and UP have shown poor performance.

The second paper in the book is on Finance Commissions and Restructuring of Panchayat Finances, which is divided in two parts. Part I focuses on the tasks before the State Finance Commissions in relation to Panchayat Functions and Finances. Part II considers the issue relating to the fiscal restructuring of the panchayats in term of their plan finance and revenue base.

The author recommends the need for dividing Panchayati functions into three categories – exclusive, state concurrent and agency responsibilities. Only inconsequential and residual functions are allotted to Panchayats. The 73rd Amendment Act's spirit is somewhat contradictory to the 11th schedule items.

Under exclusive and concurrent functions, allocations to different tiers, delivery arrangement for targeted beneficiaries and human development activities can be included. Support activities to agriculture etc. are treated as concurrent but with the farm subsidy etc. the purpose is defeated. The author says that this means that the panchayat's role is as providers of last resort and not for monopolising production services. The Panchayat has to act as a regulatory body to ensure quality and quantity of services. The author recommends privatisation of some of the panchayat's activities like collection of taxes and user charges etc. SFCs can evaluate PRI's work and allocate accordingly for existing activities and exploring the possibilities of new activities under 11th schedule.

The author argues that debureaucratisation is essential i.e. he is in favour of less staff, direct involvement of elected members in executive tasks, strengthening NGOs and private organisation. He insists on market borrowing, constitutional accountability etc.

In a nutshell, the book will be very useful to all those interested in decentralisation of planning process and rural development. It gives adequate information about the constitutional, financial and management issues in Panchayats. Every aspect has been critically reviewed and some innovative suggestions have been made. It would be an asset to the scholars and planners involved in Public Finance issues.

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