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Agriculture and India today

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ABSTRACT

Attainment of food security has been the major objective of India since independence. Today India is second largest producer of food in world and has all the potential of becoming world leader if the emerging problems of agriculture are addressed through technological development, appropriate policy interventions that improve farm profitability *vis-à-vis* agricultural sustainability. This can be done through a transition from commodity agriculture to product agriculture, that is from quantity to quality agriculture. Efforts to develop and expand new types and uses of bulk agricultural products (value addition), alternative production technology (organic and conservation agriculture) and speciality crops will create opportunities for improving economic viability of agriculture and rural communities. Value-added cooperatives that can develop new alliances with consumers (farmer-grocer contacts, internet marketing) may create new entrepreneurial opportunities in Indian agriculture. Emphasis on access to higher education and imbibition of quality and relevance in education with appropriate policy intervention will pave the ways for faster and sustainable development.

Technological development in crop science research, strong political will coupled with appropriate policy intervention and sincere efforts of farmers ushered in the "Green revolution" in India after independence. The country has achieved four-fold increase (50–212 million) in food grain production against a three fold increase (360-1081 million) in population. Today, India has also become one of the largest producers of milk (88 million t) and second largest producer of rice (73 million t), wheat (70 million t), vegetables (9.7 million t), fruits (10.5 million t) with 60 lakh tonnes of fish and 39.1 billion eggs. It was commitment of our political leaders and policy makers that India could build required infrastructure, one of the strongest national agricultural research system (NARS) in the world and the competent human resource (around 35,000 scientists) that enabled the nation to achieve self sufficiency *vis-à-vis* food security. In spite of such a spectacular success in food production, the contribution of agriculture to India's GDP has reduced from 39% to 22% during the period 1979-2004. The percentage of people employed in agriculture has come down from 64% to 54%. The decline in total factor productivity (TFP) has reflected in reduced farm profitability. Today, Indian farmers are worse off by 15-20 per cent. This trend needs to be reversed through improving farm productivity, profitability and rural employment opportunities by value addition to agricultural commodities. It will require additional investment for R & D in agriculture and allied sciences by Government and policy interventions aimed at poverty alleviation in rural India.

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Agricultural production and productivity

Historically, India's crop production scenario has been dominated by food grains more especially cereals. The country has registered a declining trend in crop and livestock production and per head food production, while maintaining increase in cereal productivity over past decade (Table 1). The most striking success during the last decade (1992-94 to 2002-04) has been steady increase in production of horticultural crops (Table 2). The production of vegetables substantially increased from 50 million tonnes to 90 million tonnes and is currently second only to China. Besides, providing nutritional and livelihood security to poor, this sub-sector sustained a large number of agro-industries which may generate huge non-farm employment opportunity.

Food and nutritional security

The perennial issue of poverty continued in rural and urban India. In spite of glorious success in food security, 25% people are still undernourished (Table 3). Billions of people in the developing countries suffer from malnutrition. The cost of these deficiencies in terms of lives lost and poor quality of life is staggering (Table 4). One of the most interesting features of country's economic development has been the decreasing trend of under-nourished people with reduced share of agriculture in national GDP (Figure 1a). Further, the population of under-nourished in-

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Table 1. Agricultural production and productivity in selected countries of Asia and the Pacific region

Country	Crop and livestock production		Per-head food production (average annual rate of growth (%)		Cereal yield (kg/ha)	
	1985–1994	1995–2004	1985–1994	1995–2004	1992–1994	2002–2004
Bangladesh	1.1	3.7	-0.8	1.7	2,583	3,410
China, Mainland	4.4	4.8	3.5	4.0	4,476	4,980
India	3.2	2.3	1.2	0.6	2,075	2,313
Indonesia	3.7	2.5	2.0	1.1	3,866	4,229
Korea, DPR	2.2	0.1	0.7	-0.6	5,487	3,310
Korea, R	2.3	0.8	1.3	0.2	5,852	5,991
Pakistan	4.6	3.1	1.8	0.6	1,893	2,332
Vietnam	4.2	5.3	1.8	3.5	3,344	4,484
Asia and the Pacific	3.7	3.6	2.1	2.3	3,089	3,459

Source: FAO, Rome (2005)

creased with increase in agricultural employment (Figure 1b).

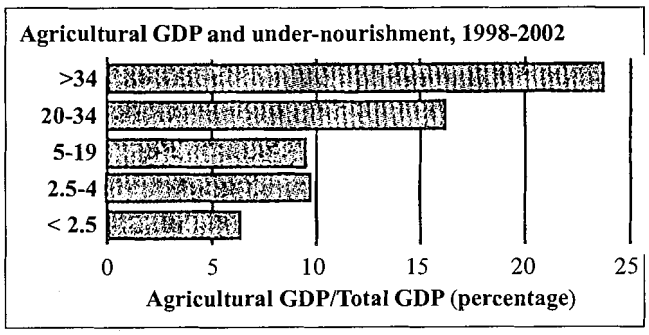

Figure 1a. Relation between agricultural GDP and population undernourishment

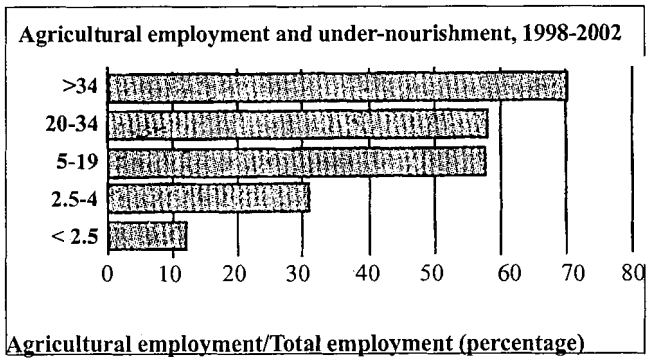

Figure 1b. Relation between agricultural employment and undernourishment

Agricultural trade

Given its magnitude, India's share in world exports of agricultural produce is relatively very small. A positive trend has been observed during 1999-2003 in which country's share in world exports rose from 1.1 to 1.3%. Agricultural contribution to total country's export was 11.2% while it was only 5.1% of total agricultural gross domestic product (GDP) (Table 5).

Table 2. Area, production and productivity of horticultural crops in India

Year	Area (million ha)	Production (million t)
1991-92	12.8	96.6
1992-93	12.9	107.4
1993-94	13.1	114.6
1994-95	13.1	118.4
1995-96	13.7	125.5
1996-97	14.4	128.5
1997-98	14.8	128.6
1998-99	15.1	146.2
1999-00	15.3	149.2
2000-01	15.7	150.2
2001-02	17.2	146.5
2002-03	16.8	148.1
2003-04	17.2	156.1

Source: Indian Horticulture Database, 2003, National Horticulture Board

Funding for agricultural research and development

The much acclaimed growth in food production in Asia and Pacific region including India can be attributed to enhanced investment on agricultural research which almost doubled from 0.26 to 0.55% of total agricultural GDP during the period 1971-75 to 1991-95. This investment is low compared with developed countries investing 1-2.5% of agricultural GDP on agricultural research. It is now critical for agriculturally dependent country like India to accord higher allocation of at least 1-2% of their GDP in agricultural research and development to meet emerging challenges of agriculture and allied sciences in the context of globalisation.

Priorities for agricultural research

Key strategies for pro-poor agricultural research in future are the following.

Table 3. Food security and nutrition in selected countries of Asia and the Pacific

Country	Number of people undernourished (million)		Proportion of undernourished in total population (%)		Dietary energy supply Kcal/person/day		Dietary energy supply Average annual increase (%)
	1990–92	2000–02	1990–92	2000–02	1990–92	2000–02	1990–2002
Bangladesh	39.2	42.5	35.0	30.0	2,070	2,190	0.60
China Mainland	193.5	142.1	16.0	11.0	2,699	2,957	0.88
India	215.8	221.1	25.0	21.0	2,366	2,420	0.19
Indonesia	16.4	12.6	9.0	6.0	2,698	2,912	0.82
Korea DPR	3.7	8.1	18.0	36.0	2,452	2,138	–0.26
Korea R	0.8	0.7	-	-	2,999	3,059	–0.03
Pakistan	27.7	29.3	24.0	20.0	2,305	2,431	0.17
Asia and the Pacific	569.2	519.0	20.0	16.0	2,521	2,674	0.53

Source: FAO, Rome (2005)

Table 4. Extent and consequences of micronutrient malnutrition

Deficiency	Prevalence in	Groups	Consequences
Iron	2 billion people	All, but especially women and children	Reduced cognitive ability complications; reduced capacity and productivity.
Vitamin A	250 million children	Children and pregnant women	Increased child and mother blindness
Zinc	May be as widespread as iron deficiency	Women and children	Illness from infectious diseases during child growth; pregnancy complications

Table 5. Agricultural trade and economic indicators in the selected countries of Asia and the Pacific

Country	Agricultural exports as share of total exports (%)	GDP per-head annual % growth	Agricultural exports relative to agricultural GDP (%)	Agriculture, value added % of GDP	Agriculture, value added Annual % growth
Bangladesh	1.7	3.2	0.9	21.8	3.1
China (Mainland)	4.1	8.7	7.1	14.6	3.6
India	11.2	4.2	5.1	22.2	3.2
Indonesia	9.5	2.4	20.0	16.6	2.2
Pakistan	10.5	3.7	6.5	23.3	3.4
Vietnam	12.4	5.9	26.3	21.8	4.2

Source: FAO, Rome (2005)

Improving staple food production

The green revolution technologies have now largely run their course in many irrigated and high-potential areas of the country. More germplasm improvement work, including biotechnology, is needed to raise yield potential of staple food crops. At the same time better management of off farm inputs like chemical fertilizers, pesticides and irrigation water can contribute to higher productivity and maintaining environmental quality.

Large gaps exist between potential, on-farm and farmers' yields of most crop varieties developed during green revolution period in the country. The concept of FARMSCAPE (Farmers, Advisers, Researchers, Monitoring, Communication and Performance Evaluation) a programme of participatory research with farming communities could be successful in translating technological development in agriculture at research institutions, agricultural universities, to farmer's fields. This will ensure the implementation of elements of precision agriculture, a scientific tool to increase input use efficiency and in turn crop productivity.

Improving productivity is of larger concern today than ever before for the reasons of decline in Total Factor Productivity (TFP). Despite being number one in milk, tea and pulses production and second in wheat, rice, groundnut, rapeseed and mustard, vegetables, fruits (after China) and sugarcane (next to Brazil) in total production, we are much behind in productivity, which has to be increased through efficient management of natural resources, human resource employed in agriculture and adopting precision

farming practices. Enhancing productivity of wheat through adoption of conservation agriculture, precision farming, balanced use of fertilisers and improved varieties would accelerate the stagnating yield scenario for the last five years. Increase in production of *durum* wheat in selected areas would accelerate prospects for future exports. Similarly, stabilizing area and production of rice, enhancing maize production, sugarcane for bio-fuel, increased productivity of pulses (at least to 1 t/ha) and oilseeds (soybean, groundnut, rapeseed and mustard, sunflower, hybrid castor and safflower) are other important areas attracting our R & D efforts.

Making dry areas green through rainfed agriculture technologies like timely operations, weed management, integrated pest management, efficient irrigation systems (sprinkler and drip), use of biofertilizers need a coordinated area-wise or ecoregion-wise approach. Emphasis on new area approach based on agro-climatic zone linked production potential will lead to faster progress.

Focus on farm profitability

Improving farm profitability is both a challenge and opportunity for agricultural scientists. It can be achieved through increasing total factor productivity, nutritional quality and value addition in agricultural raw product.

(a) Resource Conserving Technologies: The term Resource Conserving Technologies (RCTs) is being coined to describe any technology that will produce more output while improving the efficiency of inputs used to produce that output. The resource affected include water, soils, fertilizers, pesticides, air and finally people. Recent research efforts on conservation tillage, including zero tillage in rice-wheat production system in South Asia, have shown great promise to make this intensive cropping system more sustainable in future. The technology, in last five years, has spread as a 'wild fire' in north western Indo-Gangetic Plains and is gaining acceptance in north eastern Indo-Gangetic Plains of India. Farmers generally save up to rupees 2,500, besides lesser environmental pollution. It reduces turn around period between rice harvest and wheat sowing and thus facilitates timely sowing of wheat to enhance the system productivity.

(b) Value Addition: In India, value addition to raw material is only 7%, while it is 23, 45 and 188% in China, Philippines and United Kingdom, respectively. Capturing more of a commodity's value at the sites of primary production can have positive impact on farm household income and farm-related business. Value added food processing and industrial value-added manufacturing are two dominant categories of agricultural value added commodity processing. Expanding local processing of agricultural products could be a vital strategy for country like India, where nearly 54% population derives its livelihood from agriculture. By evolving supply chains into integrated agro-food value chains involving interlinked network of agribusiness firms and people managing each phase from production to consumption is one of the major objectives of value added agriculture. It is hoped for results in non-farm rural employment. Value chains in contrast to supply chains are consumer-driven and more closely integrate production, processing, marketing and distribution (Table 6a and b). Of central importance to a value chain is the capacity to ensure quality and traceability through the chain by Identity Preserved (IP) for specific users.

(c) Enhancing Nutritional Quality: One of the major causes of malnutrition, especially micronutrient deficiencies, is dominance of cereals (rice and wheat) in diet. This restriction in diet diversity appears the most likely reason for emergence of micronutrient deficiencies (hidden hunger) in the last 15-20 years (Weltch and Graham, 1999). The micronutrient malnutrition can be addressed in two ways: (i) exploring possibilities of 'gene revolution' for improving micronutrient density in cereal grains, (ii) agronomic biofortification through mineral nutrition. Both these strategies have resulted in a new paradigm for agriculture commonly termed as 'Bio-fortification of crops' for improved nutrition.

(d) Agricultural Education: Without more and better education, developing countries, especially India will find it increasingly difficult to benefit from the global knowledge-based economy. Higher education is no longer a luxury; it is essential for survival. For future development of education in the twenty-first century "we need to invest in our people". It makes out a case for higher education as a life long learning process and pleads for widening of access to include those who have traditionally been underrepresented in our colleges and universities but are manning the hard core agriculture in the rural India. Investment in education is an investment in the future. Needless to say that capital and technology would not be of much use if the human resource is not properly geared for the performance of the functions which are assigned to it. The

Table 6(a). Comparison of agricultural supply and value chains

Supply chains	Value chains
Producer oriented	Consumer oriented
Supply driven	Demand driven
Focus on quantity	Focus on quality
Focus on cost	Focus on value
Anonymous sourcing	Identity preserved
Bulk volume management	Small volume management
Many independent decisions	Few cascading decisions
Open to many producers	Closed to most producers

Source: Tadlock (2002)

Table 6(b). Research and development activities for value added products from agricultural commodities

Commodity	Research and development activity	Products
Wheat and rice	Development of varieties suited to end products. Processing units near production area/zone, storage and handling technologies. Establishment of National Board for Rice and Wheat.	Biscuits, noodles, pasta, wheat germ, rice bran for food, rice bran oil etc.
Fruits and vegetables	Research and development should focus on end use of product. Develop protocol for making end product. Technologies for co-products.	Attractive skin colour of mango and export size, mango pulp, oil from mango kernels and beta carotene from peel. Debittered citrus juice, blending with other juices. Fructose from potato. Fibres from banana. Butter,
Milk and dairy products	Nutritive product using whey. Pesticide residue monitoring. Mechanised packing.	cheese, curd, pasteurized milk, sweets etc.
Fish and marine product	Packing technology to ensure quality and hygiene as international standard. Development of usable co-products.	Fish/prawn pickles, fish papar and and fish curry, fish mince (surimi) based product like sausages, cutlets, balls, patties etc. Chitin chitosan from prawn sheels.

Source: NAAS (2002)

The term value addition expresses the manufacturing processes where raw commodities are initially processed into intermediate goods which are then processed in further stages, adding increasing market value at each stage.

"Identity-Preserved" (IP) products are commodities with special traits that differentiate them from other bulk commodities. IP products are traced from their site of production to final food or feed products to ensure that they are not mixed with similar undifferentiated commodities.

universities today will have (i) to prepare students for research and training, (ii) to provide teaching/training courses oriented to the needs of the society, (iii) to be open to all and to faster life long learning in its broadest sense and (iv) to strive for international cooperation. The need of the hour is to move outside the confines of our walls and reach out to the community through extension education of groups who will never otherwise enter the university or the college and through field action/outreach activities. The universities should come forward for offering more and more entrepreneurial courses and create avenues for more and more employment in private sectors. Some of the major areas where universities can contribute are energy (solar, bio-fuel, Thorium Nuclear Reactor), second green revolution for increasing food production from the existing 200 million tonnes per annum to 400 million tonnes with reduced land, reduced water and farm work force availability, provision of potable safe drinking water and energy efficient green habitat for the citizens, enhancing our ICT export market through the development of knowledge products and develop nano-technology based substances for social transformation.

CONCLUSION

The challenges before Indian agriculture, in the new millennium, are much different than in the past. Today, agricultural development faces three major issues: the persistence to poverty and nutritional insecurity, continuous pressure and deterioration of natural resources and globalization and its impact on farm sector. Integrated crop management, with policy interventions that provide and ensure more funding for R & D in agriculture, especially in densely populated and high potential areas creating employment for landless rural population through value addition to bulk agricultural commodities are the viable options for agricultural sustainability in future. Besides R & D, increasing emphasis on higher education with relevance and quality is to be appropriately addressed. It will require an effective public research and extension systems targeted towards pro-poor research and development. This in turn will require changes in farm incentive structures and new linkages between NGOs, private sectors and farmers. Critical policy interventions are needed if the challenges are to be addressed.

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