7

Agricultural Diversification in India

Status, Nature and Pattern

P.K. JOSHI, ASHOK GULATI and
PRATAP S. BIRTHAL

1. BACKGROUND

The dietary mix and its flavour are changing fast on the plate of Indian consumers. For more than two decades, India has registered a growth rate of 5 to 6 per cent per annum in GDP. With declining growth rate in population, the per capita income has grown by about 3.5 per cent per annum over this long period. This sustained growth is shifting the consumption patterns in the economy, away from basic staples and inching towards high-value agricultural products such as fruits and vegetables, and dairy, poultry and fishery products. The interesting feature of this change is that it is happening in the lower income brackets of the Indian population, below the so-called 'poverty line', along with upper income brackets. For example, as per the estimates of the National Sample Survey Organisation (NSSO), the per capita consumption of cereals for the people below poverty line declined by 10 per cent over the period 1983 to 1999-2000. But their consumption of milk increased by 30 per cent, of vegetables by 50 per cent, of meat, eggs and fish by 100 per cent and of fruits by 163 per cent over the same period (Table 7.1). These changes in the consumption pattern of high-value agri-products in the poorest segments of population speak of a silent revolution under way.

The rapidly rising exports of high-value agriculture, especially fruits and fish during the past two decades also reflect the revolutionary change (Figure 7.1). Given the very nature of these commodities, perishable and high-value, it has strong implications

not only for producers, but also for financing institutions, processors, and exporters, and the retail chain industry. It also has repercussions for the institutional innovations that are emerging in an effort to link the changing consumer's preferences and rising exports of high-value agriculture to the production decisions of the growers—a move from plate to plough.

Table 7.1

Change in Per Capita Consumption of Various Commodities in Different Income Groups, 1983 to 1999-2000

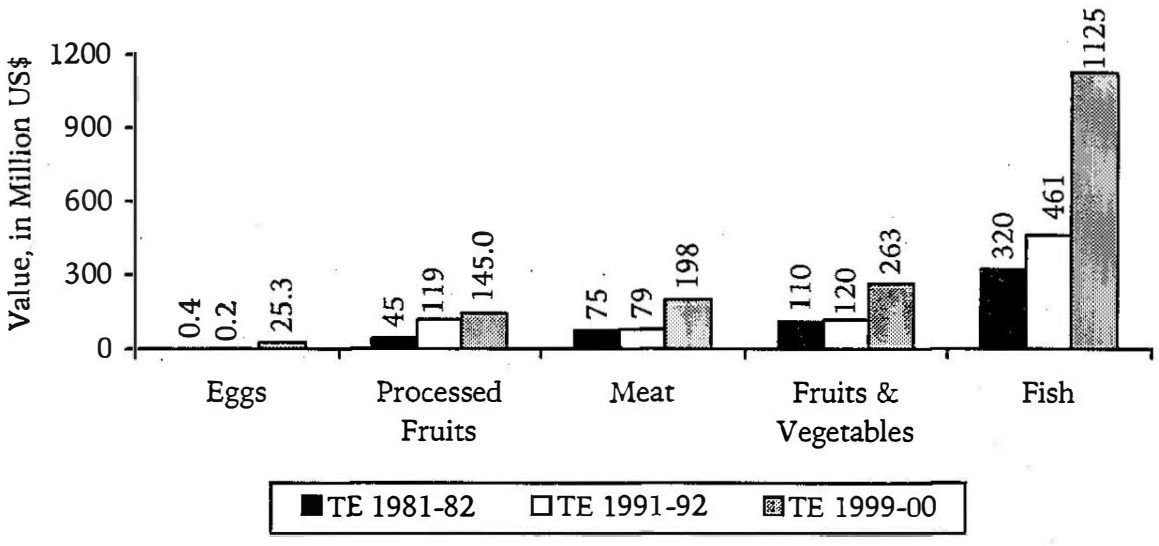
(in Kg)

Food Items	*Lower Income Group*		*Upper Income Group*	
	1983	*1999-2000*	*1983*	*1999-2000*
Cereals	147.1	132.4	194.3	154.6
Pulses	7.6	6.9	17.7	16.6
Edible Oils	2.6	4.6	7.3	13.7
Vegetables	36.0	53.9	65.2	90.8
Fruits	1.6	4.2	6.4	18.2
Milk	15.7	20.5	89.7	117.2
Meat, Eggs & Fish	1.9	3.8	4.8	10.6

Source: Kumar and Mruthyunjaya (2002).

Figure 7.1

Export of Non-traditional Commodities during the 1980s and 1990s



Source: Joshi *et al.*, (2002).

What could be driving this silent revolution? Besides rising incomes, it is the result of changing relative prices between cereals and high-value agriculture, increasing urbanisation and infrastructure, and more open trade policies (Kumar and Mathur, 1996; Kumar and Mruthyunjaya, 2002; Joshi *et al.*, 2002). Changing relative prices seem to be a mix of the technology impact as well as changing demand pressures. While the Green Revolution (wheat and rice) technology was running out of steam during 1980s, there were technological and marketing boosts given to dairy, fruits and vegetables, as well as poultry, fish, etc. Thus, this high-value segment of agriculture, within and outside the crop sector, started increasing its share. Sizeable changes took place within the crop sector: share of foodgrain segment, the hallmark of food security, gave way to high-value non-foodgrains. During the trienniums ending (TE) 1981-82 to TE 1998-99, the share of foodgrains in the output value of the crop sector fell from 48 to 40 per cent, while in area it came down from 70 to 65 per cent over the same period (Table 7.2).

Table 7.2

Share of Foodgrain and Non-foodgrain Commodities in Area and Value of Crop Sub-sector

(Per Cent)

Item	*TE 1981-82*		*TE 1998-99*	
	Share in Area	*Share in Value*	*Share in Area*	*Share in Value*
Foodgrain	70.34	48.05	65.44	39.85
Non-foodgrain	29.66	51.95	34.56	60.15

Note: TE = Average of triennium ending.

Source: Joshi *et al.*, (2002).

By the end of 1990s, there were mounting surpluses of cereals, and their storage costs were rising rapidly. This has been putting greater pressures on the farming community and policy makers to explore possibilities for a more remunerative and viable alternative production portfolio. Diversification of agriculture in favour of non-cereals and high-value commodities, such as fruits, vegetables, milk, meat, eggs, fish, etc. offers such opportunities. These commodities are also emerging as a promising source of income augmentation,

employment generation, poverty alleviation and export promotion (Jha, 1996; Ramesh Chand, 1996; Vyas, 1996; Delgado and Siamwalla, 1999; Ryan and Spencer, 2001; and Joshi *et al.*, 2002). It is, therefore, important to diagnose the production-consumption linkages in the context of agricultural diversification. It requires identification of the driving forces that were altering production portfolio and consumption basket.

The pertinent issue is to understand how production pórtfolio is transforming in response to changes in the consumption basket in India, in a scenario where smallholders dominate agriculture and a majority of consumers live in rural areas. The evidence is that the primary production centres of high-value commodities are largely concentrated with smallholders, who are relatively more efficient in production of these commodities (Jha, 2001). Unfortunately, due to tiny marketable surpluses, and lack of access to appropriate markets, and inadequate access to information, their transaction costs are high. These do not permit them to take full benefit of the changing scenario in consumption patterns at home as well as of rising exports of high-value products. Therefore, it is imperative to establish strong and cost-effective linkages between plough and plate, and examine the role of innovative institutional arrangements for integrating production and consumption. This paper is an attempt in this direction. Accordingly, we have first tried to trace the nature of agricultural diversification in India and the factors driving that diversification (Section 2). Thereafter, we have probed into the drivers of crop diversification (Section 3) and then the types of institutional arrangements (vertical linkages) that are emerging between the growers and processors/exporters in some selected segments of Indian agriculture (Section 4). The final section highlights some policy implications.

2. AGRICULTURAL DIVERSIFICATION IN INDIA: AN OVERVIEW

Approach

The paper considers 'agricultural diversification as movement of production-portfolio from a low-value commodity mix (crop and livestock) to high-value commodity mix (crops and livestock)',

distinguishing it from its usual definitions.[1] The focus is on the horticulture, dairy, poultry and fisheries sectors. These are perishable in nature but yield high, quick and regular dividends to the farmers. These commodities are also labour-intensive, which is the strength of small farm holders, as they possess large reserves of unemployed or underemployed family labour.

The paper collated information from three on-going studies on agricultural diversification: (i) agricultural diversification in South Asia: constraints and opportunities, (ii) determinants of crop diversification, and (iii) innovative institutions for accelerating diversification on small farms. Data for the first study on production performance of agricultural commodities for two decades (1980 to 2000) were drawn from national statistical bulletins (CMIE, 2001; Government of India, 2001). The data for recent study were collected from various published sources, especially the national statistical bulletin (CMIE, 2001). The third study was based on a few selected case studies on the dairy, horticulture and poultry sectors. Emperical results of the study in detail are covered in the chapter.

There were two obvious reasons for studying the past two decades (1980-2000). First, the historical evidence has shown that with the fading of the Green Revolution (during the 1980s), the crop-mix was changing. And second, the process of economic reforms had begun in the early 1990s. A comparison of these two decades was expected to provide some useful insights into the implications of economic reforms on agricultural diversification and consumption basket.

Nature, Speed and Determinants

Agricultural diversification in India is gradually picking momentum in favour of high-value crops and livestock activities to augment incomes rather than a coping strategy to manage risk and uncertainty. Crops, livestocks, fisheries and forestry constitute the core sub-sectors of agriculture. Crop sub-sector is the principal source of generating income in agriculture followed by the livestock sub-sector (Table 7.3). There exists a strong synergy in crop and

1 The usual definitions are (i) shift of resources from farm to non-farm activities, and (ii) use of resources in a larger mix of diverse and complementary activities within agriculture

livestock sub-sectors, both being complementary to each other. Fisheries sub-sector is prominent in the coastal areas, and forestry in the hilly regions.

Table 7.3

Share of Different Sub-sectors (Per Cent) in the Agricultural Gross Domestic Product

Sub-sector	*TE 1981-82*	*TE 1990-91*	*TE 1998-99*
Crop	76.25	73.65	74.91
Livestock	18.27	23.09	23.24
Forestry	3.95	1.91	0.85
Fishery	1.53	1.35	1.00

Source: Joshi *et al.*, (2002).

The share of crop sub-sector in the agricultural gross domestic product had marginally declined during 1980s (from about 76.25 per cent in TE 1981-82 to 73.65 per cent in TE 1990-91) and then recovered slowly during 1990s (rising to 74.91 per cent in TE 1998-99). There were two obvious reasons: (i) normal monsoon during most of the years during 1990s, and (ii) greater emphasis on horticultural crops, which led to their higher production. On the other hand, there was an increase in the share of livestock sub-sector during 1980s, which escalated from about 18 per cent in TE 1981-82 to 23 per cent in TE 1990-91. Later, though the value of livestock during 1990s had nearly doubled, its share in agriculture remained stagnant at 23 per cent. It was because the value of bigger crop sub-sector increased relatively higher than that of smaller livestock sub-sector; hence it masked the latter's performance. The same was true for fisheries sub-sector, whose value had swelled by about 50 per cent during 1990s, but its share in agricultural gross domestic product had marginally declined to about 1 per cent in TE 1998-99 from 1.35 per cent in TE 1990-91.

Diversification within the Crop Sub-sector

The crop sub-sector has been steadily diversifying in India. The trends showed that the non-foodgrain crops have gradually replaced foodgrain crops, with the former going up from about 30 per cent of

area in TE 1981-82 to 35 per cent in TE 1998-99, but in value terms, it went up significantly from about 52 per cent to 60 per cent in respective periods (Table 7.2). Non-foodgrain crops, like oilseeds, fruits, vegetables, spices and sugarcane have mainly substituted for coarse cereals in search of higher incomes.

Cereals dominated foodgrain crops, accounting for more than half (53 per cent) of the gross cropped area in TE 1999-2000, from about 59 per cent in TE 1981-82. Crop diversity within cereals sector has declined during the past two decades; much faster during 1990s than during 1980s. Area and production of rice, wheat and maize were rising and those of barley, millets and sorghum were rapidly descending. Expansion of wheat and rice area was mainly on account of availability and large-scale adoption of remunerative and stable technologies, and favourable and assured government policies on their prices and procurements. Maize, on the other hand, was emerging as an important crop mainly to meet the requirements of booming poultry sector. Availability of improved hybrids, flexibility in growing seasons and diverse uses of maize were responsible for its area expansion. The crop is also finding niches in the non-traditional areas (e.g. Southern part) and seasons (e.g. winter maize). Non-cereals, namely pulses, were gradually moving towards non-traditional areas, and silently picking-up.

A swift diversification of agriculture was noted in favour of oilseeds, vegetables and fruits. Oilseed production jumped remarkably from 18 million tonnes in TE 1981-82 to 30 million tonnes in TE 1991-92 and touched 40 million tonnes in TE 1999-2000. The annual compound growth rate of oilseed production was quite impressive (5.35 per cent) during the decade of 1980s, which slowed down (2.31 per cent) during 1990s. Area and production of a majority of oilseed crops increased substantially during 1980s, while only soybean, coconut, rapeseed and seed cotton gained in area during 1990s. Groundnut, sunflower and linseed lost a sizable area during the decade of 1990s. The remarkable success in the oilseed sector was the result of 'Technology Mission on Oilseeds' (TMO) launched by the Government of India in 1986 to meet the domestic demand and have control over the import of edible oils. The mission encompasses a blend of improved technologies and favourable polices to augment oilseed production in the country. However,

despite well-acclaimed success of oilseed production, the country is not globally competitive in the edible oil sector and is expecting severe threat to the domestic oilseed producers unless they are protected through high tariffs on edible oils and improve production efficiency. Sustaining the success of TMO will rely on the pushing up of the technical efficiencies at production and processing levels.

Horticulture crops (including vegetables and fruits) gained importance in production portfolio, India being the world's second largest producer of vegetables, next to China. Vegetable sub-sector in India is diversifying towards new areas, new crops and new seasons. During the past two decades, area and production of vegetables increased considerably in India (Table 7.4). The production was growing faster (annually 2.53 per cent) during 1980s, but slowed down (annually 1.99 per cent) during 1990s. Yield increase contributed significantly to higher vegetable production during 1980s. The situation changed during 1990s, when area expansion accounted for increased vegetable production. The vegetable sector is becoming strong in the peri-urban areas. Besides, it is emerging as an important source of income augmentation for small farm holders in water-scarce regions due to massive subsidies extended by the government on water-saving devices (e.g. sprinkler and drip systems). In addition, the watershed programmes gave high priority to vegetable production to enhance the efficiency of scarce water conserved in the rainfed areas.

Fruit production (both fresh and dry) is gaining importance in the country. It was growing at an annual rate of 6.3 per cent during 1990s, from about 3 per cent during the 1980s (Table 7.4). A large share (approximately 60-65 per cent) in increased fruit production in both the decades was realised through productivity gains. Indian mangoes specially *desheri*, and *alphonso* have excellent export market. Mango production during the 1990s has increased by 67 per cent; and so has the production of bananas, oranges, grapes, apples, papayas, and pineapples. Dry fruits and spices have also gained during the past two decades. Increased fruit production was the result of changing food diet of high-income group. On supply side, it was because of government's initiatives in food processing. During mid-1980s, a separate ministry on food processing was constituted to strengthen the agro-processing by reducing post-harvest losses and

Table 7.4

Temporal Changes in Area and Annual Compound Growth Rates of Area, Production and Yield of Major Commodity Groups

Commodity Group	Average Area in Triennium Ending ('000 Ha)			Annual Compound Growth Rates (Per Cent)					
				1981-90			1991-2000		
	1981-82	1991-92	1999-2000	Area	Production	Yield	Area	Production	Yield
Cereals	104350	102279	101190	-0.20	3.32	3.53	0.20	2.22	2.01
Pulses	22780	23817	23442	0.08	2.50	2.42	0.08	0.66	0.58
Oilseeds	26675	33004	37471	1.79	5.35	3.50	0.94	2.31	1.36
Vegetables	5064	5738	6767	0.41	2.53	1.09	1.48	1.99	-0.50
Fruits	2239	2638	3567	1.04	2.98	1.92	2.38	6.30	3.83
Spices	1627	1848	2142	1.45	5.13	3.64	0.55	2.73	2.17
Fibre Crops	1354	777	800	-7.43	0.53	8.61	0.87	0.91	0.04
Dry Fruits	646	766	1030	1.59	3.87	2.24	3.87	4.52	0.63
Miscellaneous	11762	13470	14084	1.39	—	—	0.59	—	—

Source: Joshi *et al.*, (2002).

enhancing value-addition. Private sector participation has been growing in fruit processing area but the speed is slow.

Diversification within the Livestock Sub-sector

Livestock sub-sector has been growing at a fast rate and its share in total value of agricultural output has been progressively rising in India (Birthal and Parthsarthy, 2002). Milk had a large share (around 68 per cent) in total value of livestock products during the past two decades (Table 7.5). The remaining share of livestock products (32 per cent) was distributed over several items like meat, poultry, wool, etc. Milk production more than doubled, from 33 to 71 million tonnes from TE 1981-82 to TE 1998-99, with an annual compound growth rate of about 4.6 per cent. The growth of milk production was much higher (5.23 per cent) during 1980s than 1990s (3.46 per cent). Such a breakthrough was helped by the implementation of the Operation Flood Programme—A programme launched to accelerate the progress and development of the dairy sector.

Table 7.5

Share of Different Commodities (Per Cent) in the Value of Livestock Sub-sector

Item	*TE 1982-83*	*TE 1991-92*	*TE 1998-99*
Milk	68.09	69.22	68.96
Meat	6.57	7.97	8.39
Poultry	7.85	8.97	9.58
Miscellaneous	17.48	13.88	13.07

Source: Joshi *et al.*, (2002).

Meat and poultry sub-sectors have also registered a good performance; from a low of 0.80 million tonnes in TE 1982-83 to 2.73 million tonnes in TE 1991-92, and finally to 4.41 million tonnes in TE 1998-99, giving an annual compound growth rate of about 5.81 per cent during the 1980s *vis-à-vis* 3.90 per cent during the 1990s. The high increase in meat production during 1980s was partly contributed by the severe drought in 1987 in most parts of the country. Acute shortage of green and dry fodder forced people to dispose-off less

productive animals for slaughtering at a large scale. The poultry also flourished during the 1980s, contributing to a higher growth of livestock sector. The share of poultry and goat meat in total value of meat production went up from 66 per cent in TE 1982-83 to 77 per cent in TE 1998-99. Similarly, egg production also increased by 8.46 per cent annually during 1980s as against 4.60 per cent annually during 1990s. It was interesting to observe that, unlike dairy, the poultry sector grew at the instance of private organised sector, which controls roughly 80 per cent of total poultry production in the country.

Future of livestock sector is quite promising in the country, as there still exists huge potential to augment production, consumption and export of different livestock commodities. The meat production is mostly confined to the unorganised sector, and is crying for setting up of modern slaughter facilities and development of cold chains.

Diversification within the Fisheries Sub-sector

Fisheries sub-sector has also diversified over the years. It was mainly due to gradual shift from marine to inland fisheries. Traditionally, the marine fisheries used to dominate the fish production in the country, which was more than 75 per cent in 1960-61. Recognising the importance and potential of fish sector in the inland areas, a greater impetus was accorded to the inland fisheries. The share of marine fish in the total production has fallen to about 54 per cent in TE 1999-2000, while that of inland fisheries has risen to about 46 per cent in TE 1999-2000 from less than 25 per cent in 1960-61. The annual compound growth rate of inland fisheries was higher (6.54 per cent) during 1990s than 1980s (5.27 per cent). The marine fish production, which performed poorly during 1980s (0.12 per cent) improved during 1990s (2.53 per cent) due to greater impetus accorded to the fisheries sub-sector. The inland fish potential is still higher with a well spread location of rivers, canals and reservoirs.

The higher growth in inland fisheries was mainly attributed to the overwhelming progress in aquaculture, both in fresh and brackish waters. The share of culture fisheries in the inland sector has risen from about 43 per cent in 1984-85 to a high level of about 84 per cent in 1994-95 (Kumar *et al.*, 2001). A bulk of growth in culture

fisheries has come from the fresh water aquaculture (Krishnan *et al.*, 2000). There is a good scope in expanding production of culture and other products in the brackish water areas. Only 10 per cent of the available brackish water area (12 million hectares) in the country was exploited until 1995-96 (IASRI, 2001). The expansion of inland fisheries has also led to some negative externalities related to degradation of arable lands due to salinity.

The remarkable progress in fisheries sector was the outcome of a well-knit strategy to accomplish multiple goals of augmenting production, enhancing export, and overcoming poverty of fishermen. Several production and development-oriented programmes were launched in the potential areas. These programmes were implemented in both marine and inland areas such as Development of Freshwater Aquaculture, Integrated Coastal Aquaculture, and Development of Coastal Marine Fisheries. Under these programmes, Fish Farmers' Development Agencies were established in fresh water areas, and Brackish Water Fish farmers' Development Agencies in brackish water areas. To encourage the aquaculture, the programmes were initiated to upgrade the technology, and encourage involvement of private sector for activities such as quality seed, feed and other inputs and creation of suitable infrastructure for storage, transport, marketing and credit. To develop better infrastructure facilities, 'Fisheries Industrial Estates' were developed by grouping the cluster of fishing villages.

The future of fisheries sector is bright with the opening-up of the economy. There exists a promising export market for both marine and inland fish and aqua products. In this context, the Sanitary and Phyto-sanitary (SPS) issues are more important to tap the export potential. The need is to focus more on quality control, modernise the crafts used in marine areas and utilise the full potential of the inland fisheries.

3. DETERMINANTS OF CROP DIVERSIFICATION

Several forces influence the nature and speed of agricultural diversification, from staple food to high-value commodities. Earlier evidence suggests that the process of diversification out of staple food production is triggered by rapid technological change in agricultural production, improved rural infrastructure, and

diversification in food demand patterns (Pingali and Rosegrant, 1995). These are broadly classified as demand and supply side forces. The demand side forces that have been hypothesised to influence the diversification include per capita income and urbanisation. On supply side forces, the diversification is largely influenced by infrastructure (markets and roads), technology (relative profitability and risk in different commodities), resource endowments (water and labour), and socio-economic variables (pressure on land and literacy rate).

Generalised Least Square (GLS) technique with fixed-effect model was applied to examine how different forces have influenced crop diversification in India. The analysis was based on pooling of cross-section and time series information from major states (19 out of 28[2]) in India for the period 1980-81 to 1998-99. The GLS technique eliminates the effect of heteroscedasticity arising due to cross-section data, and autocorrelation as a result of time series data. Following model was used to examine the determinants of diversification:

$$D_c = f \text{ (TECH, INFR, PROF, KNOW, DEMA, RAIN)}$$

The variables were defined as follows: The dependent variable, D_c, was defined in two ways: (i) Simpson index of diversity in crop sector (SID_c), and (ii) index of output values of horticultural commodities at constant prices with base 1980-81. Results for the latter were found statistically superior, and were therefore used for discussion (Joshi *et al.*, 2003).

Independent variables were broadly grouped as (i) technology (TECH)-related, (ii) infrastructure (INFR)-related, (iii) profitability (PROF)-related, (iv) resources and information (KNOW)-related, (v) demand (DEMA)-related, and (vi) climate (RAIN)-related. To capture their effect, few proxy variables were used in the model. For technology (TECH), these included: proportionate area under high-yielding varieties of foodgrain crops (per cent), fertiliser use (kg per ha), proportion of gross irrigated area to gross cultivated area (per cent), mechanisation (number of tractors per 1000 ha area). For infrastructure (INFR), the proxy variables were market density (number of markets per 1000 ha of gross cropped area), and roads

2. Nineteen states in the country are major ones, while nine are small with respect to geographical area, production and population.

length (square km per 1000 ha of gross cropped area). Relative profitability of high-value enterprises with cereals and other crops was the proxy for profitability (PROF)-related variables. Average size of landholdings (ha) and proportion of small landholders in total holdings were used as proxy for available resources, and rural literacy (per cent) for information (KNOW)-related variables. On demand side (DEMA) variables, urbanisation (per cent urban population) and per capita income (rupees per person) were used in the model. Annual rainfall (mm) was used to define the climate (RAIN)-related variables in the model.

Table 7.6

Determinants of Diversification in Favour of Horticultural Commodities: Double-log Estimates of Generalised Least Square (GLS)

Explanatory Variables	*Dependent Variables: Index of Gross Value of Horticultural Commodities at 1980-81 Prices*		
	Equation 1	*Equation 2*	*Equation 3*
Irrigation	-0.4575*** (0.0614)	-0.4697*** (0.0607)	-0.5073*** (0.0564)
Relative Profitability	0.3549*** (0.04450)	0.3329*** (0.0411)	0.3152*** (0.0441)
Roads	0.2873*** (0.0664)	0.2843*** (0.0665)	—
Markets	0.1261* (0.0710)	0.1870*** (0.0528)	—
Rural Literacy	-0.7976*** (0.1458)	-0.8415*** (0.1419)	-0.5497*** (0.1389)
Small Landholders	1.1964*** (0.2283)	1.2016*** (0.2285)	1.6043*** (0.2002)
Urbanisation	0.1840 (0.1438)	—	0.3050*** (0.1094)
Income	0.4892*** (0.0668)	0.5082*** (0.0652)	0.4671*** (0.0686)
Rainfall	-0.0583 (0.0422)	-0.0712* (0.0411)	-0.0949** (0.425)
Time Dummy: 1981-90=0; 1991-99=1	0.8944*** (0.0700)	0.8839*** (0.0696)	0.8960*** (0.0722)
R-square	0.7735	0.7722	0.7572
Adjusted R-square	0.7642	0.7637	0.7490
F-statistic	82.82***	90.00***	91.40***

Note: Figures within the parentheses are standard errors of the respective coefficients; ***, **, * denote significance at 1, 5 and 10 per cent, respectively.

Different combinations of independent variables were tried to arrive at the best-fit equations. Both linear and double log equations were estimated and the best ones were selected. The estimated double-log equations of Generalised Least Square are given in Table 7.6.

To capture the effect of infrastructure development, two important variables, namely markets, and roads, were included in the model. Both these variables yielded positive and significant influence on diversification of crop sector. Obviously, better market and road network induced diversification in favour of horticultural commodities. Better market and road network meant low marketing cost and easy and quick disposal of commodities. It also reduced the risk of post-harvest losses in case of perishable commodities.

The technology was defined by area under high-yielding variety of cereals, irrigated area and extent of mechanisation. But it was the irrigated area that turned-out to be significant and represented the technological advancement in the region. The regression coefficient of this variable was showing negative relationship with diversification. It means that the crop diversification in favour of horticultural commodities was declining with increasing irrigated area. This suggests that crop diversification is more pronounced in rainfed areas, which are deprived of technological advancement in terms of irrigation. These areas are characterised as rainfed, low resource endowed with abundant labour force and were by-passed during the 'green-revolution' period.

Relative profitability of horticultural commodities with other crops is also an important determinant for diversification in their favour. The regression coefficient was significant and positive. Obviously, the higher profit of these crops would induce farmers to diversify in their favour. Fruits and vegetables were highly profitable in comparison to cereals and other crops. Relative profitability of fruits was more than 8-times higher than that of cereals. The corresponding figure for vegetables was 4.8. Although high profits of horticultural crops encouraged their cultivation but uncertain prices and high-yield instability limited their wide spread cultivation. The price instability is more in the case of fruits and vegetables than cereals (Subramanian, *et al.*, 2000). The high-price variability of fruits and vegetables is due to poor vertical linkages between production, marketing and processing. This calls for

developing appropriate institutional arrangements for minimising the price uncertainty. Some scattered success stories are available for strengthening farm-firm linkages, but more rigorous work needs to be done in this area.

There was a positive relationship between growth of horticultural commodities and the proportion of smallholders. This indicates that diversification in favour of horticultural commodities was more confined with the smallholders. Such a move of small farmholders in favour of high-value commodities is expected to enhance their income. Cultivation of horticultural crops suits the small farmholders. The advantage is that these are labour-intensive and generate regular flow of income. The caution is that the absence of appropriate markets and rise in supply may adversely affect the prices and opportunities for higher income (Tewari, *et al.*, 2001).

Rainfall was another variable included in the model to assess the effect of climate on crop diversification. The variable was highly significant with negative sign, indicating that crop diversification was limited in high rainfall areas. Obviously, high rainfall areas specialise towards rice, while farmers go for diversification in medium and low rainfall areas to increase income and minimise risk.

Demand-side factors such as urbanisation and per capita income showed positive and significant impact on crop diversification.

The above discussion suggests that assured markets and good road network could stimulate agricultural diversification in favour of high-value crops as they help maximise profits and minimise uncertainty in the output prices. Inadequate markets may deprive farmers to take potential benefits of cultivating high-value crops. Encouraging appropriate institutional arrangements for better markets through cooperatives or contract farming would go a long way in strengthening farm-firm linkages. Besides, role of technology cannot be ignored. The high-yielding and more stable genotypes in fruits and vegetables need to be propagated through developing a strong seed sector.

4. INTEGRATION OF CONSUMPTION AND PRODUCTION

The demand for non-cereal commodities is growing fast, but farmers are constrained to produce and expand the scale of their

production due to high transaction costs. A majority of Indian farmers are smallholders. Their transaction costs are higher due to (i) lack of access to markets, (ii) limited marketable surplus, and (iii) perishable nature of the product. Due to rising demand for high-value commodities, different forms of production-market integration are slowly emerging in the food supply chain. These include (i) spot or open market transactions, (ii) agricultural co-operatives, and (iii) contract farming. Each mode of integration has some advantages, and the success depends upon the interest of all the parties.

Spot Market

The spot or open market transactions are traditional and common in developing countries. In this mode, the prices are determined by the demand and supply of commodity under transaction. Market uncertainty is high under this system. In India, the concept of spot or open markets has been initiated in some states, where producers and consumers transact without any middlemen. *Ryat Bazar* in Karnataka and *Apna Bazar* in Andhra Pradesh are few examples of spot or open market transactions for fruits and vegetables. These markets provide a forum to the producers to deal directly with the consumers, eliminating the middlemen completely. However, uncertainty of prices during excess supply periods and high transport costs still persist in the spot market mode.

Cooperative Model

The agricultural co-operative model has overcome the problems of spot markets. In this mode, a group of producers with common interest own and manage production and/or marketing to take advantage of economies of scale. This mode enhances the bargaining power of the producers in input and output markets. Co-operatives may undertake one or more functions in the production-processing-distribution chain. By integrating input and output markets, co-operatives tend to reduce transaction costs. In India, one of the most successful models of cooperatives is in the dairy sector, which brought out revolutionary changes in the country during 1980s and these continued during 1990s. The breakthrough in this sector is ascribed to the implementation of the 'Operation Flood Programme' through The National Dairy Development Board (NDDB), which

developed a cooperative model for procuring and marketing of milk and milk products. Under the programme about 170 cooperative milk unions were established, operating in over 285 districts and covering nearly 96 thousand village level societies in different states by making nearly 10.7 million farmers their members until 1999-2000 (NDDB, 2002). The programme resulted in enhanced production, procurement and marketing of milk, and generated employment opportunities in the rural and peri-urban areas.

Encouraged with the success of dairy cooperatives, the National Dairy Development Board in recent years has diversified its product portfolio to include fruits, vegetables, oilseeds and plantation crops. It was established in 1985 to meet the growing demand for fruits and vegetables of Delhi metropolitan area. Under the banner *Safal*, it started with 12 outlets on experimental basis. It is today one of the biggest public sector undertakings in marketing of fresh fruits and vegetables in the world. It also deals in processed and frozen vegetables and fruits. Frozen pea is a premier product of *Safal*. Besides, it offers jams, jellies, fruit drinks, pickles, tomato ketchup, squash, etc. In 1996, the company established an ultra modern 100 per cent export-oriented fruit-processing unit in Mumbai. The company establishes direct links with producers and consumers. At present, there are 150 associations with a membership of 18,000 growers throughout the country. It sells about 250 tonnes of fruits and vegetables everyday through its 300 retail outlets in and around Delhi. This model has benefited the smallholders most in remote areas where markets were absent for fruits and vegetables.

Contract Farming

The contract-farming model is relatively new in India. In this model the farmers are contracted to produce the commodity desired by the marketing firm. The firm controls the production process without owning or operating the farms but ensures assured procurement of output and remunerative prices. This is a kind of arrangement where both the farm and the firm have synergy. There are several successful examples of contract farming in the country. It has covered several commodities, namely horticultural crops, sugarcane, wheat, oilseeds, medicinal crops, milk, poultry, organic produce, etc. Country is witnessing a silent revolution in this form of

integration among farm, firm and consumers. The model is providing markets in the potential niche areas to benefit the farm, firm and consumer.

One successful model of contract farming is of Nestlé India Limited, a private sector multinational company. Nestlé entered into the dairy business in 1961 by collecting a mere 510 kg milk from 180 farmers in four villages and setting up a milk plant at Moga in Punjab. The milk collection in 2002 has grown to over 650 thousand kg/day from about 90,000 farmers in about 1600 villages in Moga and adjoining districts of Ferozpur, Faridkot, Muktsar and Ludhiana in Punjab. The success was a result of developing effective backward and forward linkages by the company which provides stable and remunerative market to the milk producers. Most of the milk comes from the small dairy producers. The company provides free veterinary aid and extension, breeding services, fodder production techniques, etc. for quality milk production.

Another successful example of integrating production and marketing is witnessed in poultry sector. The poultry industry grew mainly due to a strong integration between poultry producers and firms. Several poultry firms have entered into contract farming for production, marketing, processing and export of eggs and broilers. The most important ones are Saguna Hatcheries Limited (SHL) and Venkateshwara Hatcheries Limited (VHL). The latter is a leading firm in the poultry sector, operating since 1971. Initially the firm was engaged in breeding of chicks and production of vaccines, and their selling to poultry producers. Since early 1990s, the VHL has ventured into contract broiler farming in most of the major poultry producing states, namely Andhra Pradesh, Karnataka and Maharashtra. VHL has its own poultry-breeding farm, feed plant, vaccine manufacturing unit and a research laboratory. The company has developed innovative approaches to reduce transaction costs and enhance production efficiency. The contract farming in the poultry sector has markedly increased production of eggs and broilers in Andhra Pradesh, Karnataka and Maharashtra.

In summary, the integration of production and marketing is critical for high-value commodities. It is important because these are perishable in nature and their markets are too limited. To expand their scale of production, integrating production and

marketing through cooperatives or contract farming seems to be a pre-requisite.

5. CONCLUSIONS

Agricultural production portfolio is gradually diversifying in favour of high-value commodities. In particular, the production of horticultural commodities, milk, meat, fish and eggs has shown remarkable increase during the past two decades (1980-2000). These commodities yield high, quick and regular dividends to the small farmers and, therefore, their production suits them. These are also labour-intensive, which is a resource of the small farm holders. Strengthening of horticulture, livestock and fisheries sub-sectors would benefit them in rural areas. Incidentally, small holders in rural and peri-urban areas largely control horticulture, livestock and fisheries production. And these are the sectors that can significantly contribute to the enhancing of farm income, offering employment opportunities in rural areas and meeting the food and nutritional needs of rural poor.

Incidentally, the consumption basket is also diversifying in favour of high-value commodities in both rural and urban areas. Interestingly enough, even the poor consumers have diversified their food basket in favour of high-value commodities. Consumption of high-value commodities has been fast increasing in urban areas and by high income consumers. In the absence of appropriate integration of production, markets and consumption, the potential of high-value commodities is not being fully exploited. Strengthening of production-market-consumption integration is a way to promote production of high-value commodities whose demand is growing fast.

To cater the demand for high-value commodities in metropolitan cities, few innovative institutional arrangements are gradually emerging in the form of cooperatives or contract farming, and benefiting producers, firms and consumers. By establishing strong farmer-firm linkages, the strength of each other can be utilised in a competitive market to tap the advantage of expanding domestic and international markets. These kinds of arrangements need to be replicated to effectively involve small farm-holders for sharing the benefits of growing markets of high-value commodities. This will

have several macro-level benefits. Important among others maybe food management and diversification of agriculture. The price distortion in favour of rice and wheat, and lack of markets for high-value commodities, like poultry, meat, milk, fruits and vegetables, have created imbalance in production portfolio in favour of rice and wheat. Innovative institutions promoting high-value commodities should ensure their assured markets and diversify agriculture to augment income and food security. Appropriate policy support for attracting private sector in strengthening farm-firm integration would enhance supply of high-value commodities, and benefit the small farm-holders.

In terms of policy implications, the following points are worth considerations:

- In policymaking, greater thrust should be given to non-grain economy in terms of R&D expenditure, and investments in marketing, storage and processing facilities. The share of non-grain component in the total value of Indian agriculture is already more than half, but it does not get commensurate attention and resources. It needs to be corrected by reprioritising R&D portfolio.
- The government needs to enhance the allocation of resources to the basic research on these high-value commodities, as well as their marketing, storage and processing. The private sector, including FDIs, has to be invited in a big way. India has constrained its own potential by restrictive laws towards the development of high-value chain in this segment of agriculture. Preference to cooperatives or public sector firms in the past restricted the entry of big players in the private sector. This needs to be corrected if one has to unleash a revolution in the value-addition process. All legal impediments that restrict the entry of big private sector in marketing, storage and processing facilities need to be abolished. Essential Commodities Act, Agricultural Produce Marketing Act, the Cold Storage Act, the Small Scale Industry Reservation, and so on, all would have to be abolished or modified with regard to agriculture. Retail chain stores with FDI are still not permitted as per the latest task force on FDIs.

- To lay an efficient foundation for value-addition processes, it is necessary to withdraw preferences extended to cooperatives and public sector concerns in the form of corporate tax exemptions, subsidised finance, etc. Such preferences often negate private sector investments.
- Major investments in retail chain sector, processing and storage would emerge, if legal environment is made clean and attractive and provides private sector a level playing field *vis-à-vis* cooperatives and public sector concerns.
- It is essential to facilitate the emergence of vertical integration between farmers, processors and retailers (farm-firm-fork linkages) in high-value agriculture. India has to graduate from producing raw commodities to adding value and developing brand equity. It requires a major contribution from the private sector. It was ironic to see that it took 10 long years to de-license dairy and sugar industries. Many others in agro-processing are still waiting, including the processing of groundnuts and mustard oilseeds, reserved for Small-Scale Industries. To ensure food safety, laws need to be duly enforced, and sanitary and phyto-sanitary (SPS) standards be adopted. It is also desirable to promote large processing facilities with state-of-the-art technology.

These policy changes are basically in line with the emerging demand pull forces, and therefore are likely to be more sustainable. But they need to be supplemented by appropriate policy changes on the supply side too. These could be on:

Farms: It is desirable to free the land-lease market, and help the smaller cultivators to increase the size of their operational holdings. Though they are efficient producers, they need to cut down the transaction costs, if Indian agriculture is to become competitive internationally.

Infrastructure: Investment in basic infrastructure, especially roads and power, where private sector is still reluctant to enter, will have to be stepped up. Government programme on highways and rural roads are laudable but the power sector reforms are a painful story of failure so far. Major institutional and price reforms are required

in the power sector to plug leakages, raise efficiency, and generate surpluses to plough back into investments. Private sector participation in generation, transmission and distribution of power will have to be expedited. Today, no society can develop without reliable and cost-effective power supplies, be it agriculture or otherwise. Slow and tardy pace of India's power sector reforms is costing India at least 1 percentage point GDP each year. The cold storage chain, an important infrastructure for high-value agriculture, cannot come up without reforming the power sector in rural areas.

R&D: R&D expenditure as percentage of agricultural GDP (less than 0.5 per cent) is way below the level that most of the developing countries are spending (around 1 per cent). In bio-technology research, the record is even grimmer. We are losing out a revolution in bio-technology that is waiting in the wings. If government does not have ample resources for this, private sector can be invited on a large scale. But experience of private firms in the release of Bt cotton does not speak of very favourable environment for the private sector to invest in agricultural research. The government should establish appropriate regulatory institutions for bio-safety that are transparent and time-bound.

Agriculture Credit: High-value agriculture needs higher working capital, and has to face higher risks. The Indian agricultural credit scenario is amusing. Commercial banks are saddled with excess liquidity while farmers are still relying on informal sources of finance for almost 45 per cent of their requirements and that too at much higher rates of interest (normally two to three times) than what is offered by the commercial banks. While schemes like 'Kisan credit cards' are a step in the right direction, facilitating credit through processors, input dealers, etc. that are vertically integrated with the farmers for providing them critical inputs or processing their produce, could increase the credit flow to agriculture manifold. These dealers/processors can act as non-banking financial intermediaries, with a fee and bear the risk of default. Such a scheme would revolutionise agriculture financing if government provides the policy support.

References

Birthal, Pratap S. and P. Parthasarathy Rao (eds). (2002). *Technology Options for Sustainable Livestock Production in India.* National Centre for Agricultural Economics and Policy Research, New Delhi and International Crops Research Institute for the Semi-Arid Tropics, Patancheru, India.

Chand, Ramesh (1996). "Diversification through High-value Crops in Western Himalayan Region: Evidence from Himachal Pradesh", *Indian Journal of Agricultural Economics,* 41(4): pp. 652-663.

CMIE (2001). *Agriculture: Economic Intelligent Service* Centre for Monitoring Indian Economy Pvt. Ltd., New Delhi.

Delgado, C.L. and A. Siamwalla (1999). "Rural Economy and Farm Income Diversification in Developing Countries", pp. 126-143, in *Food Security, Diversification and Resource Management: Refocusing the Role of Agriculture,* G.H. Peters and Joachim Von Braun (eds.), Proceedings of Twenty-Third International Conference of Agricultural Brookfield, Economists, Ashgate Publishing Company, Vermont, USA

Government of India (2001). *Indian Economic Survey: 2000-2001,* Akalank Publications, New Delhi.

Government of India (2002). *Agricultural Statistics at a Glance.* Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi

IASRI (2001). *Agricultural Research Databook 2001,* Indian Agricultural Statistics Research Institute, New Delhi.

Jha, D. (1996). "Rapporteur's Report on Diversification of Agriculture and Food Security in the Context of New Economic Policy", *Indian Journal of Agricultural Economics,* 51(4): pp. 829-832.

Jha, D. (2001). "Agricultural Research and Small Farms", *Indian Journal of Agricultural Economics,* 56(1): pp. 1-23.

Joshi, P.K., Ashok Gulati, P.S. Birthal and L. Tewari (2002). "Agricultural Diversification in South Asia", paper presented in a *Workshop on Agricultural Diversification in South Asia,* November 21-23, Paro, Bhutan.

Krishnan, M. and PS Birthal (eds) (2000). *Aquaculture in India: Retrospect and Prospect,* National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi.

Kumar, Anjani, P.K. Joshi and P.S. Birthal (2001). "Fisheries Sector in India: An Overview of Performance, Policies and Programs", in *International Workshop on Strategies and Options for Increasing and Sustaining Fisheries Production to Benefit Poor Households in Asia,* August 20-25, ICLARM. Penang, Malaysia

Kumar, P. and V.S. Mathur (1996). "Structural Changes in the Demand for Food in India", *Indian Journal of Agricultural Economics,* 51(4): pp. 664-673

Kumar, P. and Mruthyunjaya (2002). "Long-term Changes in Food Basket in India", paper presented in *Workshop on Agricultural Diversification in South Asia,* November 21-23. Paro, Bhutan,

National Dairy Development Board (2002). *Annual Report 2001-02,* NDDB, Anand, India.

Pingali, P. and M.W. Rosegrant (1995). "Agricultural and Commercialisation and Diversification: Processes and Policies", *Food Policy,* 20(3): pp. 171-186.

Ryan, J G. and D.C Spencer (2001). *Future Challenges and Opportunities for Agricultural R&D in the Semi-arid Tropics,* India: International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh.

Subramanian, S.R., S. Vardarajan and M. Asokan (2000). "India", in Mubarak Ali (ed.), *Dynamics of Vegetable Praduction and Consumption in Asia,* Asian Vegetable Research and Development Centre, Taiwan.

Tiwari, L., K. Elumalai, Pratap S. Birthal and P.K. Joshi (2001). "Implications of Globalization on Small Farm Holders: A SWOT Analysis, paper presented in the Annual Conference of the Agricultural Economics Research Association on 21-22 November at Indian Agricultural Research Institute, New Delhi.

Vyas, V.S. (1996). "Diversification in Agriculture: Concept, Rationale and Approaches", *Indian Journal of Agricultural Economics,* 51(4): pp. 636-643.