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Economic reforms and agriculture sector

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Abstract
Agricultural Sector is the mainstay of the rural Indian economy around which socio-economic privileges and deprivations revolve and any change in its structure is likely to have a corresponding impact on the existing pattern of Social equity. Sustainable Agricultural production depends on the judicious use of natural resources (soil, water, livestock, plant genetic, fisheries, forest, climate, rainfall, and topography) in an acceptable technology management under the prevailing socio-economic infrastructure. Various research studies and policy papers highlight that the Indian Agricultural sector faces resource constraints, infrastructure constraints, institutional constraints, technology constraints, and policy induced limitations. To achieve sustainable agricultural development, it is essential to combine natural resources, capital resources, institutional resources, and human resources (i.e. to optimally utilize the agricultural resources). As an enabling technology, Information Technology (IT) plays an important role in the rapid economic growth and social transformation in developing countries. Information Technology and Bio-Technology, which are "the drivers" of globalisation with their complementarities of liberalisation, privatisation and tighter Intellectual Property Rights (IPR), are bound to create new risks of marginalisation and vulnerability in the Indian Agricultural sector. To reduce the risks of marginalisation and vulnerability, this paper suggests development of a comprehensive Agricultural Resources Information Systems using Geomatics Technology in districts with public funding, facilitating sustainable agricultural development, and also suggests the need for development of metadata and application of Open GIS model for optimal utilisation of agricultural resources in India.

Keywords: Agriculture sector, economic reforms process, agricultural

Introduction

The existence or absence of favourable natural resources can facilitate or retard the process of economic development. Professor W.A. Lewis writes: "Natural resources determine the course of development and constitute the challenge which may not be accepted by the human mind". Developing countries, embarking on programmes of economic development, "usually have to begin with and concentrate on the development of locally available natural resources as an initial condition for lifting local levels of living and purchasing power, for obtaining foreign exchange with which to purchase capital equipment, and for setting in motion the development process" [Fisher64]. With the basic thrust on higher growth in food grain production and other agricultural commodities, increase in productivity and efficient use of resources in agriculture has received special emphasize all through the process of the development, since independence. Sustainable agricultural production depends on the judicious use of natural resources (soil, water, livestock, plant genetic, fisheries, forest, climate, rainfall, and topography) in an acceptable technology management under the prevailing socio-economic infrastructure. Food and Agriculture Organization (FAO) has formulated the following definition for sustainable development in the context of agriculture, forestry and fisheries:

"Sustainable development is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for the present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable".

Economic reforms process

Since July, 1991 the country has taken a series of measures to structure the economy and improve the balance of payments position. The New Economic Policy (NEP-1991) introduced changes in the areas of trade policies, monetary & financial policies, fiscal & budgetary policies, and pricing & institutional reforms. The salient features of NEP-1991 are (i) liberalization (internal and external), (ii) extending privatization, (iii) redirecting scarce Public Sector Resources to Areas where the private sector is unlikely to enter, (iv) globalization of economy, and (v) market friendly state. Research reports reveal that this macro-economic adjustment programme is remarkable for its relatively painless transition compared with similar programmes elsewhere and a large part of the credit for absorption of these shocks is due to the steady increase in agricultural production. The GATT Agreement signed in 1995 will fundamentally change the global trade picture in agricultural sector.

Impact of economic reforms process on Indian agricultural sector

Agricultural sector is the mainstay of the rural Indian economy around which socio-economic privileges and deprivations revolve, and any change in its structure is likely to have a corresponding impact on the existing pattern of social equality. No strategy of economic reform can succeed without sustained and broad based agricultural development, which is critical for

- raising living standards,
- alleviating poverty,
- assuring food security,
- generating buoyant market for expansion of industry and services, and
- making substantial contribution to the national economic growth.

Studies also show that the economic liberalization and reforms process have impacted on agricultural and rural sectors very much.

According to [Bhalla 97], of the three sectors of economy in India, the tertiary sector has diversified the fastest, the

secondary sector the second fastest, while the primary sector, taken as whole, has scarcely diversified at all. Since agriculture continues to be a tradable sector, this economic liberalization and reform policy has far reaching effects on (I) agricultural exports and imports, (ii) investment in new technologies and on rural infrastructure (iii) patterns of agricultural growth, (iv) agriculture income and employment, (v) agricultural prices and (vi) food security [Bhalla 93].

Reduction in Commercial Bank credit to agriculture, in lieu of this reforms process and recommendations of Khusrao Committee and Narasingham Committee, might lead to a fall in farm investment and impaired agricultural growth [Panda 96]. Infrastructure development requires public expenditure which is getting affected due to the new policies of fiscal compression. Liberalization of agriculture and open market operations will enhance competition in "resource use" and "marketing of agricultural production", which will force the small and marginal farmers (who constitute 76.3% of total farmers) to resort to "distress sale" and seek for off-farm employment for supplementing income.

Marginalisation of small farmers

A central issue in Agricultural Development is the necessity to increase productivity, employment, and income of poor segments of the agricultural population. Among the rural poor, the small farmers constitute a sizeable portion in the developing countries. Studies by FAO have shown that small farms constitute between 60-70% of total farms in developing countries and contribute around 30-35% to total agricultural output [Randhawa & Sundaram 90].

Liberalisation era (1990-91) began in India when over 40% of rural households were landless or near landless, and over 96% of the owned holdings and 68.53% (over 2/3rd) of owned land belonged to the size groups (marginal, small and semi-medium). The decade of 1981-82 to 1991-92 seems to have witnessed a marked intensification of the marginalisation process – the percentage of small owners increased from 14.70% to 21.75%.

Small farmers emerged as the size group with the largest share of 33.97% in the total land, which is just doubled during this decade. As regards the Large Farmers, they were 1% of the total owners in 1990-91 but owned nearly 13.83% of the total land. An interesting, but speculative, inference is that the changing position of the large owners represents the other side of the marginalisation process, i.e., the presence, and possibly growing strength, of a small but dominant and influential group in agriculture. Analytical reports reveal that marginalisation process could gather further momentum in the years ahead to become an explosive source of economic and political turbulence, due to the features of prevailing policy-cum-market environment in the country.

Trend towards a greater casualisation (erratic and low-paid work) of the workforce that was witnessed in the 1980s appears to have continued in the1990s. Low productivity and inability to absorb the growing labour force make the agricultural sector in India witness to a pervasive process of marginalisation of rural people. This process is likely to get intensified in the coming years, raising formidable problems in achieving sustained development of rural areas and rural people [VMRao & Hanumappa 99].

Both Information Technology, Genetic Engineering and Bio-Technology, which are the "drivers" of globalisation with their complementarities of liberalisation, privatisation and tighter Intellectual Properties Rights, are bound to create new risks of marginalisation and vulnerability. Information Technology is able to produce a penetrating and clinical mapping of the land, encompassing the physical, chemical and biological features, and groundwater resources, and forecast of climatic conditions in a focussed manner, that even small geographical segments – the small farms – can be benefited through the guidance provided by the ways in which natural and human resources can be optimally combined with appropriate technologies, inputs and options to enhance and diversify agricultural production. Information Technology will facilitate dissemination of information on development, education, extension, husbandry, marketing, production, and research, to agricultural farmers.

Indian agricultural sector

The Indian Agricultural sector provides employment to about 65% of the labour force, accounts for 27% of GDP, contributes 21% of total exports, and raw materials to several industries. The Livestock sector contributes an estimated 8.4% to the country GDP and 35.85% of the agricultural output. India is the seventh largest producer of fish in the world and ranks second in the production of inland fish. Fish production has increased from 0.75 million tons in 1950-51 to 5.14 million tons in 1996-97, a cumulative growth rate of 4.2% per annum, which has been the fastest of any item in the food sector, except potatoes, eggs and poultry meat.

- new technologies which are not only "cost effective" but also "in conformity" with natural climatic regime of the country;
- technologies relevant to rain-fed areas specifically;
- continued genetic improvements for better seeds and yields;
- data improvements for better research, better results, and sustainable planning;
- bridging the gap between knowledge and practice; and
- judicious land use resource surveys, efficient management practices and sustainable use of natural resources.

Plan strategy on agricultural development

The agricultural development strategy for the Ninth Five Year Plan is essentially based on the policy on food security announced by the Government, to double the food production and make India hunger free in ten years. The Strategy to ensure food security is as follows:

- Doubling food production
- Increase in employment & incomes
- Supplementary/sustained employment and creation of rural infrastructure through Poverty Alleviation Programmes (PAP)
- Distribution of food grains to the people Below Poverty Line (BPL)

The Ninth Plan Target is to achieve a growth rate of about 4.5% per annum agricultural output and production of 234 MT of food grains by 2001-02. The Policy thrust and key elements of Growth strategy, as proposed in the Ninth Five Year Plan Document are as follows:

- Conservation of land, water, and biological resources
- Rural infrastructure development
- Development of rainfed agriculture
- Development of minor irrigation
- Timely and adequate availability of inputs
- Increasing flow of credit
- Enhancing public sector investment

- Enhanced support for research
- Effective transfer of technology
- Support for marketing infrastructure
- Export promotion

The Ninth Five Year Plan Document (1997-2002: Volume II) reveals that development of the vast rain-fed areas of about 90MH would require over Rs.37,000 Crores. Further, scientific treatment for soil and water conservation for 12 MH of arable and 3 M.H of non-arable land would require about Rs.7500 Crores. Development of rain-fed areas require a substantial public investment, which may not be possible due to the new policies of fiscal compression. In the coming millenium, on the basis of current trends in the consumption pattern, the estimated total requirement of food grains is likely to be around 245 Million Tons by 2006-07.

Agricultural planning and development

India is a vast country with a variety of landforms, climate, geology, physiography, and vegetation India is endowed with regional diversities for its uneven "economic and agricultural" development, on account of (i) Agro-climatic environments (15 Zones/127 regions), (ii) Agro-ecological regions (20) and 60 sub-regions, (iii) Agro-Edephic regions, (iv) Terrain mapping sub-units, (v) Natural resources endowments (geology, geomorphology, soil, ground water, surface water, & infrastructure), (vi) Human resources (Population density), (vii) Level of investments in rural infrastructure, and (viii) Level of investment in technology and its adoption.

India has a total geographical area (TGA) of 329 Million Hectares (MH) out of which, about 265 MH represent varying degrees of potential for biological production report reveals that more than 50% of TGA is threatened by various types of land degradation, such as soil erosion, gully & ravine formation, salinity, water logging, shifting cultivation, etc. Development of irrigation potential is considered as the key factor in the sustenance of "Green Revolution". Despite 50 years of development planning, rainfed agriculture is the largest and the most important sector of crop production in India.

Soil resources are the most precious non-renewable vital resources for growing food, fibre, and fuel wood to meet the human needs. Management of Soil Resources is essential for both the continued agricultural productivity and protection of environment. By considering various factors like population growth rate, diminishing per capita of land and water resources, and increasing land degradation problems, it is estimated that India will be required to produce an additional 5 – 6 million tons of food grains annually in 21st Century. This will lead to tremendous pressure on soil resources along with competitive demand for it from industrialization and urbanization. However the capacity of soil to produce is limited and its limits to production are set by its inherent characteristics, agro-ecological settings, and its use and management.

Forests are an important natural resource of India, having a moderating influence against floods and also protecting the soil against erosion. About 95% of the forests in India is owned by States and the total area under forests is about 22% of the total geographical area.

Development of livestock has been envisaged as an integral part of sound system of diversified agriculture. In animal production, the major aim is for raising ecologically adapted animals and efficient utilization of locally available feed resource. Dairy development is intimately linked with cattle population, breed improvement, cattle health and disease management, and fodder development, etc. Animal Husbandry in India is essentially a endeavor of millions of small holders (Resource-Poor-Farmers) who rear animals on "crop residues" and "common property resources" without generally allowing them to compete with man for food grains. The small holders produces milk, meat, wool, etc., for the community, with virtually no capital, resource, training and at a cost that no modern technology in the world had ever produced. Food and Fodder Resources will be crucial to the future development of "livestock resources" in the Country. There is very little scope for increasing the area under fodder production, keeping in view the priority for food grains, pulses and oil seeds. Development of Fodder Resources is basically an activity based on a multi-disciplinary approach involving the areas of agriculture, animal husbandry, environment & forests, revenue, rural development, and wasteland development.

Water Resources of India contain diverse group of flora and fauna. Agriculture is the greatest user of Water accounting for about 80% of all consumption. Animal Husbandry and Fisheries require abundant water. Development of Water Resources, since Independence, has been undertaken for specific purposes like irrigation, flood control, hydro-power generation, drinking water supply, industrial and various miscellaneous uses. Minor irrigation projects have both surface and ground water as their source, while major and medium projects mostly exploit surface water resources. The break up of the ultimate irrigation potential under the above three categories is,

- 58 M.Ha by major and medium irrigation projects,
- 17 M.Ha by minor surface water schemes, and
- 64 M.Ha by minor ground water schemes.

Good infrastructure helps in raising productivity and lowering the unit cost in the production activities of the economy. "Agricultural Infrastructure" refers to "Rural Infrastructure" whereas "Industrial Infrastructure" refers to "Urban Infrastructure". Agricultural development requires (i) agricultural research and extension, (ii) rural financial institution, (iii) irrigation and drainage, (iv) agricultural inputs (fertilizers, seeds, credits), and (v) marketing and storage facilities.

Agriculture Credit is a crucial input for increasing agricultural production and productivity. Institutional finance for Agricultural credit is disbursed mainly by Commercial banks, Regional Rural Banks, Land Development Banks, and Cooperative banks. Share of commercial banks in total institutional credit to agriculture is about 48%, that of Cooperative banks is about 46%, and Regional Rural Banks account for 6% only. Short-term Credit accounts for 2/3rd of the total institutional lending to the Agriculture.

Drought has multiplier effect on agricultural production during the subsequent year also, due to (i) non-availability of quality seeds for sowing of crops, (ii) inadequate draught power for carrying out agricultural operations as a result of either distress sale of cattle or loss of life, (iii) reduced use of fertilizers as the investment capacity of the farmers decline, (iv) non-availability of raw materials in agro-based industries, and (v) deforestation to meet the energy needs in domestic sector as agricultural waste may not be available in required quantity.

The Central Ministry of Agriculture (MOA) is responsible for implementation and formulation of national policies and programs to achieve agricultural growth through optimum utilization of the land resources, water, soil, plant, fisheries, & livestock resources. Government of India implements the following agricultural related Schemes (whether Watershed based or Agro-climatic region based) in the country, which deal agricultural resources information for Planning and Development:

- Agro-climatic Regional Planning (ACRP) Project
- Agro-Ecological Mapping Project of the National Bureau of Soil Survey & Land Use Planning (NBSS&LUP)
- All India Soil and Land Use Survey (AISLUS)
- Early Warning System of Agricultural Situation in India
- Forecasting of Agricultural output using Space, Agro-meteorology and Land based observations (FASAL) Project
- Land Records Computerization Project
- National Agricultural Research Project (NARP)
- National Agricultural Technology Project (NATP) to strengthen research-extension-farmer (r-e-f) linkage
- National Watershed Development Program for Rain-fed Areas (NWDPRA)
- Soil and Water Conservation Programs
- Drought Prone Area Development programme
- Desert Development Programme
- National Wastelands Development programme
- Integrated Mission on Sustainable Development (IMSD) Programme

Agricultural resources information system

It is clear that sustainable agricultural production depends on the judicious mix of natural resources (soil, water, livestock, plant genetic, fisheries, forests, climate, rainfall, and topography) in an acceptable technology management under the prevailing socio-economic infrastructure. In addition to the natural resources components, it is also essential to combine natural resources with capital resources, institutional resources, and human resources for sustainable agricultural development. Agricultural Resources components include

- Animal Resources
- Capital resources
- Climate resources
- Environment data
- Fisheries Resources
- Forestry Resources
- Institutional resources
- Land owners data
- Plant Resources
- Socio-economic & Infrastructure data
- Soil resources
- Water Resources

For increasing production at micro level, an inventory of currently used, potentially available, and an evaluation of the quantity and quality of these resources is required. This requires design and development of agricultural resources information system using state-of-the-art IT Tools, as given below, to facilitate effective agricultural planning and development:

- Data warehousing (Data Bases & Model Bases)
- Expert Systems & Knowledge Bases
- Networking (Internet, Intranet and Extranet)
- Geographical Information System (GIS)
- Application of Remote Sensing Data
- Multi-media Information System
- Decision Technology System
- E-Commerce & E-Governance, and
- Digital Library

Agricultural planning and development require (a) knowledge about recent progress in agriculture, (b) the existing situation (especially the main problems impeding development), and (c) the potentialities for achieving agricultural objectives. This information is needed for re-assessing current investment and other development activities as well as for planning new measures, setting benchmarks against which to monitor progress.

Proper analysis of the agricultural sector requires that it is seen as a system of functionality inter-related and inter-dependent elements, each of which contributes to the existing and potential level of performance of the sector. A stock taking and diagnostic survey is needed early in the planning process to provide information about the wide range of factors influencing agricultural performance.

Both the Ministry of Agriculture and Ministry of Rural Development implement, through corresponding State departments, various central sector and centrally sponsored schemes related to agricultural and rural development, on watershed basis. The landscape, climate, and agronomic characteristics of each watershed vary considerably. Each watershed contains a complex mixture of

- soil types,
- landscapes,
- climatic regimes,
- land use characteristics, and
- agricultural systems.

Each watershed can be subdivided into agro-eco-regions having similar soil types, landscapes, climatic regimes, crop and animal productivity, and hydrologic characteristics. Integrated Watershed Development and Management has been recognized as an effective strategy for sustainable agricultural development in the country.

The Report of the Committee on "Natural Resources Information System (NRIS) – Linkage and Networking Project", constituted by the Department of Space in early 1990s, envisaged about 435 district level NRIS nodes in conjunction with DISNIC nodes of NIC, 26 state level NRIS nodes, 182 NRIS project nodes (7 Themes and 26 States), and 42 NRIS Regional nodes (7 themes and 6 regions). Development of "Natural Resources Information System (NRIS) – Linkage and Networking Project" was initiated by NIC in its pilot project districts. Department of Land Resources through its land resources development programmes, Department of Agriculture & Cooperation through its NWDPRA Projects, and Department of Science & Technology through its NRDMS Projects, have been involved in the implementation/ development of Natural Resources Information System (NRIS) to strengthen their schemes through their implementing agencies. The existing data available from the following reports can facilitate strengthening resources databases:

1. Soil survey
2. Geological survey
3. Forest inventories

4. Hydro-meteorological studies
5. Aerial photographs and contour maps
6. Ownership data and infrastructure information
7. Rainfall and stream flow data
8. Land use details
9. Development plans

Development of metadata is required as the overall rate of collection of data increases rapidly with advances in technologies such as high resolution satellite-borne imaging systems and global positioning system, and with growing number of people and organizations who are collecting and using data (spatial and non-spatial). Metadata standards on soil geographic data, vegetation geographic data, developed by, provide a systematic way to collect metadata.

Agricultural Resources Information System will have data and information on basic resources such as (i) soil resources, (ii) water resources, (iii) climate resources, and other data sets (collated from Remote Sensing as well as conventional means) such as (iv) basic data on crops, (v) animal husbandry and fisheries, (vi) genetic (plant, animal & fisheries) materials, (vii) land ownership, (viii) Socio-economic data, (viii) infrastructure for agricultural development. The data sets are as follows:

1. Basic Data on Crops
   - Production of major crops
   - Area cultivated under each major crop
   - Yields per Unit of Area for each crop
   - Areas sown but not harvested
   - Areas of fallow, double cropped, irrigation and inter-cropped land
2. Information on livestock numbers, production and Yield per unit
3. Trade statistics on agricultural commodities and the extent to which imports/exports are involved
4. Information on size, character, technology and organization of farms, by groups

The inventory and appraisal should cover natural, capital, institutional and human (manpower) resources.

Natural resources

- Information on physical feature [topography, geology, soils, natural vegetation, and hydrology (surface and sub-surface)] to determine the land's capability for agricultural development;
- Maps depicting differences in physical land characteristics, meteorological, climatological, hydrological, geological, and geo-morphological conditions; population densities, types of land tenure systems used, proximity to markets and urban centres, transportation and other infrastructures;
- Areas of immediate growth potential (where climate, soil and water conditions are favourable for agriculture and where technology needed to substantially increase output of major crops already being grown;
- Areas of future growth potential (where favorable climatic and soil conditions exist but lack one or more elements of (i) adequate & controlled supply of water, (ii) technology required for substantially increasing production of a major crop or crops, currently grown, or capable of being grown, and (iii) transportation needed to bring the areas into national economy);
- Areas of low growth potential (where climatological, soil, topological or other deficiencies without economic means for correcting them, exist) which require technological breakthroughs before substantial increases in output are possible.

Conclusion

The central issue in agricultural development is the necessity to increase productivity, employment and income for poor segments of the agricultural population of whom the small and marginal farmers constitute a sizeable portion. Information Technology Tools *viz*., Data warehousing (Data Bases & Model Bases), Expert Systems & Knowledge Bases, Networking (Internet, Intranet and Extranet), Geographical Information System (GIS), Application of Remote Sensing Data, Decision Support Systems, and E-Commerce (b2b, b2c solutions), facilitate the Farmers to know the "agricultural situation" in Indian as well as abroad and accordingly undertake agricultural production.

This IT-led globalisation will certainly benefit the medium and large farmers who can invest on IT, as has happened during "green revolution". Since the agricultural development strategy has been mostly "growth-oriented" and therefore had a "built-in bias" in favour of Large farmers over Small farmers. Farmers can invest on computers to get access to Internet, but it is not possible for them to invest on "agricultural informatics" with decision support system using geomatics technology.

Agriculture being a "state subject" and a primary sector which accounts for about 27% of GDP, 65% of labour force, and 21% of total exports, the Central Government implements agricultural resources development schemes under both central sector and centrally sponsored sector. These schemes generate voluminous information, both spatial and non-spatial, related to agricultural resources, using conventional, remote sensing and GPS technology.

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