
Introduction

Agriculture continues to be the mainstay of the Indian economy. At around 26.8%, agriculture and allied activities continue to be the single largest contributor to the gross domestic product (GDP). The dominance of the sector is even greater, in terms of employment as it employs two-third of the country's workforce. Several major Indian industries, such as sugar, textiles, jute, food processing, and milk and milk processing depend on agriculture. On account of its backward and forward linkages with other economic sectors, changes in agricultural performance have a multiplier effect on the entire economy. It's performance is therefore crucial in the task of reduction and eventual elimination of poverty in India.

The following section gives an overview of Indian agriculture, followed by the corresponding Agenda 21 concerns. The next section reviews policies and initiatives in agriculture and thereafter, the policies are measured against the concerns in Agenda 21 and directions suggested incorporate these concerns.

Overview of the sector

The Ministry of Agriculture and Cooperation is the focal point for all issues relating to agriculture and allied activities such as Animal Husbandry and Fishing. The Ministry of Agriculture comprises three departments: Department of Agriculture and Cooperation, Department of Agricultural Research and Education, and Department of Animal Husbandry and Dairying. Other important related ministries are the Ministry of Food Processing Industries, Ministry of Chemicals and Fertilizers and Ministry of Water Resources. Under the Ministry of Food Processing Industries, the Department of Food Processing Industries is responsible for developing a strong and vibrant food processing sector. In the Ministry of Chemicals and Fertilizers, the Department of Fertilizers deals with fertilizer planning and production and its imports, movement and distribution. The Ministry of Water Resources is responsible for laying down the policy guidelines and programmes for the development and regulation of the country's water resources.

In India, agriculture is the dominant land-use type. The net sown area has stabilized at around 143 Mha since the 1970s, accounting for 47% of the reporting area. Around 34% of this area is sown more than once, amounting to a gross cropped area of 191 Mha (1997/98). The area under foodgrains accounts for 65% of the total gross cropped area and commercial crops (such as oilseeds) make up 25%. Nearly two-thirds of the area under food grain crops is under rice and wheat cultivation. About 38% of the total gross cropped area was irrigated in 1997/98 (MoA, 2001b).

Though around 84% of the country's total water consumption is consumed by agriculture, 62% of the cropped area is still dependent on the monsoons for water. Fortunately, the country has been having normal monsoons ($\pm 10\%$ of long period average) since 1992 (MoF, 2002).

The distribution of certified seeds had increased to 0.83 million tonnes by 1998/1999 (MoA, 2001b). Both private and public sectors are major players in the country's seeds industry. The availability of better seeds has brought more area under the high yielding varieties (HYVs). The area under HYVs was 78 Mha in 1998/99. Nearly 73% of the area covered by HYVs is under rice and wheat. Because HYVs are susceptible to pests and diseases, pesticides have become indispensable for modern agriculture. The consumption of technical-grade pesticides was 49 thousand tonnes during 1998/99. Modern agriculture largely depends on the use of inputs such as concentrated fertilizers and, over time, the fertilizer consumption in the country has increased. At present India is the third largest consumer of fertilizers in the world, and in 2001/02 the total consumption of nitrogenous, phosphatic and potassic fertilizers was 19.3 million tonnes (FAI, 2001).

India's food production has exceeded its requirement in the last decade. Food stocks are well above the minimum buffer stock norms, with 58 million tonnes having accumulated by January 2002. Imports were resorted to only once in the last decade. Apart from food grains, the production of other crops and activities allied to agriculture – dairying, fishing, forestry – have all been growing.

The horticulture sector has been growing more rapidly and has registered a growth rate of 6% per annum in the 90's. India accounts for 10% of the world's production of fruits and is the second largest producer of vegetables after China. Exports of fruits and vegetables increased by almost 90% in the 90's (Planning Commission, 2001b).

The average annual growth rate of agriculture and allied sectors (agriculture, forestry and fishing) during the post-Rio conference period 1992 to 2000, was 3.6% (at 1993/94 prices). The growth rate of agriculture (includes all crops,

animal husbandry and dairying) was marginally higher (3.7%) during the same period. Crop agriculture grew by 2.2% during the period 1992 to 2000. Food grains and non-food grains registered annual average growth rates of 2.0 and 2.4%, respectively. This was much higher than the population growth rate of 1.6% for the same period. Agricultural products constituted 13.5% of the total export earnings in 2000/2001 (MoF, 2002).

There is an extensive network of institutions for education, research and extension work. The most important institution is the Indian Council for Agricultural Research (ICAR) which has a wide network of research institutions.

Agriculture and Agenda 21

The major concerns in agriculture sector, as articulated in Agenda 21, are to increase food production and enhance food security in a sustainable way. To achieve this, the need for developing appropriate and new technologies, farm education initiatives, and utilizing economic incentives has been emphasized. The main issues identified in the agriculture sector relate to food security and sustainable development, people's participation and human resource development, diversification of rural employment, land resources planning, land conservation and rehabilitation, water availability, plant and animal genetic resources conservation and utilization, pests and nutrient management, rural energy, and ozone depletion and its impacts on plant and animal species (Agenda 21). Some of these issues have been dealt with at length in other chapters of the document^a.

Food security and sustainable development

This issue includes the integration of sustainable development considerations with agricultural policy, including inputs management, review of agricultural policies, especially with respect to post-harvest technologies, and review of agricultural policies in relation to foreign trade, pricing policy for inputs and output, exchange rate policies, subsidies and taxes.

People's participation and promoting human resources development

^a Specifically, rural energy is covered in Chapter 3 on Energy; irrigation and water availability in Chapter 7 on Water resources; land management and land-use planning in Chapter 13 on Land resources; and rural poverty alleviation in Chapter 16 on Poverty alleviation and human resource development.

This issue emphasizes peoples' participation in sustainable agriculture and rural development; ensuring access to natural resources, technology, financing, marketing and distribution; and strengthening people's capabilities in managing resources and decision-making.

Diversification of rural employment and infrastructure development

Agenda 21 emphasizes the need for efficiency in using local resources while minimizing environmental and economic risks in meeting food demands. It also stresses avoiding the expansion of agriculture into marginal and fragile ecosystems.

Where intensification of farming systems is not possible opportunities for diversification should be developed. There could include on-farm and off-farm employment opportunities, such as cottage industries, wildlife utilization, recreation and tourism, agro-based industries. A strong infrastructure would catalyze the development of these activities.

Conservation and utilization of plant and animal genetic resources

Plant and animal genetic resources are of paramount importance in increasing the quantity and quality of plant and animal products. Recent technological developments in biotechnology have opened up a whole new set of opportunities. The success of these new technologies depends on the availability of suitable genetic resources. Agenda 21 highlights the need to safeguard plant and animal genetic resources while preserving them for sustainable use.

Integrated pest and nutrient management

Estimates of pre-harvest and post-harvest losses due to pests range between 25-50%. Pest control is an essential part of the package of improved cultivation practices. The overuse of chemical pesticides has led to undesirable effects on human health and environment. Integrated pest management, which combines biological, host plant resistance and agronomic practices minimizes the use of chemical pesticides and contributes to the sustainability of agriculture.

Plant nutrients tend to get depleted as a result of intensive cultivation. As a result more and more marginal and fragile ecosystems have been put to agricultural use causing further land degradation and associated environmental problems. Excessive dependence on chemical fertilizers is proving to be harmful to soil health and is harming the environment. An integrated approach to plant

nutrition needs to be adopted to ensure a sustainable supply of plant nutrients so that future yields can be increased without harming soil productivity and environment.

Role of farmers

The role of farmers needs to be encouraged and special care needs to be taken of weaker groups such as the poor and women.

Review and analysis of policies, programmes and other initiatives in the agriculture sector

Review of major policies, programmes and other initiatives

Table 14.1 Important initiatives in the Agriculture sector

Year	Initiative	Objectives
(1) Agricultural productivity		
1988-89	The Special Foodgrain Production Programme (SFPP)	To maximize productivity in high and low yield areas alike.
1985-90	National Pulses Development Programme (NPDP)	To encourage pulses in irrigated areas, inter-cropping, multiplication and use of improved seeds, adoption of plant protection measures, remunerative prices and marketing support.
1989	Integrated oilseeds policy	To extend support to farmers with improved technology, inputs and remunerative prices.

Year	Initiative	Objectives
Initiated in Sixth Plan and continued thereafter	National Watershed Development Project	A holistic approach towards farming systems through micro-watershed development in each block with assured irrigation of 30%. For rainfed areas that aim at ensuring long-term food security, bridging regional disparity and providing employment opportunity. The Programme integrates components such as diverse production systems (including seasonal cropping, horticulture, forestry and animal husbandry, silvi-pasture development), crop demonstrations, organic farming, and use of vegetative barriers to prevent soil erosion and conserve moisture, land-use planning, reclamation of alkaline soils and control of shifting cultivation.
1985-90	Integrated Cotton Development Programme and Special Jute Development Programme,	Specially targeted schemes to encourage production of cotton, jute and mesta initiated during the VII
1997-2002	Establishment of Cotton Technology Mission during the Ninth Plan.	Plan from the viewpoint of enhancing export potential
2000	National Agricultural Policy	Integrated approach to enhance and optimize efficiencies of farm practices, natural resources use, rural marketing, and infrastructure.
(2) Agriculture research and education		
1929 onwards	Indian Council of Agricultural Research (ICAR) National Grid Comprising	Education, Research and Extension in agriculture and allied technologies

Year	Initiative	Objectives
	<ul style="list-style-type: none"> - Central Research Institutes (49) - Nation Bureaux (4) - National Academy of Agricultural Research Management - Central Agricultural University (1) - Agricultural universities (30) - Regional stations (158) - AICRP (80) involving 24000 agricultural scientists - Project directorates (10) 	
(3) Agricultural extension		
End of Fourth Plan onwards	Krishi Vigyan Kendras (KVKs- 261), Trainers training centre (TTC - 8), Technology assessment and refinement through Institution Village Linkage Programme (IVLP- 70), technology evaluation and Impact assessment (60), and Agriculture Technology Information Centers (ATICs - 40) and , Zonal Agricultural Research Stations (ZARS- 53)	Technical training programmes for transfer of technology in different branches of agriculture. Agriculture extension, Human resources development in agriculture, diversification of rural employment
Sixth Plan onwards 1988	Training and visit system Agro-climatic Regional Planning Approach	Re-organization and strengthening extension Integrated development plan for agriculture and allied sectors differentiated by homogenous agro-climatic regions.
Ninth Plan	National Agriculture Technology Project National grid comprising 46 institutes including 4 deemed universities, 4 national bureaux, 9 project directorates, 31 national research centres, 158 regional stations, and 80 AICRP	Research and human resources development Agricultural research and education
(4) Dry land development		

Year	Initiative	Objectives
1970/71 onwards	Dry Land Agricultural Development Scheme	Technologies for improving dry land agricultural productivity
1972-73	Drought Prone Areas Programme	Economic development of the area with focus on disadvantaged sections
(5) Crop insurance		
1985	Comprehensive Crop Insurance Scheme (CCIS)	To provide crop insurance against damage due to natural calamities for rice, wheat, millets, pulses and oilseeds
1999	National Agricultural Insurance Scheme (NAIS) or Rastriya Krishi Bima Yojana (RKBY)	To provide crop insurance to all farmers to cover all food, oilseeds and annual commercial/horticultural crops

Year	Initiative	Objectives
(6) Infrastructure		
1996-97	Accelerated Irrigation Benefit Programme (AIBP) under which the Centre provides additional central financial assistance by way of loans to the states on matching basis	Speedy and timely completion of selected large irrigation and multi-purpose projects to ensure timely benefits to farmers. Additional features of the AIBP include encouragement of improved water management practices, installation of drip and sprinkler irrigation, conjunctive use of surface and groundwater and farmers' participation in irrigation water management.
Ninth Plan	Credit Linked Capital Subsidy Scheme	Cold storage and onion storage facilities
(7) Plant genetic resources		
1976	National Bureau Of Plant Genetic Resources (NBPGR)	Exploration and collection, exchange, quarantine, evaluation/characterization, documentation and conservation of plant genetic resources

Year	Initiative	Objectives
1988	New Seed Development Policy announced.	This is a follow up to the policies initiated in the earlier years to increase the availability of quality seeds. The new policy permitted the import of superior quality seeds, germplasm and planting material after they have been verified for performance in Indian conditions.
1985-90	Third phase of National Seed Project with support from the World Bank launched.	100% foreign ownership of seeds units allowed, with focus on production of low-volume-high-value seeds. Public sector units given larger responsibility for high volume low value seeds to fulfil national objectives.
1988	New Seed Development Policy (NSDP)	Liberalize import of seeds and germplasms
2000	Draft Seeds Act	Reforms covering, seed production, distribution, quality control, legislation, import and export of seeds, quarantine, breeders and farmers rights, foreign investment in seed sector.
2001	Plant Varieties Act	Breeders right with respect to production, sale, marketing, export, import of varieties. Also farmers and researchers rights to use the improved varieties are recognized.

(8) Animal genetic resources

Year	Initiative	Objectives
1983	National Bureau of Fish Genetic Resources (NBFGR)	Collection, classification and evaluation of information on fish genetic resources of the country, cataloguing of genotypes, Maintenance and preservation of fish genetic material in coordination with other agencies and conservation of endangered fish species and monitoring the introduction of exotic fish species in Indian waters.
1984	National Bureau of Animal Genetic Resources (NBAGP, Karnal)	Identification, evaluation, characterisation, conservation and utilization of livestock and poultry genetic resources.
(9) Integrated pest management and control		
1985-90	Thrust on integrated pest management (IPM) through adoption of cultural, mechanical, biological and chemical methods of control.	To minimize the use of harmful chemicals which will affect human and ecosystem health
1989	Plant Quarantine Rules including Plant, Fruit, and seeds (Regulation of Import into India) Order 1989 (PFS order, 1989)	To prevent introduction of exotic pests, diseases and weeds etc. into India
(10) Sustainable plant nutrition to increase food production		
1990-91 & 1991-92. Continued during Eighth Plan (1992-97)	Centrally-sponsored Schemes for Balanced and Integrated Use of Fertilizers and National Project on Development of Fertilizer Use in Rainfed Areas Integrated Nutrient Management (INM)	Soil test based NPK and micro-nutrients application Setting up of compost plants for processing city waste/garbage. To promote need-based use of chemical fertilizers
1985-90	National Project on Development of Bio-Fertilizers (40 Blue-Green Algae Sub-centres established) and National Project on Quality Control.	Aim was to encourage use of bio-fertilizers and produce blue-green algae through field multiplication.
1992 & 1994	Changes in policy of fertilizer pricing	Price decontrol for P&K; increase in urea prices; flat subsidy for P&K.
(11) Animal husbandry		

Year	Initiative	Objectives
2000	National Project on Cattle and Buffalo Breeding	Improved services, greater use of private and community institutions.
2001	Aquaculture Authority	Regulation of shrimp culture specially in CRI areas.
2001	Amendment to Livestock Importation Act	Safeguarding livestock from diseases
Ongoing schemes	i) Assistance to State for Control of Animal Disease ii) Integrated Dairy Development Project iii) Assistance to Cooperatives for Dairy Development iv) Establishment of Fishing Harbours v) Development of Freshwater Aquaculture	Promoting various aspects of livestock development and fisheries.

Source. Seventh, Eighth and Ninth Five-Year Plans, Economic Survey (various issues).

Achievements

Food security and sustainable development

Food security and sustainable agriculture growth have occupied the centre-stage in formulation of policies for India's agriculture and rural sectors. Indian agriculture has made rapid strides in the past. The annual per capita production of rice and wheat rose from 152 kg in 1991 to 163 kg in 2000, and then came down to around 150-155 kg in the last two years, that is, 2001 and 2002. The achievements over the last two decades have contributed significantly to the attainment of self-sufficiency in food and in reducing food shortages and imports. Imports of cereals were resorted to only in two years, 1993 and 1994. The volume of imports was also small at less than 2% of the total production of cereals. Special efforts have been made to raise the productivity and production of crops to meet the increasing demand for food generated by unabated demographic pressures and the need for raw materials to expand agro-based industries. Several other policy interventions on the output side, such as the grain support policies executed through the Minimum Support Prices (MSP) for wheat and rice and major food grains, have contributed to it. The MSP for all the major agricultural products are announced at the start of each season after considering the suggestions of the Commission for Agricultural Costs and Prices (CACP). The MSPs have been steadily raised in the 1990s (Planning Commission, 2000).

From 1992 through 2000 the production of rice, wheat and pulses grew annually by 2.2, 3.6 and 0.8%, respectively (Eighth and Ninth Five-Year Plans). However the production of coarse cereals declined by 1.6%, indicating the producers' inclination towards high-value food grains. The production of (9 major) oilseed crops, jute, mesta and sugarcane also increased between 1992 and 2000 but cotton production fluctuated largely due to pests and diseases. The Technology Mission for Cotton has resulted in a significant improvement in production of cotton with improved export potential.

Horticulture has grown rapidly in the 90s. The production of fruits increased from 28.63 million tonnes in 1991-92 to 44.04 million tonnes in 1998-99 which represents an increase of over 50%. The production of vegetables increased from 58.53 million tonnes to 87.53 million tonnes representing an increase of about 50% over the same period (Planning Commission, 2001b).

Buffer stocks

Besides subsidies on food supplies and food procurement, buffer stock operations also constitute an important element of policy to attain food security. Given that agricultural production is subject to climatic swings, if left to the market forces, the price of food grains would tend to fluctuate, and that may be costly both for the producers/farmers as well as the consumers. To check price variability, building and maintaining buffer stocks has been the policy (GoI, 2000a; Planning Commission, 2000). However, interestingly enough the challenge faced by the policy makers now is to reduce the prevailing levels of stocks of agricultural produce to provide wider access to consumers while avoiding a reduction in product prices to the seller. The buffer stocks in the 1990s were consistently above minimum norms, except in 1997 (MoF, 2002).

Food distribution systems

For effective distribution of food procured by the agencies, there is a network of more than 400,000 fair price shops under the public distribution system (PDS). The PDS distributes Rs 15,000 crores worth of commodities to over 16 crore families each year. The PDS has been modified from time to time. In 1997 a new Targeted Public Distribution System (TPDS) was started with the objective of ensuring food and nutritional security of the poor by giving foodgrains at lower prices to those below the poverty line. This was further modified in 2000 when the Antyodaya Anna Yojana scheme was launched. Under this scheme the 10 million poorest families were identified out of the 65.2 million below poverty line families and provided foodgrains at a price even lower than the price for below-

poverty-line families (Economic Survey, 2001-02). In addition to the TPDS, two additional schemes are in operation—Integrated Child Development Scheme (ICDS) and the Mid-day Meal Programme of the Central Government—aimed at reducing household malnutrition. The government expenditure on these schemes is more than Rs 13,400 crores per annum (Planning Commission, 2000).

Inputs for agriculture development

The growth in agricultural output achieved over the nineties because of higher output support prices was combined with a range of input subsidies on water, fertilizers and power. Land is a crucial input for agriculture and several measures have been taken to ensure that its quality is maintained and optimum use is made of land resources for agriculture. (For a discussion on the policies for land resources see the Chapter on Land resources). The creation of irrigation potential and its optimum utilization have been accorded a high priority in governmental planning. The net irrigated area has increased from 22.6 Mha in 1950/51 to 94.7 Mha in 1999/2000. Most significantly, the government launched the Accelerated Irrigation Benefit Programme (AIBP) in 1996/97, under which the Centre has committed additional financial support to states for the early completion of selected large irrigation and multi-purpose projects (for more details on this aspect, see chapter on water resources) (MoF, 2002).

The consumption of fertilizers (mainly nitrogen (N), phosphorus (P) and potassium (K)) has steadily increased over the years. The overall consumption of fertilizers increased more than three-fold from 5.5 million tonnes in 1980/81 to 18.07 million tonnes in 1999/2000. The Central Government has promoted the use of fertilizers by providing a subsidy on urea, phosphatic and potassic fertilizers to encourage and move towards a more balanced use of NPK. The Retention Price-cum-Subsidy Scheme (RPS) was introduced in 1977 to help insulate the farmers from fluctuating fertilizer prices, encourage fertilizer consumption to sustain the green Revolution and provide stable mark-ups to the indigenous fertilizer industry. The level of subsidy was fixed for each plant separately. Since 1992 this has been done only for urea, while for P and K it is a flat subsidy. The total subsidy on fertilizers (including imports) was estimated at Rs 14170 crores in 2001/02 (MoF, 2002).

The private sector will also be increasingly used to provide better inputs and technology for the benefit of farmers.

Seeds development

Improved varieties of seeds together with a sound and equitable system of distributing these are another component of India's success in agriculture. The Seed Multiplication Programmes for cereals, pulses, oilseeds, fibre, fodder crops and potato have been put into operation largely by the National Seeds Corporation Limited, State Farms Corporation of India Limited, the state Seeds Corporations, state-level seed-producing agencies and private seed companies. Following the recommendations of the Seed Policy Review Group, the Draft Seeds Act proposes legislation that would establish a National Seeds Board to encourage indigenous development of newer varieties and their registration, promote research and development and regulate trade in seeds types (GoI, 2000a; Planning Commission, 2000).

Credit development

To encourage the flow of credit to the agriculture sector, a share of 18% of net bank credit is targeted for lending by commercial banks. The National Bank for Agriculture and Rural Development (NABARD) is the key institution directing flow of credit to agriculture. Some noteworthy developments in recent years have been the launch of the Rural Infrastructure Development Fund (RIDF) in 1995/96 and the Kisan Credit Card Scheme (KCCS) in 1998/99, to facilitate short-term credit to farmers. The RIDF has been set up to assist the state governments while state-owned corporations provide financial support for ongoing rural infrastructure projects. Successive Union Budgets have been raising the allocations to the RIDF. The Union Budget for 2001/02 provided for RIDF VII with a corpus of Rs 5,000 crores. Cooperative banks, the Regional Rural Banks and the commercial banks together had issued 14.4 million KCCs up to the end of March 2001, with the amount sanctioned at Rs 26,058 crores (Planning Commission, 2001c).

The Reserve Bank of India (RBI) has also evolved an annual plan of action for disbursement of credit to agriculture called the Special Agricultural Credit Plan (SACP) that targets 25% growth in disbursements each year.

Farm mechanization development

In nineties, farm mechanization grew in an unprecedented manner. Through the period 1993/94 to 1999/00, 1.47 million tractors and 85,000 power tillers were sold in the country. The employment of agricultural machinery that had earlier remained confined to a few states, such as Punjab, Haryana and Western Uttar Pradesh, now showed increasing penetration to other rice-growing states, too. The capital intensity per unit of land has been increasing for all categories of

farmers, but in relative terms this has grown much faster in the regions covered by the Green Revolution and for large farmers. The prevailing high capital intensity has been sustained by awareness campaigns, training and capacity-building programmes, subsidized power and water and other forms of subsidies (unpaid loans, cheap fertilizers) etc (Planning Commission, 2000).

Animal husbandry development

The livestock sector helps in providing essential proteins for human diet, besides providing employment opportunities to the rural people. It has also registered a notable growth. Between the period 1991/92 and 2000/2001, milk production has increased from 55.7 million tonnes to 81 million tonnes. India has become the largest producer of milk in the world. The value added from milk production is now about the same as added from rice. Fish and egg production also increased over the same period from 5 million tonnes to 5.7 million tonnes and 22 billion to 32.5 billion (numbers) respectively. All these achievements have increased the per capita availability of these products. It has also helped to diversify rural incomes (MOA, 2002).

This increase in production has been brought about by an equally impressive rise in the livestock population (Table 14.2).

Table 14.2 Livestock population, 1987-92 (in million)

Species	1987	1992
Cattle	200	205
Buffalo	76	84
Sheep	46	51
Goats	110	115
Pigs	11	13
Poultry	275	307

Source. Agricultural Statistics at a Glance (2001), Live Stock Census, Ministry of Agriculture

Exports and international trade development

India's exports of agricultural products are divided into three categories: (i) raw products, (ii) semi-raw products, and (iii) processed and ready-to-eat products. At the beginning of the nineties, the value of agricultural exports stood at US \$ 3521 million with a share of 19.4% to the total value of exports. These rose to US \$ 6828 million in 1996-97 (accounting for 20.4% of aggregate exports) and subsequently declined to US \$ 6037 million (18.2% of total exports) in 1998-99. The major commodity groups include cereals, oilmeals, plantation crops (tea,

coffee, cashew, and spices), and marine products (MoF, 2002). In 2000/01, these exports stood at US \$ 6004 million, accounting for 13.5% of total exports.

The World Trade Organisation's (WTO's) Agreement on Agriculture (AoA) offers both threats and opportunities to India's agriculture sector. The AoA requires that developed countries lower the barriers to trade in agricultural commodities faster than the developing countries by undertaking a reduction in export subsidies, production subsidies and import tariffs. Nonetheless, experience points to a lack of adequate progress in the implementation of these commitments to provide market access to developing countries such as India. While the AoA may not have an impact the entire agricultural sector, certain crop types will gain and others may lose. The analysis of the AoA on trade in select commodities points to raising of domestic wholesale and farm gate prices of rice and maize, with a magnified impact on the former. The prices of edible oils and oilseeds such as rapeseed/mustard would decline on account of freer imports of seeds (Planning Commission, 2001c).

Although quantitative restrictions were removed last year, a large-scale imports of agricultural products have not occurred thus far. Nevertheless, given the large scale support to agriculture in other parts of the world, constant monitoring would be necessary.

Peoples' participation and promoting human resources development^a

The initiatives taken by the government have improved the quality of human resources in agriculture. So far a total of 29 state agricultural universities, 1 central agricultural university and 4 deemed universities have been established in different parts of the country. The agricultural education system in the country offers degree programmes in 11 specific disciplines viz. agriculture, veterinary science, agricultural engineering, forestry, home science, dairy technology, fisheries, sericulture, marketing, banking and cooperation, horticulture and food science with a total intake of about 11,000 students. These institutions also offer post-graduate programmes in more than 55 fields of specialization with a total intake capacity of about 5,000 students. Under the human resource development programme the council offers about 1200 scholarships and fellowships from the undergraduate to post-doctoral levels. Special fellowships are also offered for socially and economically weaker groups.

^a Source: MoA 2001a

A World Bank-assisted project on Agricultural Human Resource Development (AHRD) has been launched to improve the educational system in agriculture and meet future challenges. During the project period steps will be taken to establish an accreditation board, reform the syllabus, improve faculty, upgrade and modernize laboratory facilities, farms, libraries, hostels, communication systems and other ancillary facilities. A National Agricultural Technology Project (NATP) is also contemplated to bridge gaps in technology generation, assessment, refinement and transfer and to enhance the ICAR's institutional capability to meet future challenges on the research and development fronts.

Considerable emphasis has been laid on developing a sound extension service to bring to the farmers the latest knowledge and developments. In the public sector these are categorized into three areas as follows.

- State government line departments-operated extension (Departments of Agriculture, Horticulture and Livestock development)
- State agriculture universities-based extension (Directorate of Extension, Krishi Vigyan Kendras (KVKs) and Krishi Gyan Kendras (KGKs)
- ICAR extension (Zonal Research Stations/Krishi Vigyan Kendras, Agriculture Technology Information Centres (ATICs), Institute Village Linkage Programme (IVLP) etc.)

In the private sector the types of extension are:

- Community-based organization (Farmers' organizations, farmers' cooperatives, self-help groups, farmer interest groups, etc.)
- Para-extension workers (contact farmers, link farmers, master farmers, *gopals*, *mitra kisans*, *mahila mitra kisans*, etc.)
- Agri-clinics and agribusinesses
- Input suppliers/dealers (pesticides, seeds, nutrients, farm implements, etc.)
- Corporate Sector (commercial crops – tobacco, tea, coffee, oilseeds (sunflower), vegetables, seeds, farm implements – tractors, threshers, sprinklers, drip irrigation, etc.)

Cooperatives have played a major role in ensuring the peoples' participation in agricultural development. The role of cooperatives in agriculture has been substantial covering every aspect of it – inputs, marketing, credit and distribution. These initiatives have resulted in improved quality of manpower and higher productivity in different crops ranging from 20 to 72% compared to conventional yield levels.

The participation of people has also been sought in animal husbandry. Breeders associations have been promoted to address common problems. Improvement in the maintenance of grazing/pasture lands has been sought by involving the community. The National Project for Cattle and Buffalo Breeding (NPCCB) is a recent project which was started in 2000. The project aims at streamlining the storage and supply of liquid nitrogen, providing artificial insemination at the doorstep, introduction of quality bulls, improved quality of existing services etc. NGOs, breeders associations and even private individuals are encouraged to participate in this process.

Diversification of rural employment and infrastructure development

The concerns of rural poverty are inextricably linked to low productivity of rural activities and incidence unemployment/underemployment. It has therefore been considered a policy imperative that productivity and employment levels be enhanced. While there has been a marked decline in the incidence of poverty in rural areas, any average estimates tend to hide wide variations across regions in the concentration of rural poor. A decline in poverty and rural development both follow the economic betterment of people as much as social transformations. The government has launched many programmes to this effect, that have addressed the peoples' participation in rural areas, diversification of employment opportunities, decentralization of planning (through enlargement of role of panchayati raj institutions and voluntary organizations), enforcement of land reforms and greater access to credit and inputs. The specific schemes are the Integrated Rural Development Programme, Training of Youth for Self-Employment, the Supply of Toolkits for Rural Artisans, Development of Women and Children in Rural Areas, Jawahar Rozgar Yojana etc. These have been dealt with in much greater detail in the Chapter 16 as well as Chapter 13. In addition the development of fisheries, horticulture and animal husbandry have all played an important part in diversifying rural incomes. Details of the growth of these sub sectors have been given earlier in this chapter under the section dealing with Food Security and Sustainable Development.

Steps have also been taken to encourage a greater role for private individuals to provide a range of services for the livestock sector. Apart from improving the quality of service these initiatives will also play a role in diversifying rural incomes.

Conservation and utilization of plant genetic resources for food and sustainable agriculture

The setting up of the National Bureau of Plant Genetic Resources (NBPGR) in 1976 has paid rich dividends. So far the Bureau has conducted 564 explorations in diverse agro-ecological regions and habitats representing different phyto-geographical zones of the country. This has resulted in assembling 1,07,346 accessions of agri-horticultural crops/genera. The Bureau has also established a National Herbarium of cultivated plants which has 12,599 herbarium specimens of 2,657 species belonging to 1,085 genera and 215 families. The corresponding holdings of seeds as voucher specimens are 1818. In addition to exploration of indigenous germplasms the Bureau actively promotes the introduction of exotic germplasms. So far, 13,71,814 accessions from 81 countries and 8 international agricultural research centres have been introduced and 3,95,223 accessions supplied to other countries including SAARC countries (ICAR, 2001). Realizing the need to characterize the indigenous diversity and to protect the country's genetic resources, the ICAR established a National Research Centre for DNA fingerprinting at the NBPGR. The centre will develop molecular fingerprints of released varieties and genetic stocks of crop plants of India. The All India Co-ordinated Research Project on Under-utilized and Under-exploited Plants (UU&UEP) was initiated 15 years ago, to find new plant resources for food, fodder and industrial use and to prioritize a few promising ones among these for development of improved technology. In all, 24 crop species have been identified for research under this project. Besides augmentation of over 6,700 germplasm accessions in these crops at NBPGR locations and other centres, the project has recommended/released 12 improved varieties in 7 different crops. Improved packages of cultivation practices and certain cropping systems have been standardized and recommended.

The ICAR system has so far developed and released more than 2300 high-yielding varieties and hybrids, fuelling the Green Revolution. In all, 452 high-yielding varieties and hybrids of various field crops were released for general cultivation during the period 1992 to 1996.

Conservation and utilization of animal and fish genetic resources for sustainable agriculture

The National Bureau of Animal Genetic Resources (NBAGR) has been engaged in conserving Indian animal breeds. The data on livestock and poultry genetic resources have been computerized in the form of databanks. This covers (i) district-wise livestock population for all species of domestic livestock from 1961 to 1992 for each census year and for all categories i.e. sex-wise, age-wise and function wise; (ii) germplasm repositories containing the name and addresses of

livestock farms, breeds maintained, herd strength, number of bulls, semen banks, semen doses for each breed; (iii) Breed characteristics containing complete information on the natural habitat of a breed, socio-economic status of farmers in the tract, management practices, physical characteristics and performance parameters.

The livestock census data has been integrated with the information system on animal genetic resources of India (AGRI-IS). A menu-driven information system has been developed by combining all the databases. Facilities have been provided for data entry, retrieval, display etc. This also contains colour photographs of the male, female, calf and herd for each breed. A software package has been developed for entry and analysis of data collected for evaluation of breeds under field conditions. Field surveys have been conducted on a few chosen farm animal breeds to study yield, population trends, and substitution of cattle by buffaloes. Through various initiatives, different improved breeds of cattle, buffaloes, goats, sheep, pigs, poultry and fish are being developed and released (ICAR, 2001b).

The National Bureau of Fish Genetic Resources has been working in five major programme areas related to the conservation of fish germplasm resources. The incorporation of the geographic information system (GIS) into the fish biodiversity database will help in planning macro-and micro-level location-specific conservation programmes. With a battery of genetic markers developed under its genetic characterisation programmes, definite conclusions about prioritized species have emerged. In the Bureau's programme on in situ conservation, greater stress has been given to understanding the habitat requirements of endangered species and the communities' perception of conservation issues. Under the gene banking programme, the NBFGR has added more endangered species for which sperm cryopreservation protocols have been perfected for commercial application. Under exotic and quarantine regulation, greater emphasis has been laid on the quarantine database and developing capabilities for screening exotic diseases so that the necessary research support for establishing aquatic quarantine can be given.

Integrated pest and nutrient management

Modern crop varieties require a high degree of plant protection measures. In India the consumption of technical-grade pesticides increased from 8,620 tonnes in 1960/61 to 75,000 tonnes in 1990/91. As a result several pesticide-induced pest outbreaks have been reported from the various parts of the country. Out of 166 registered pesticides in India under the Insecticide Act 1968, 34 are either banned or restricted in developed countries. The indiscriminate use of pesticides has

resulted in the loss of biodiversity of natural enemies, secondary pest outbreaks, and development of resistance to pesticides, food contamination, adverse health impacts, and ecosystem damage. Based on the recommendations of registration committee and the expert committees, 27 pesticides have been banned and 10 other pesticides have been put under restriction so far. The Government of India has been practising Integrated Pest Management since 1985. In IPM the emphasis has been on pest management through a combination of agronomic, chemical and biological methods. IPM is being promoted in the country through 26 Central Integrated Pest Management Centres located in 22 States and 1 Union Territory. Timely sowing, use of tolerant and resistant plant varieties, biocontrol agents, and need-based application of chemical pesticides have all resulted in the reduction in the consumption of technical-grade pesticides from 75,000 tonnes in 1990/91 to 49,160 tonnes in 1998/99. This trend is a positive move towards sustainable agriculture. Greater awareness creation on outbreak of pests and diseases amongst the farming community is expected to lead to a greater success (MoA, 2001a).

Integrated nutrient management

The fertilizer (NPK) consumption in India has increased from 0.5 MT in 1963/64 to 18.1 MT in 1999/2000. The fertilizer production of 14.3 MT during 1999/2000 fell short of the consumption by 27%. This gap is likely to widen for economic and environmental reasons. To meet the challenge of promoting sustainable plant nutrition to increase food production various initiatives such as centrally-sponsored schemes on the balanced and integrated use of fertilizers, and a national project on the development and use of biofertilizers have been initiated. The government had promoted the use of chemical fertilizers in the past. While this would continue, it also needs to be complemented by greater use of organic/biofertilizers. Accordingly, the Government of India has been promoting the use of organic manures and supplementary sources of plant nutrients to crop as a means of protecting the environment. A task force has been set up to go into all aspects of organic farming. It is proposed to promote the use of organic manure and organic farming in a big way during the Tenth Plan. A strategy for judicious combination of chemical and biofertilizers will be pursued to reduce dependence on chemical fertilizers alone (Ninth Five-Year Plan, 1997-2002).

Role of farmers

The Government has increasingly involved farmers in decision-making. A key concept is to decentralize decision-making to the district level through the *District*

Agriculture Technology Management Agency (ATMA) model. This model seeks to ensure a greater representation and voice for farmers in recognition of their role as the primary stakeholders. Secondly this seeks to provide a greater say to the farmers in allocation of resources and to increase their accountability to stakeholders. A third major goal is to increase programme coordination and integration between departments.

Rural women form the most important productive workforce in the economy of most developing nations including India. The agriculture sector employs 4/5th of all economically-active women; they make up 1/3rd of the agriculture labour force and 48% of self-employed farmers. There are 75 million women as against 15 million men in dairying, the number of women engaged in animal husbandry accounts for 20 million (as against 1.5 million men). Nearly 80% of approximately of all economically-active women are engaged in agriculture as compared to 63 % of men.

Despite such significant contributions by women in crop husbandry, animal husbandry, fisheries, forestry and post-harvest technology, those engaged in formulating packages of technologies, services and public policies for rural areas have often ended to neglect the productive role of women. There has been however, a significant shift in the approach towards well-being of women from 'welfare during the fifties', to 'development during the seventies' to 'empowerment during the nineties' and to 'participation during 2000s'.

The Ninth Plan had identified 'empowerment of women' as one of its objectives and had stressed the preparation of a component plan for women in every sector of development. The agriculture policy has also highlighted the incorporation of gender issues in the agricultural development agenda. The policy framework of agriculture extension has also stressed the need for mainstreaming women in the agriculture sector. Efforts are being made by different governmental/non-governmental organizations to incorporate gender issues into the developmental agenda and ensure women full and equitable participation in agriculture development programmes. The Department of Agriculture and Cooperation is implementing special schemes/projects with Central/bilateral assistance to provide training and extension support to women farmers in 21 states of the country. These projects aim to encourage and mobilize women to form groups and all agriculture support services such as technology, information, extension, credit, input and marketing interventions are channelized through these groups. At present 15,000 groups have been mobilized and approximately 3 lakh women have been directly trained under these programmes.

Concerns

Slower growth

The agricultural sector has shown high growth rates in the 80s. These growth rates have tended to slacken in the 90's (MoA, 2000). The production growth rates of rice and wheat declined on account of lower growth in productivity. This was because of saturation in the yields of rice and wheat in the established high productivity areas coupled with lower yields in the central, eastern and north-eastern parts of the country. The production of coarse cereals production grew negatively because land was diverted to other, more remunerative crops. For pulses, the lowering of production growth rates could be attributed to a sharp decline in the growth of yields in the nineties as compared to the eighties. Further, the infusion of cross-breeding programmes and Operation Flood that had boosted milk production in the eighties was not sustained through the nineties. The production of eggs which had increased sharply due to establishment of modern poultry practices in Southern India, followed the same pattern.

Amongst the key policy concerns, the relative slow down in the nineties can be attributed to a much lower accumulation in capital assets in irrigation, power, canals and roads (Planning Commission, 2000). These not only reduced the pace of technological change but also impacted total factor productivity (TFP) adversely. The continuing regulation of inter-state trade in agricultural commodities and canalization of trade have also implied that markets are not fully developed and this can hamper the sector's competitiveness, as also the industries based on it (e.g. cotton textiles and oilseeds).

Public Distribution System

The operations of the PDS also needs improvement notwithstanding the huge increases in annual food subsidy bills from Rs 2,450 crores in 1990-91 to Rs 14,700 crores in 2001/02. Diversion of PDS supplies to non-targeted groups has always been a matter of grave concern. Reportedly, 36% of wheat, 31% of rice and 23% of sugar gets diverted to wrong groups at the national level. On the other hand, the levels of grain stocks with the FCI have shot up. In January 2002, the central food grain stocks stood at 58 million tonnes against the prescribed level of 24.30 million tonnes (MoF, 2002).

Inputs

The present fertilizer pricing policy has been successful in promoting their use and increasing incomes. However there is an imbalance between nitrogen, potash and phosphorous usage with the relative use of nitrogen being excessive. Moreover, there are wide variations in fertilizer application rates across different regions of the country. In Punjab, Tamil Nadu, Haryana and Andhra Pradesh that have high adoption rates for improved technology and a better developed irrigation infrastructure, the fertilizer consumption is much higher than in the north-east or Madhya Pradesh, Rajasthan and Himachal Pradesh, where agriculture is prone to high risks. The deficiency of other forms of micro-nutrients such as zinc, iron, sulphur etc. is also being increasingly felt especially in regions where multiple cropping is practiced. Moreover, over the years the carbon content of soils has decreased in some regions, affecting soil health and productivity.

The impact of water and power pricing policies has been discussed in the chapters on energy and water resources. There is a need to review the past policies with a view to making best use of available resources. The availability of credit to agriculture from nationalized banks has not been growing at desired rates; the share of agricultural credit has been declining from the targeted 18% and is a matter of concern. While the availability of certified/quality seeds has increased substantially, the seed replacement rate (SRR) has still remained much below the desired level of 20% for self-pollinated crops. For rice and wheat it ranges between 8-9% and is much below desirable levels for other crops such as pulses and oilseeds. As a follow up to the WTO agreement on TRIPs, a new Act for the adoption of a *sui generis* system for granting of plant varieties protection has been introduced. The Act is expected to provide an effective system of protection to plant breeders' rights and would support the growth of the seeds industry as well as safeguard farmers' and researchers' rights.

Conservation of genetic resources and R&D

Where crop varieties, are concerned, although landraces and farmers' varieties have been well-explored, weedy and wild relatives of cultivated crop species, endangered species and plant species with potential uses remain under-explored. Storage and field testing of vegetatively propagated germplasm is a major problem due to inadequate facilities. Protection from pests during screening of germplasm materials is limited. In germplasm evaluation little attention is paid to the evaluation of materials for biotic and abiotic stresses. Less attention has been given to exsitu conservation of wild crop relatives and other useful plants.

Conservation of recalcitrant seeds and vegetative propagules has been done on a limited scale using *in vitro* conservation and cryopreservation.

A species catalogue is important to identify gaps and to initiate studies to fill the gap. There is a need to quantify any constriction in the genetic base of target species and to identify heterogeneous populations of endangered and commercial species whose conservation should be given a priority. *In situ* conservation has not been undertaken on a large scale because of inadequate experience in field testing procedures. The absence of infrastructural facilities has limited large-scale gene banking. *Ex situ* conservation in a live gene bank cannot be undertaken in absence of such a facility. Absence of detailed information on unauthorized introductions and spread of exotics in India, has limited the development of an action plan to control exotics (ICAR 1997 a, b & c).

Bio-pesticides

The rate of adoption of bio-pesticides has been slow largely due to inadequate knowledge reaching the farmer. A combination of traditional (organizing field days etc) and modern methods can be used to influence farmers to adopt these techniques. Reliable models to predict insect populations can be developed using the weather information and programmes available on the Internet. Use of GIS can also help better control of pests and diseases through timely adoption of plant protection measures.

Fertilizers

The fertilizer production of 14.3 million tonnes during 1999/2000 fell short of consumption by 27%. This gap is likely to widen due to economic and environmental reasons. To meet the challenge of promoting sustainable plant nutrition to increase food production, various initiatives such as centrally-sponsored schemes on the balanced and integrated use of fertilizers, and use of bio-fertilizers have been initiated. A strategy to encourage judicious combinations of chemical and bio-fertilizers is required to reduce dependence on chemical fertilizers alone.

The current demand for bio-fertilizers in India is estimated at about 1.25 million tonnes and the actual production capacity about 2610 tonnes. This huge gap between demand and supply needs to be bridged. Another concern is the slow adoption of bio-fertilizer by farmers. This is largely because bio-fertilizers do not show instant responses like chemical fertilizers do. In many cases bio-fertilizer technology faces the problems of quality control, inconsistent field performance, poor transport and storage and lack of knowledge. There is need to

put in place better quality control mechanisms and to strengthen the extension services at the grassroots levels.

Integrating Agenda 21 concerns - directions

The National Agriculture Policy (NAP) (MoA, 2000) is an effort by the Government of India to address the issues facing agriculture in India. These also cover the concerns expressed in Agenda 21. Given its comprehensive nature, the NAP is a starting point to providing directions towards a sustainable and equitable growth of agriculture in the future. The policy seeks to actualize the vast untapped growth potential of Indian agriculture, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro business, create employment in rural areas, secure a fair standard of living for the farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization and to ensure sustained food production.

The slackening of the growth of agricultural production is clearly a major concern in realizing these objectives. It calls for a multi-pronged strategy aimed at tackling the root causes for the slowdown, especially the saturation in productivity gains. The strategy must also ensure that the pattern of growth can be sustained in the long run.

A major cause for this slowdown is the reduced inflow of capital and creation of rural infrastructure. The government has already drawn upon plans for accelerated development of irrigation potential. The RIDF has also been strengthened over time and this has also been done in this year's Union Budget (MoF, 2002a). Enhanced public investment will continue to be a key component of the strategy to revive agricultural growth rates.

These measures would be coupled with policies aimed at ensuring a more sustainable use of inputs. Fertilizer applications, which are currently skewed in favour of N, need to be nudged in the proper direction. The present fertilizer policy has been reviewed by the Expenditure Committee and a decision on these recommendations will be taken shortly. The financial and environmental sustainability of the present policies will be the major factors governing the future course of direction. To supplement chemical fertilizers, greater emphasis will be placed on the use of bio-fertilizers.

The use of water has to be regulated in a similar manner to ensure equitable access today as well as for the future. Water Users' Associations have already demonstrated marked success. The management of water through its users and a

community-based approach will be strengthened. This calls for more research, spread of the success stories of such research and creation of awareness amongst users of the potential of better water management practices.

The impact of the Green Revolution has been uneven in the country. The problems in the more developed regions are different. Areas which have not had the high rates of growth that states like Punjab have experienced will need a different approach. New resource conservation technologies, such as zero-tillage, reduced tillage, surface seeding, bed-planting and the associated agronomic practices, can help in reducing costs, both financial and in terms of natural capital also.

Apart from better use of inputs, it is quite essential to provide the right signals for better crop choices to the growers. The present system, based on the support price mechanism, has yielded impressive results thus far. Food security has been achieved and imports of food grains have become a rare phenomenon. There has, however, been a sudden build-up of food grain stocks. Government has set up a high level committee to look into this issue. The Committee has given its interim report and its final report is expected soon. The Government will take a decision on these recommendations with a view to providing security to farmers and ensuring that India's agriculture is competitive and can exploit the opportunities that international markets can provide in the future. Considerable progress has been made in diversification of agriculture and these steps will be further pursued.

In the international arena, the government will continue its efforts to ensure that the developed countries open their agricultural markets. The country's tariffs will be calibrated to ensure that the agriculturists are protected from unfair competition. In the expectation that the present denial of access to the markets of developed countries will not last, steps will be taken to develop a more competitive domestic market, necessary to tap these likely opportunities. Towards this end the government has already announced its decision to have a unified national market, remove restrictions on stockholding under the EC Act and establish a futures market for all agricultural commodities.

These policies need to be complemented by steps to preserve the animal and plant genetic resources of the country. The institutional mechanisms for this already exist in the shape of the NBPGR and NBAGR. These will be supported to address the concerns identified above.

These steps will be complemented by measures for poverty removal. Greater involvement of farmers and breeders in decision-making will be promoted through measures such as the ATMA model and the NPCBB. The role of women

which has been recognized as important will be further strengthened. A combination of these measures, involving the people and the local and community-based self-help institutions at every step will provide the pathway to a sustainable rural development strategy.

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