

Background

A sustained economic growth, rising per capita income and growing urbanization are ostensibly causing a shift in the consumption patterns in favor of high-value food commodities like fruits, vegetables, dairy, poultry, meat and fish products from staple food such as rice, wheat and coarse cereals. The demand for and supply of these commodities have grown much faster than those of foodgrains (Kumar et al. 2003; Joshi et al. 2004). The share of these commodities in the total expenditure on food increased from 34 percent in 1983 to 44 percent in 1999-2000 in the rural areas, and from 55 to 63 percent in the urban areas (Kumar and Mruthyunjaya 2002). And, this change is not confined to the higher income group of the Indian society only but is visible in the lower income or 'below poverty line' segment also. Such a shift in consumption patterns in favor of high-value food commodities even among the poorest strata of the India society depicts an on-going process of transformation that is leading towards a 'silent revolution' of agricultural diversification. This revolution or process of transformation is also reflected in the rising exports of high-value agricultural products (Government of India 2003). In value terms, the exports of these commodities increased magnificently from about US\$ 430 million in 1980 to US\$ 1415 million in 2000.

The farming community has responded to the changing consumption patterns of consumers by diversifying its production portfolio towards high-value food commodities. Experiences from many developing countries have revealed about the changing production portfolio at the farm level due to altering dietary patterns (Barghouti et al. 2003; Dorjee et al. 2002). What could be the factors behind this silent revolution? Besides rising income levels, the expanding urbanization, increasing infrastructural development and liberalization of trade policies have been identified as factors that triggered the process of agricultural diversification out from the arena of staple food production (Joshi et al. 2004; Pingali 2004). Despite a 'silent revolution' in the high-value food segment, performance of the agricultural sector was not as impressive as that of the overall economy of the country.

The changing scenario of agriculture has forced the farming community and policy makers in agriculture to search for a more remunerative and viable production portfolio. The diversification of agriculture towards non-foodgrain and high-value commodities has been the right answer for it, because these commodities have potential of income augmentation, employment generation, poverty alleviation and export promotion (von Braun 1995; Pingali and Rosegrant 1995; Jha 1996; Ramesh Chand 1996; Vyas 1996; Delgado and Siamwalla 1999; Ryan and Spencer 2001 and Joshi et al. 2004). It is, therefore, important to diagnose the production-consumption linkages in the context of agricultural diversification. It will require identification of the driving forces that can alter production portfolios and consumption baskets. It is also important to understand how the production portfolio is evolving itself in response to changes in the consumption pattern, in a scenario where smallholders dominate agriculture and a majority of them live in the rural areas.

This paper attempted these issues. The specific objectives are: (i) examining the extent, nature and pace of crop diversification, (ii) quantify role of diversification in agricultural growth, (iii) identifying the key drivers of crop diversification, and (iii) document policy constraints in accelerating the speed of agricultural diversification.

The study spans over a period of 20 years from 1980-81 to 1999-2000, and was divided into two decades: (i) 1980-81 to 1989-90 and (ii) 1990-91 to 1999-2000. There were two specific reasons for choosing this period for study. One, the historical evidence showed that the impact of 'green revolution' in India had started fading gradually since late 1980s. And two, the second-generation economic reforms were launched in the early 1990s, which also coincided with the implementation of WTO regulations in the agricultural sector. We hypothesized that the changing consumption patterns, decreasing impact of 'green revolution' and opening-up of the economy will lead to greater diversification of agriculture in favor of high-value commodities.

II. Patterns of Agricultural Diversification

Agricultural diversification in India is slowly picking up momentum in favor of high-value food commodities primarily to augment income rather than the traditional concept of risk management. The nature of diversification differs across regions due to existence of wide heterogeneity in agro-climatic and socio-economic environments. It was considered interesting to delineate the key regions and sub-sectors of agriculture where diversification was catching up fast.

Nature of Agricultural Diversification

Crops, livestock, fisheries and forestry constitute the core sectors of agriculture. The crop sector is the principal income-generating source in agriculture followed by the livestock sector (Figure 1 and Table 1). A strong synergy exists

¹ The paper has been heavily drawn from Joshi (2005)

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between these two sectors, both being complementary to each other. The fisheries sector has a prominence in the coastal areas, and forestry dominates in the hilly regions.

The share of crop sector in the agricultural gross domestic product declined marginally during the 1980s (from about 76.25% in TE 1981-82 to 73.65% in TE 1990-91) but recovered slowly during the 1990s (rising to 74.60% in TE 1998-99). The two obvious reasons for this phenomenon are: (i) normal monsoons during most of the years in 1990s, and (ii) greater emphasis on horticultural crops, leading to their higher production.

Another revelation was a quantum jump in the share of livestock sector during the 1980s; from about 18 percent in TE 1981-82 to 23 percent in TE 1990-91. Later in 1990s, the value of livestock (at constant prices) though nearly doubled, its share in agriculture remained almost stagnant at 23 percent. It was because the value of bigger sector of crops increased relatively more than that of the livestock sector and hence masked the latter's performance. The same was true of the fisheries sector. The value of fisheries sector swelled by about 50 percent during the 1990s, but its share in agricultural gross domestic product declined marginally to about 1.02 percent in TE 1998-99 from 1.35 percent in TE 1990-91. It was despite the fact that fisheries production has increased at an annual rate of 5.35 percent during the decade of 1990s.

In general, the regional patterns revealed a shift from crops to livestock during the 1980s and 1990s (Table 1). The exceptions were eastern and northeastern regions, where the shares of both crop and livestock sectors increased in the total value of agricultural output at the cost of fisheries and forestry. In the southern region also, the shares of fisheries and forestry in the total output during the 1980s and 1990s declined. The livestock sector across different regions expanded as a result of higher demand for products, like milk, meat and eggs. The 'cooperative model' and the 'contract farming' concept linking cultivation, processing and retail distribution seemed to have attained a reasonable degree of success, contributing to increased livestock production.

Table 1. Share of different sectors in gross value of agricultural output in India during the period 1981-82 to 1998-99 (at 1980-81 prices) (percent)

Regions	Crop			Livestock			Forestry			Fisheries		
	TE 1981-82	TE 1990-91	TE 1998-99	TE 1981-82	TE 1990-91	TE 1998-99	TE 1981-82	TE 1990-91	TE 1998-99	TE 1981-82	TE 1990-91	TE 1998-99
Eastern	73.90	70.65	75.20	16.83	24.44	21.93	6.65	2.35	0.87	2.62	2.56	2.00
North-eastern	77.48	75.95	79.00	13.74	18.44	18.32	5.68	3.08	1.18	3.10	2.54	1.50
Northern	75.73	73.98	72.21	21.62	24.94	27.11	2.44	0.75	0.40	0.21	0.33	0.28
Southern	80.06	78.46	76.35	15.64	19.10	22.10	2.29	1.28	0.55	2.01	1.16	1.00
Western	75.71	71.65	73.00	18.95	23.79	24.55	4.08	3.40	1.60	1.25	1.16	0.85
All-India	76.25	73.65	74.60	18.27	23.09	23.54	3.95	1.91	0.84	1.53	1.35	1.02

Diversification within Crop Sector

The crop sector is depicted a steady diversification in India with replacement of foodgrain crops with non-foodgrain crops. The share of non-foodgrain crops in terms of area went up from 30 percent in TE 1981-82 to 35 percent in TE 1998-99, and in value terms it had a significant rise, from about 52 to 60 percent (Figure 2). Several non-foodgrain crops such as oilseeds, fruits, vegetables, spices and sugarcane have substituted mainly coarse cereals in the farmers' pursuit for higher income.

Regional patterns in crop diversification in India were quite stark (Table 2). The southern region depicted maximum diversification followed by the western region. It may be mentioned that these were the regions, which had accomplished higher agricultural growth during the 1990s over the preceding decade. These regions moved swiftly towards more non-cereal crops, which perhaps contributed to the acceleration of agricultural growth. These regions were relatively less developed in irrigation and largely relied on rainfall. Since pulses and oilseeds require less water, they had found niches in these regions. Like pulses and oilseeds, these regions witnessed substantial increase in area under fruits and vegetables also. The government-supported programs had promoted the cultivation of fruits and vegetables. Among others, watershed program had facilitated conservation of rainwater and gave higher priority to the cultivation of fruits and vegetables. Among cereal crops, maize was picking up fast in the southern region, and to some extent in the western region also, largely as poultry feed. Among the crops gaining in these regions, oilseeds were under serious threat in the wake of import liberalization of edible oils, as the cost of imported oils, especially palmolean, was much lower than their domestic price. To sustain oilseed production, technical efficiencies in their production and processing will have to be innovated with better management and technology options (Gulati and Kelly 1999).

Table 2. Share of foodgrain and non-foodgrain crops in cropping pattern and value of output in India at constant prices (percent)

Region	Share of foodgrain and non-foodgrain crops							
	TE 1981-82				TE 1998-99			
	Foodgrain crops		Non-foodgrain crops		Foodgrain crops		Non-foodgrain crops	
	Area	Value	Area	Value	Area	Value	Area	Value
Eastern	81.63	51.73	18.37	48.27	73.83	43.04	26.17	56.96
Northeastern	70.11	44.43	29.89	55.77	65.06	35.80	34.94	64.2
Northern	77.42	54.92	22.58	45.08	76.86	53.74	23.14	46.26
Southern	62.86	41.82	37.14	58.18	53.08	28.20	46.92	71.80
Western	71.92	44.44	28.08	55.56	61.85	36.10	38.15	63.90
All-India	70.34	48.05	29.66	51.95	65.44	39.85	34.56	60.15

The northern region in India has more specialized in rice and wheat crops. The favorable government pricing policies, assured procurement, high-yielding technologies, and irrigation development have encouraged farmers to allocate more area in favor of these crops. Rice and wheat have replaced coarse cereals and pulses in this region and it is diversifying only marginally towards non-cereal commodities. With the availability of short-duration black gram, green gram and pigeonpea, pulses had started regaining area in this region (Joshi et al. 2000). Other important crops of the region were sugarcane, vegetables and fruits. There are reports, however, that extensive cultivation of rice and sugarcane was causing negative externalities related to soil and water resources. The soil fertility with respect to macro- and micro-nutrients was declining, and the water resources were depleting. These negative externalities have adversely affected the total factor productivity of rice-wheat based cropping system in this region (Kumar et al. 1998). It has potential for cultivating a variety of fruits and vegetables, but its exploitation depends on developing appropriate infrastructure with suitable linkages between production and consumption.

The eastern region of India is the most backward in terms of per capita income, agricultural growth and infrastructure development. The yield levels are low because of the uncertain production environment and poor adoption of improved varieties and technologies. Overall, the region was food-based concentrating largely on rice, with little diversification. The humid atmosphere and high rainfall make cultivation of rice more favorable in this region. In the limited non-rice areas, however, there was high diversity. It is an important vegetable growing area with about 44 percent share in the total vegetable area in the country in TE 1998-99 (Government of India 2001). The cultivation of fruits was also increasing gradually. It has emerged as an oilseeds producing region too with cultivation of crops like rapeseed-mustard, groundnut, sesame and soybean.

During the post-green revolution period, fruits and vegetables performed impressively in all the regions of India. It was due to the greater thrust to these commodities. To encourage the horticulture sector through coordinating production and processing of fruits and vegetables, National Horticultural Board was constituted in 1984 on the lines of National Dairy Development Board (NDDB). To strengthen food processing and promote their export, the Government of India, established the Agricultural and Processed Food Products Export Development Agency (APEDA). The main aim was to build links between Indian producers and the global markets. It yielded promising results. The export of fruits and vegetables went-up during the 1990s due to the development of infrastructural facilities like cold storage and cargo handling at the international airports.

Figure 1. Share of different agricultural sub-sectors in gross-value of agricultural output

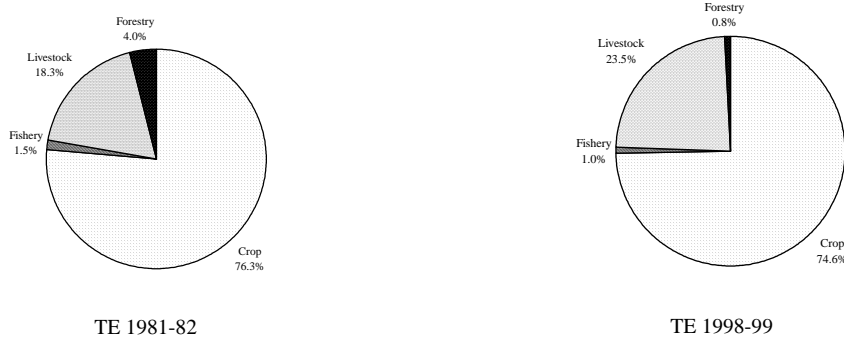
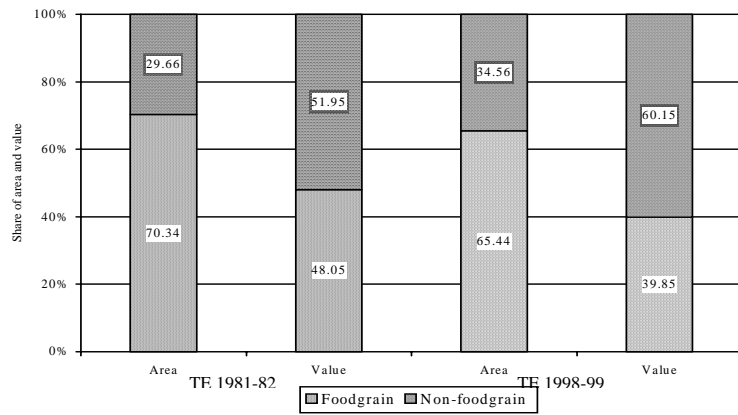


Figure 2. Share of foodgrain and non-foodgrain in area and value (percent)



III

Sources of Growth and Role of Agricultural Diversification

In this section, the past sources of agricultural growth have been identified with a focus on agricultural diversification. The future growth sources have been predicted with a view to evolving suitable R&D strategy and initiating appropriate policy environment. The methodology to decompose the sources of agricultural growth has been elaborated first and then results have discussed as (i) changes in past sources of growth in agriculture and delineate the role of agricultural diversification, and (ii) regional differences in sources of growth in agriculture. We hypothesized that during the 1990s, characterized as the reform period, agricultural prices and agricultural diversification towards high-value commodities were responsible for agricultural growth. We also hypothesized that during the pre-reform period, it was mainly the technological development that contributed towards agricultural growth.

Framework for Decomposition of Agricultural Growth

Agricultural growth is a function of the level of technology, government policies, cropped area and production-portfolio. A temporal change in agricultural growth is therefore the cumulative effect of changes in all these components. We have decomposed the effect of different sources on the value of crop output. Since crop sector is the main constituent of agricultural gross domestic product (AgGDP), the value of its output was considered as a proxy of income from agriculture. And crop yields were used as a proxy of the level of technology, real prices as proxy for government policies, gross cropped area for area expansion, and change in production-portfolio (i.e. crop substitution) for agricultural diversification. The contribution of each of these sources to the value of crop output was quantified following the Minot (2003).

If A_i is the area under crop i , Y_i is its production per unit area, and P_i is the real price per unit of production, then the gross value (R) from n crops is given by Equation (1):

$$R = \sum_{i=1}^n A_i Y_i P_i \quad \dots (1)$$

Expressing A_i as the share of crop i in the total cropped area, $a_i = (A_i / \sum A_i)$, Equation (1) can be rewritten as Equation (2):

$$R = (\sum a_i Y_i P_i) \sum A_i \quad \dots (2)$$

Taking total derivatives of both the sides of Equation (2) yields Equation (3):

$$dR \equiv (\sum_i a_i Y_i P_i) d(\sum_i A_i) + (\sum_i A_i) d(\sum_i a_i Y_i P_i) \quad \dots (3)$$

The second term on the right-hand side of Equation (3) can be further decomposed from 'the change in sum' into 'the sum of changes', i.e.

$$dR \equiv (\sum_i a_i Y_i P_i) d(\sum_i A_i) + \sum_i A_i \sum_i d(a_i Y_i P_i) \quad \dots (4)$$

Further expansion of the second term in Equation (4) results into Equation (5):

$$dR \equiv \{(\sum_i a_i Y_i P_i) d(\sum_i A_i)\} + \{\sum_i A_i \sum_i (a_i Y_i dP_i)\} + \{\sum_i A_i \sum_i (a_i P_i dY_i)\} + \{\sum_i A_i \sum_i (P_i Y_i da_i)\} \quad \dots (5)$$

The first term on the right-hand side of Equation (5) denotes the change in total value of crop output due to change in total cropped area (area effect). The second-term depicts the effect of change in real prices (price effect). The third-term represents the effect of yield change (technology effect), and the fourth-term provides the share of land reallocation (diversification effect). Dividing of both sides of Equation (5) by the overall change in revenue (dR) would yield the proportional contribution of each component to the overall growth. The decomposition was only approximation, as the interaction effects were not considered, and can be carried-out for any crop, farm group or region.

Each of the above growth sources has implications for future agricultural development policies (Minot 2003). If the growth stems from the technological change (yield improvements), investments in research and extension need to be accorded priority. The area-driven growth implies need for greater extension efforts to make agriculture broad-based, while the price-driven growth requires an appropriate pricing policy for a balanced growth of the agricultural sector. If the growth occurs due to crop diversification, there is a need for increasing investments in development of markets and infrastructure. The growth being a dynamic process, the relative importance of its different components is likely to change over time, and so would be the policy orientation. For example, if the technology starts showing signs of fatigue, resource allocation in research should be more towards the basic research than applied research.

Past Sources of Agricultural Growth

The results of decomposition exercise revealed that sources of agricultural growth had changed dramatically over the last two decades (Figure 3). While rise in the real prices of different crops was the principal source of growth in agriculture during the 1990s, it was increase in the yield levels of different crops during the 1980s. Interestingly, the share of real prices in the growth jumped to 35.2 percent during 1990s from 7.7 per cent during 1980s. On the other hand, the share of yield levels declined from 54 percent to 29.3 percent during this period. Agricultural diversification consistently improved its contribution as an important source of growth in agriculture. The trends indicated that superior and high-value crops substituted inferior and low-value crops to accelerate agricultural growth and augment income. Since expansion in area has slowed down, crop substitution towards high-value and superior crops will be a potential source of this growth in future.

Commodity-wise contribution to the growth in agriculture is reported in Table 3. It was interesting to note that fruits & vegetables were the most important sources of agricultural growth both during 1980s as well as 1990s, despite limited area under their cultivation. The share of rice in the agricultural growth though prominent but remained constant at around 21 percent during this period. The most striking difference was noted in oilseeds and wheat. Oilseeds were among the principal growth sources during the 1980s, while it became wheat during the 1990s. The greater thrust accorded to the oilseeds sector through 'Oilseed Mission' launched in 1987 was responsible for making it as an important source of growth in agriculture. During the 1990s, the liberalization of economy attracted huge import of edible oils and conspicuously overshadowed the contribution of the oilseeds sector. On the other hand, wheat cultivation expanded to many non-traditional areas due to favorable policies (government price support, assured markets, and low risks) and plethora of technologies. The oilseeds area, which had attained an annual growth rate of 3.2 percent during the 1980s, started showing a declining trend (-0.4 percent) during the 1990s.

Details of the share of different commodities in the sources of agricultural growth are presented in Table 4. Surprisingly, the share of real prices of all cereals, which depicted a declining trend during the 1980s, turned out to be positive during the 1990s, which eventually contributed to agricultural growth. The prices of a majority of commodities, except oilseeds, increased during the 1990s, with maximum rise in prices of rice, wheat, and fruits & vegetables. Rice and wheat were, however, covered under the government policy of 'Minimum Support Price' (MSP); consequently their prices were consistently increased to protect the interests of the farmers. But for fruits & vegetables, it was the growing demand that pushed up their prices.

The yield-effect on agricultural growth slowed down during the 1990s. A majority of crops depicted either stagnation or deceleration in their yield levels during the 1990s as compared to values in 1980s. It was a clear indication of the fatigue in the technology being used for these crops. The improved technologies were reported inaccessible to the farmers due to various reasons. This indeed is a matter of concern as the potential yield of most of the crops is yet to be tapped to harness the benefits of improved technologies. Moreover, with only a limited scope of expansion in the area, increase in yield through technological innovation is the only viable option as the source of agricultural growth in the future.

The crop diversification emerged as a prominent source of growth in agriculture both during 1980s and 1990s. The rise in its share in the growth was an indication of the changing production portfolio in favor of superior and high-value commodities. It was noted that the areas under most of the coarse cereals, pulses, and spices had shifted towards fruits & vegetables and other more remunerative crops. During the 1980s, the area substitution was in favor of oilseeds, while the trend shifted to wheat and fruits & vegetables in 1990s. The share of fruits & vegetables in crop diversification went-up to 61 percent during 1990s from about 56 percent during 1980s. Their share in the total cropped area increased from 2.8 percent in TE 1981-82 to 4.8 percent in TE 1999-2000. Their corresponding share in the gross value of agricultural output moved-up from 8.9 to 17.5 per cent during this period.

It was interesting to note that the contribution of output prices and crop diversification (particularly fruits & vegetables) had gone-up in agricultural growth during the reform period, whereas during the pre-reform period, it mainly relied on technology and crop diversification (particularly oilseeds and fruits & vegetables). During the reform period, the focus was on agricultural prices, particularly of rice and wheat, whose prices depicted a change of 30 and 27 percent, respectively. However, a continuous rise in the output prices is not a sustainable source of growth in the long-run. Increasing production and globalization could suppress the output prices and may affect the agricultural growth adversely.

Thus, accelerating the pace of crop yields (through technological change) and crop diversification (in favor of high-value commodities) are the options to provide sustainable sources of agricultural growth in future.

Regional Patterns of Growth Sources

The performance of agriculture was quite varied across different regions. It was much better in the western region with an annual compound growth rate of 3.8 percent during 1990s. In agriculture-dominated northern region, the performance of agriculture was dismal, with an annual growth rate of 2 percent during the 1990s as against 3.2 percent during 1980s.

The results of decomposition analysis on the sources of agricultural growth in different regions revealed that 'yield increase' was the predominant source of agricultural growth in all the regions during the 1980s, while during the 1990s, these varied across regions (Table 5). As for example, it was prices in the eastern and northern regions, and crop diversification in the southern and western regions. A brief account of growth sources in different regions is given below:

Northern Region

Rice, wheat, sugarcane and fruits & vegetables were the principal commodities which contributed about 77 percent to the gross value of crop output in TE 1999-2000. Rice and wheat were the main crops that had brought the 'Green Revolution' in this region. During the 1980s, the real prices of major commodities declined in the region but were well compensated for by (i) phenomenal rise in the yield levels of important crops, and (ii) crop diversification in favor of rice, wheat, sugarcane and fruits & vegetables (Table 5). The situation changed dramatically during the 1990s, when increase in the real prices of rice, wheat and sugarcane dominated in the value of agricultural output. Expansion in area and crop diversification towards rice and wheat continued during 1990s but the pace slowed down. However, area expansion and crop diversification picked-up speed for fruits & vegetables. The future growth opportunities in this region would rely on another technological breakthrough to augment yield of important crops and promote agricultural diversification towards more remunerative food commodities for processing and value-addition.

Eastern Region

Rice and fruits & vegetables were the major commodity groups, which accounted for roughly 69 percent share in the gross value of agricultural output during the 1980s and 71 percent during the 1990s. The region witnessed a decline in the net and gross cropped area during the 1990s as compared to 1980s. The decline in agricultural growth due to fall in cropped area was compensated for by (i) rise in prices, (ii) higher crop yields, and (iii) crop substitution towards more remunerative commodities (Table 5). Besides rice and fruits & vegetables, this region witnessed expansion in areas under oilseeds, pulses and wheat through crop substitution. This region characterized as 'low-yielding and slow-growth' areas needs introduction of improved technologies or diversification towards such commodities as could tap the potential of available resources such as labor and water.

Western Region

Crop diversification was the dominant source of agricultural growth during both the decades of 1980s and 1990s followed by rise in prices and yield in this region (Table 5). However, the contribution of yield to agricultural growth was less during the 1990s than 1980s, while the trend was just the reverse for prices. Among commodities, pulses, oilseeds and fruits & vegetables made a significant contribution (76 percent) to agricultural growth during 1980s. During 1990s, production portfolio included wheat, pulses, oilseeds, cotton and fruits & vegetables, with contribution of about 80 percent growth in the crop sector. The contribution of fruits & vegetables, wheat and cotton increased during the 1990s, while that of pulses and oilseeds decreased. Interestingly, crop diversification and prices were mainly responsible for the growth in wheat and fruits & vegetables, while these were crop diversification and higher yields in the case of cotton. The region had witnessed a transformation as a result of investment in the watershed programs and incentives on adopting water-saving technologies. These initiatives in the region led to crop diversification and higher crop yields, which eventually contributed to agricultural growth.

Southern Region

This region witnessed crop diversification as the major source of agricultural growth (Table 5) and its pace was much faster during the 1990s than 1980s. Rice, oilseeds, fruits & vegetables and spices substituted coarse cereals during the 1980s, with a contribution of roughly 80 percent to the agricultural growth. During the 1990s, their contribution improved to 88 percent, substituting oilseeds and cotton. Coarse cereals, particularly maize also boomed in the region for the poultry sector. Increase in the yield of major crops also emerged as an important source of agricultural growth in the region, as a major part of it was characterized as rainfed and technologically laggard. However, greater emphasis on the watershed development in the southern and western regions had augmented water availability, leading to adoption of improved technologies, and consequently higher yields of crops.

To sum-up the regional patterns of agricultural growth, it can be concluded that the southern and western regions have conspicuously followed the growth path of crop diversification towards high-value commodities during the reform period. Consequently, the agricultural growth has been much higher in these two regions than in the eastern and northern regions, which have witnessed only price-led growth. Also, the southern and western regions are rapidly switching over to the high-value commodities. The annual compound growth rates of area and gross value of high-value commodities in these regions are much higher than in the eastern and northern regions, and difference has been more during 1990s than 1980s (Table 6). The share of high-value commodities in the gross cropped area and value of agricultural output has risen consistently in the southern and western regions during the period 1980-2000 (Table 7). Therefore, these regions need concerted efforts in strengthening the supply chain of high-value commodities. Policies to promote agro-processing industries could reap the benefit of value-addition in these commodities. These regions require incentives for investments in the agro-processing sector and strengthening of innovative institutional arrangements. In their absence, the pace of crop diversification may be affected adversely.

Table 3. Contribution of different commodities in agricultural growth during 1980-2000 (percent)

Commodity	1980s	1990s	1980-2000
Rice	21.3	21.5	21.4
Wheat	6.8	22.2	15.6
Coarse cereals	-1.6	2.1	0.5
Pulses	7.9	1.5	4.2
Oilseeds	20.4	1.8	9.9
Fibers	5.0	-0.4	1.9
Sugarcane	7.0	8.8	8.0
Beverages	2.7	2.6	2.6
Fruits and vegetables	23.7	32.1	28.5
Spices	6.4	7.6	7.1
Others	0.4	0.4	0.4
Total	100.0	100.0	100.0

Table 4. Share of different commodities in the sources of agricultural growth in India during 1980s and 1990s (percent)

Commodity	1980s					1990s				
	Area effect	Yield effect	Price effect	Diversification	Interaction	Area effect	Yield effect	Price effect	Diversification	Interaction
Rice	23.2	37.38	-70.73	9.17	4.21	23.13	29.65	29.95	4.58	30.59
Wheat	12.6	17.6	-48.67	-3.46	-5.88	11.8	22.25	26.79	17.83	60.51
Coarse cereals	6.35	6.17	-26.58	-13.98	-12.06	6.16	7.84	8.11	-10.18	2.47
Pulses	6.8	2.64	67.88	-0.83	31.31	5.95	2.49	5.66	-4.88	13.35
Oilseeds	15.07	7.13	25.71	45.27	54.51	14.48	17.43	-20.55	11.06	-28.49
Fibers	8.3	17.36	5.82	-3.81	-52.43	7.88	-5.38	-3.92	7.09	-28.3
Sugarcane	7.54	5.84	-2.63	10.95	5	6.73	4.52	12.45	8.76	15.07
Beverages	1.59	1.26	17.28	1.28	4.58	1.3	4.16	2.21	1.6	8.16
Fruits & vegetables	16.18	2.99	93.29	56.26	29.13	20.02	12.84	32.67	60.69	49.16
Spices	1.7	1.16	24.5	-1.69	40.88	1.8	4	4.88	1.01	-20.65
Others	0.67	0.47	14.13	0.84	0.75	0.75	0.2	1.75	2.44	-1.87
Total	100	100	100	100	100	100	100	100	100	100

In contrast to the southern and western regions, the agricultural growth in the eastern and northern regions has relied more on increase in prices of agricultural commodities. Efforts, therefore, be directed towards gradually switching-over to commodities yielding higher returns. This could be achieved by using advanced technologies. The eastern region though has a sizable area under high-value commodities, is not able to exploit the potential benefits because of its lower yield levels and poor road and market infrastructure. The northern region seriously needs to diversify away from rice-wheat system to high-value and resource-conserving commodities for stimulating growth in agriculture.

Table 5 Sources of agricultural growth in different regions of India during 1980s and 1990s (percent)

Region	Period	Sources of agricultural growth				
		Area	Yield	Prices	Diversification	Interaction
Northern	1980s	1.4	75.4	-6.5	29.7	0.1
	1990s	10.1	16.6	44.0	28.2	1.1
Eastern	1980s	17.8	49.7	11.8	19.7	1.0
	1990s	-29.7	38.7	45.8	42.6	2.6
Western	1980s	11.6	36.5	7.3	39.0	5.5
	1990s	13.4	24.8	25.7	35.8	0.4
Southern	1980s	10.4	39.5	16.8	32.1	1.3
	1990s	-8.7	36.2	29.3	45.0	-1.8
All-India	1980s	10.1	54	7.7	26.6	1.6
	1990s	4.0	29.3	35.2	30.7	0.8

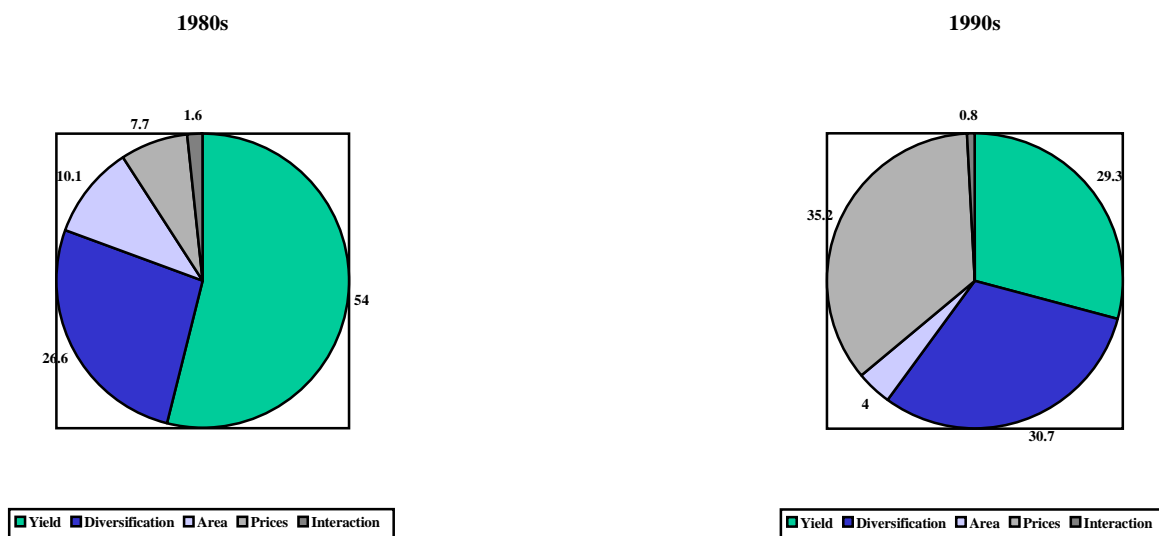
Table 6. Annual compound growth rates of area and value of high-value and other crops in different regions of India (percent)

Period	Northern	Eastern	Western	Southern
High-value commodities				
<i>Annual growth rates in area</i>				
1980s	2.2	3.8	2.4	1.4
1990s	2.6	1.2	4.3	2.2
<i>Annual growth rate in value</i>				
1980s	3.6	5.8	5.6	7.7
1990s	3.5	1.4	7.2	5.5
Other crops				
<i>Annual growth rates in area</i>				
1980s	0.2	0.4	0.1	0.1
1990s	0.4	-0.6	0.8	-0.1
<i>Annual growth rate in value</i>				
1980s	3.5	4.7	2.9	2.5
1990s	3.4	2.1	4.2	1.1

Table 7. Share of high-value food commodities in area and value in different regions of India (percent)

Period	Northern	Eastern	Western	Southern
Share in area				
TE 1981-82	2.5	7.6	1.6	8.1
TE 1991-92	4.0	11.2	2.2	9.0
TE 1999-2000	4.8	12.3	2.7	10.5
Share in value				
TE 1981-82	12.1	31.7	9.6	15.1
TE 1991-92	17.7	43.6	14.4	22.8
TE 1999-2000	17.8	42.8	17.4	28.1

Figure 3. Share of different sources of growth in agriculture in India during 1980s and 1990s



IV

Drivers of Agricultural Diversification

Several forces influence the nature and speed of agricultural diversification from staple to high-value food commodities. The earlier evidence suggests that this process of diversification was triggered by the rapid technological change in agricultural production, improved rural infrastructure, and changing consumers' preferences (Pingali and Rosegrant 1995). These are broadly classified as demand and supply forces. The demand side forces that have been hypothesized to influence the agricultural diversification include per capita income and urbanization. On the supply side, this diversification is largely influenced by infrastructure (markets and roads), technology (relative profitability and risks in different commodities), resource endowments (water and labor) and socio-economic variables (pressure on land and literacy rate). In this section, we have identified the key drivers of agricultural diversification. The model used to identify the determinants responsible for crop diversification has been described first and then the results have been presented.

Model

The Generalized Least Square (GLS) technique with fixed-effect model was applied to examine the impact of different forces on crop and livestock diversification in India. The analysis was based on pooling of cross-sectional and time series data from the major states (19 out of 28⁴) in India for the period 1980-81 to 1998-99. The GLS eliminates the effect of heteroscedasticity arising due to cross-sectional data and autocorrelation as a result of time series data. Following model (Equation 6) was used to examine the determinants of diversification:

$$D_c \text{ or } D_i = f(\text{TECH, INFR, PROF, KNOW, DEMA, RAIN}) \quad \text{----- (6)}$$

The variables were defined as follows:

The dependent variable, D_c or D_i was defined as the index of output values of horticultural commodities at constant prices with 1980-81 as the base. The independent variables were broadly grouped into (i) technology (TECH) related, (ii) infrastructure (INFR) related, (iii) profitability (PROF) related, (iv) resources and information (KNOW) related, (v) demand (DEMA) side, and (vi) climate (RAIN) related. To capture their impact, few proxy variables were used in the model. For technology (TECH), these included: proportionate area under high-yielding varieties of foodgrain crops (%), fertilizer use (kg/ha), proportion of gross irrigated area to gross cultivated area (%), and mechanization (number of tractors/1000 ha area). For infrastructure (INFR), the proxy variables used were market density (number of markets per 1000 ha of gross cropped area), and roads length (square km per 1000 ha of gross cropped area). The relative profitability of high-value commodities with cereals and other crops was the proxy for profitability (PROF) related variables. Average size of landholding (ha) and proportion of smallholders in the total holdings were used as proxies for available resources, and rural literacy (%) for information (KNOW) related variables, respectively. On the demand side (DEMA) variables, urbanization (% of urban population) and per capita income (Rupees per person) were used in the model. The annual rainfall (mm) was used to define the climate (RAIN) related variable in the model. 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.

Determinants of Diversification in Crop Sector

The estimated double-log equations of Generalized Least Square approach are given in Table 8. To capture the effect of infrastructural development, two important variables, viz. markets and roads, were included in the model. These variables yielded positive and significant influence on diversification in the crop sector. Understandably, better markets and road network induced diversification in favor of horticultural commodities and offered low marketing cost and easy and quick disposal of these commodities. Such facilities also reduced the risk of post-harvest losses in the case of perishable commodities. Similarly, the demand-side factors such as urbanization and per-capita income showed positive and significant impact on crop diversification.

The technology was defined by the area under high-yielding varieties of cereals, irrigated area and extent of mechanization. But it was the irrigated area that turned-out to be significant. The regression coefficient of this variable showed a negative relationship with diversification. It meant that the crop diversification in favor of horticultural commodities declined with increase in the irrigated area. This suggested that crop diversification should be more pronounced in the rainfed areas, which lacked advanced irrigation facilities. For example, the southern and western regions, which are characterized as rainfed, low-resource, but endowed with abundant laborforce, and were by-passed during the 'green-revolution' period, depicted higher and faster crop diversification as compared with the northern region, which is endowed with better irrigation facilities.

The relative profitability of horticultural commodities with other crops is also an important determinant of agricultural diversification. The regression coefficient for it was found significant and positive. Obviously, the higher profitability of these crops will induce farmers to diversify in their favor. Fruits & vegetables were also found more profitable than cereals and other crops. The relative profitability was higher by 8-times for fruits and 4.8-times for vegetables than cereals. Although higher profitability of horticultural crops encouraged their cultivation, the uncertainty in their prices, unstable yield levels and lack of access to markets restricted their widespread adoption. The price volatility was more pronounced in fruits & vegetables *vis-a-vis* cereals (Subramanian et al. 2000) and was due to poor vertical linkages between production, marketing and processing. This calls for developing appropriate institutional arrangements for minimizing uncertainty in prices. Some scattered success stories were of course available depicting strengthening of farm-firm linkages through cooperatives and contract farming, which were becoming popular in many developing countries.

A positive relationship existed between growth in cultivation of horticultural commodities and the proportion of smallholders. It indicated that crop diversification was more pronounced in areas having higher concentration of

⁴ 19 states selected for the study are the major states of the country in terms of their geographical areas, production and population.

smallholders. Moreover, cultivation of horticultural crops being labor-intensive, suits the smallholders well who make use of their family labor force and ensure regular flow of income. However, the absence of appropriate markets and rise in supply may adversely affect the prices of these commodities and opportunities for higher income (Tewari et al. 2001).

Rainfall was another variable considered in the model to assess the impact of climate on crop diversification. The variable was highly significant with negative sign, indicating that crop diversification was limited in areas with higher rainfall. The farmers in these areas naturally preferred cultivating rice, and it was only in the medium and low rainfall areas that farmers wanted to diversify to increase their income and minimize risks.

Table 8. Determinants of diversification in favour of horticultural commodities: double-log estimates of Generalised Least Square technique

Explanatory variables	Dependent variable: 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)
Smallholders	1.1964*** (0.2283)	1.2016*** (0.2285)	1.6043*** (0.2002)
Urbanization	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 ²	0.7735	0.7722	0.7572
Adjusted R ²	0.7642	0.7637	0.7490
F-statistic	82.82***	90.00***	91.40***

Figures within the parentheses are standard errors of the respective coefficients.

***, **, and * denote significance at 1%, 5% and 10% levels, respectively.

V

Policy Constraints in greater involvement of private sector

Private sector is not actively participating in the process of agricultural diversification. We have interviewed few representatives of private sector, who are involved in linking production and marketing of high-value commodities. The important constraints highlighted by the private sector representatives are enumerated below:

- High-value food commodities require an infrastructure that is quite different from that of cereals and pulses. Most of the high-value food commodities being perishable in nature, which require refrigerated transportation and cold storages at every stage of value addition. These are, however, woefully lacking and hence, there are substantial post-harvest losses.
- One important requirement for successful coordination of value-addition and agro-processing is a regular supply of good quality raw material from farm to firm. This can be achieved through either self-production by the firm or contract farming. The existing land ceiling act restricts the first option, while the latter is not possible unless the government enacts appropriate legislation. As on date, none of the options has a legal standing; which is a discouragement to contract farming. Apart from this, no legislation exists for a breach of contract by any party (farmer or the firm).
- In many states, the by-laws of the market committee legislation restrict the sale within a specified area. Market fee including commission charges are high; ranging from 2 to 7 percent. Some states also impose developmental charges. Transfer of goods outside the defined geographical boundaries attracts imposition of sales tax, octroi, etc. Such restrictions distort the market, reduce its efficiency and discourage formation of farm-firm linkages through contract farming.
- Promotion of agro-processing industry may provide a fillip to contract farming of high-value food commodities. However, this sector is afflicted with various ailments like (i) scale of industry, (ii) over bureaucratisation and complicated legal wrangles, and (iii) high taxes. Scale of industry and its operation affect the production efficiency of processing firms. Until recently a number of food products were reserved for Small-Scale Industries (SSIs), which often lack capital, use obsolete technology, are inefficient in production and weak in marketing,

and not have any incentive to develop effective farm-firm linkages for reducing their transaction costs. Realizing the importance of scale of industry in agro-processing, the Government of India has recently taken-off some of the food items reserved for SSIs. In a competitive environment it would have been difficult for the SSIs to take advantage of the new technologies and economies of scale in production and marketing, both in domestic and international market.

- Existing bureaucratic and cumbersome procedures discourage the potential agro-processors to venture to this promising business. There are about 17 laws governing the food industry. There are laws that govern a specific commodity or a group of commodities. And, there are separate laws relating to weights and measurements, packaging, adulteration, etc. These laws are administered and implemented by different departments and/or ministries. As for instance, Prevention of Food Adulteration Act 1954 is implemented by the Ministry of Health; Agriculture Produce (Grading and Marking) Act by the Ministry of Rural Development; laws related to standards, weights and measurements are under the jurisdiction of Ministry of Civil Supplies, Consumer Affairs and Public Distribution and the laws related to environment are implemented by the Ministry of Environment and Forests. For setting up a agro-processing unit an investor has to get clearance from all the concerned departments. Such a multiplicity often results in conflicting approaches, lack of coordination and administrative delays.
- Despite fiscal reforms, excise duty and sales tax imposed on processed foods continue to remain high. Processed food items attract an excise duty of 8 percent of the retail price. If all other levies are added to it, the figure increases up to 17 percent. This pushes-up the market prices of processed food items, which would be naturally much higher than the fresh food.
- Rising demand for food and non-food processed products has provided expanding opportunities for the growth of their organized retailing that hitherto had comprised only about 2 percent of the total retail sales in India. This has attracted some large domestic business groups such as Tatas (Westside), RPG (FoodWorld), Rahejas (Shopper's Stop) and Piramal (Pyramids and Crossroads) into food retail trade. Some of these retail food chains are sourcing raw materials directly from the farmers through vertical coordination (Chengappa et al. 2003). The organized retailing is concentrated mainly in the southern metropolis. That is why a silent revolution of innovative institutions is so evidently visible in the southern states of India. The organized retailing should be encouraged to improve marketing efficiency and profit-sharing with producers and consumers.

The Government of India has undertaken several steps to overcome some of the constraints in agricultural marketing and agro-processing sector, particularly after the regulatory and fiscal reforms have been introduced to attract private investment in food industry (Government of India 2002). Among others, a series of economic reforms program started in early 1990s. These include (i) doing away with the industrial licensing requirement for most of the food items, (ii) automatic approval of investment up to 51 percent foreign equity or 100 percent for Non-Resident Indians, (iii) relaxation in monopoly and foreign exchange acts, (iv) free import and export of food items (except items on the negative list) and capital goods, and (v) permission to financial institutions to finance contract farming schemes strengthening backward linkages. The fiscal incentives include: (i) reduction in import and excise duty and corporate taxes, and repatriation of benefits, (ii) establishment of free trade, and export processing zones, (iii) reduction in custom duty on imports of capital goods, and exemption from corporate and minimum alternative taxes to the firms located in free trade and export processing zones.

The Government of India has recently initiated a scheme to strengthen farm-firm linkages in which reimbursement up to 10 percent of the total purchase by the processor is allowed limited to Rs 1 million (approximately US\$ 22.5 thousand) a year. The assistance is also provided for the market survey and brand promotion up to 50 percent of the cost of campaign, limited to Rs 5 million (approximately US\$ 112.5 thousand). These measures are slowly attracting the organized sector to participate in strengthening of farm-firm linkages and evolving different innovative institutional models.

Agriculture being a state subject in India, some state governments too have taken initiatives to facilitate/encourage entry of the private/corporate sector to agriculture. As for example, Tamil Nadu has come out with a policy document on contract farming. Industries promoting cultivation of fruits and vegetables through value-addition have been exempted from land ceiling act. In addition, provisions have been made to lease degraded forestlands and wastelands to the private sector for cultivation of plantation crops with state as a partner. Under the policy, the state provides a capital subsidy up to 20 percent of the fixed assets (green house structures, irrigation and fertilizer equipments, cold room, tissue culture, etc.) subject to a ceiling of Rs 2 million (approximately US\$ 45 thousand) to fruit and vegetable industries. The fruit and vegetable industry has been given the status of an industry, enabling it to get preferential treatment in power supply. Punjab has also aggressively launched contract farming to replace the existing rice-wheat system. In some other states, including Madhya Pradesh, Rajasthan and Uttar Pradesh, incentives and other mechanisms to attract private investment in agriculture through contract farming have been worked out. Market fee (2-7 percent) has been exempted in these states for producers who sell their produce directly to the processors. Consequently, some well-known agro-processing players like Hindustan Lever Limited, Nestle India Limited, Britannia Industries, Pepsi Co, Rallis India Limited, Escorts, Mahindra & Mahindra, and Venkateshwara Hatcheries have started adopting 'innovative institutional arrangements' as a means of sourcing raw materials directly from the farmers.

It may be concluded that the present policy environment and infrastructure network are inadequate for promoting vertical coordination and encouraging agro-processing sector. The scattered attempts made in this direction are showing promising results and they need to be replicated in niche areas. It appears that the private sector is keen to invest in the agriculture and agro-processing sector to harness the huge untapped potential but the existing policies are discouraging it from venturing into these areas. It is high time the private sector is encouraged to evolve new institutional arrangements to take advantage of the opportunities emerging from trade liberalization. The government should ensure that smallholders are not left behind in sharing the benefits of the emerging opportunities.

VI

Conclusions and Policy Implications

The Indian agriculture is gradually diversifying in favor of high-value food commodities, and the production in particular of fruits, vegetables, milk, meat, poultry, and fish has increased remarkably during the last two decades. Such a shift is the result of rising income of consumers, changing consumption patterns and growing urbanization. The consumption patterns are fast changing in favor of high-value food commodities with rising per capita income, and changing tastes and preferences of consumers. This shift in consumption patterns is not only observed in the urban areas and high-income strata but in rural areas and poor-income group also.

The rise in prices of agricultural commodities and agricultural diversification were the main sources of agricultural growth during the reform period (1990s). In the 'green revolution' belt, it was the 'price', which was the most important source of agricultural growth. During the pre-reform period (1980s), it was 'technology' that led the agricultural growth. The present analysis has revealed that contribution of high-value commodities has been considerably higher in inducing diversification of agriculture, particularly in developing countries like India. This diversification has been found to be occurring much faster in the urban/ peri-urban than near-urban areas and hinterlands. Also, the road network has been found to be a strong driving force for this diversification, which is seen more pronounced in areas that are connected with at least one national highway.

The analysis has found that smallholders are benefited immensely from agricultural diversification because the high-value food commodities yield regular, quick and high returns to the small farmers, and provide income-security to them. The production of these commodities being labor-intensive, generate the needed employment opportunities for them in the rural areas. However, the small marketable surpluses and high transaction costs are constraints being faced by the smallholders, limiting the speed of agricultural diversification towards high-value food commodities. In the absence of appropriate integration of production, markets and consumption, it is not possible to exploit the market potential of these commodities in domestic and global trade. The strengthening of production-market-consumption integration is a way to promote the production of high-value food commodities, whose demand has been growing fast. For linking production, markets and processing in the high-value food sector, innovative institutions are emerging. These institutions are involving smallholders, and are reducing their transaction costs and minimizing (sometimes sharing) their production and marketing risks.

The agricultural diversification has contributed significantly to the agricultural growth. It must be viewed as an opportunity, particularly in the rainfed areas, which were rather by-passed during the 'green revolution' phase. This study has corroborated the earlier findings that agricultural diversification towards high-value food commodities could augmented income, generated employment opportunities, empowered women farmers and conserved natural resources. Promoting agricultural diversification towards high-value commodities, doing value-addition through their processing and creating appropriate markets for them can be used as effective measures to alleviate rural poverty, generate rural employment and conserve natural resources in the niche areas.

Policy Implications

The speed of agricultural diversification has not been found as fast as that of demand for high-value food commodities. The projections for 2025 are that demand for these commodities will grow at a much faster rate than for cereals and/or foodgrains under the existing and high-growth scenario (Kumar et al. 2003). As for example, under the assumption of the existing income growth scenario, the per capita demand will increase by 43 percent for vegetables and 45 percent for fruits. These figures are much higher under the assumed high-growth scenario. On the contrary, the per capita demand for foodgrains is projected to fall by about 2.5 percent. Considering the growth in population also, the increase in demand for various commodities under the existing income growth scenario is projected as follows: foodgrains, 28 percent; vegetables, 90 percent and fruits, 92 percent (Kumar et al. 2003). Besides, the rise in the consumption of high-value commodities will contribute significantly to agricultural GDP. To accelerate agricultural growth and meet the rising demand for these commodities under the land-constraint scenario, there is a need to design a comprehensive strategy comprising innovative technology, policy support, infrastructural development and appropriate institutional arrangements, including reforms in the financial sector.

Technology

The share of non-foodgrain commodities in the total value of agriculture has already crossed the fifty percent level, but it is not getting the required attention and resources. It needs to be corrected by reprioritizing R&D portfolio for agriculture. There is a strong case for allocating relatively higher research priorities to horticulture sector based on their rising demand and higher contribution to the agricultural growth in the country.

Improved technologies can be targeted for high-value food commodities to increase their productivity, minimize post-harvest losses, enhance shelf-life and improve commodity traits as per consumers' preferences (like shape, color, size, nutrition, etc.). The conventional research complemented with biotechnology is expected to pay high dividends from investments in R&D on high-value commodities. The research in these commodities has already shown its positive impact by evolving novel food commodities in non-traditional areas even in unconventional seasons. Higher resource allocations are required to promote agricultural diversification in the non-traditional areas and conduct R&D on their production, marketing and processing including their technical sustainability and economic viability.

Policy Support

Policy response to promote agricultural diversification towards high-value commodities has been lukewarm in the past. Some efforts have been initiated through establishment of institutions like Agricultural and Processed Food Products Export Development Agency (APEDA) and National Horticultural Development Board (NHDB), and providing a few incentives to the private sector for promoting agro-processing of high-value commodities. But, these have not been able to compensate the high priority accorded to foodgrain production *per se*. More specifically, rice and wheat receive

priorities in terms of assured procurement and higher minimum support prices. These two commodities share a large amount of subsidies allocated to fertilizers, irrigation and power supply. Huge incentives for the cultivation of these commodities and assured marketing mechanisms have constrained the promotion of high-value commodities. The analysis has clearly revealed that output prices have been the important source of agricultural growth during the reform period. Obviously, the price-led agricultural growth may not sustain in the long-run unless it is supported by the government, as is being done for rice and wheat. During the reform period, the prices of rice and wheat were raised consistently to protect the interests of farmers. On the other hand, it is the rising demand for fruits & vegetables, which has caused the increase in their prices. However, such a situation may not prevail in the event of globalization when demand-induced cheaper imports could control the market prices. Also, the price-led growth will benefit only those farmers who have large marketable surpluses. The smallholders with tiny marketable surpluses may be deprived of these benefits. Such a phenomenon may lead to agricultural growth but may widen the economic disparity and cause social discontentment in the country.

A new set of policy framework is needed to promote high-value commodities. Institutions like price support and assured procurement by the government may not be feasible for these commodities. A strong policy thrust is warranted to attract the private sector, promote agro-processing through special incentives and tax concessions, de-reserve important food commodities from the processing list of Small-Scale Industries, and strengthen financial and insurance management. The government needs to enhance resource allocations to marketing, storage and processing of high-value commodities. India seems to have constrained its own potential by restrictive laws towards the development of high-value chain in this segment of agriculture. Giving preference to cooperatives or public sector firms in the past has restricted the entry of big players of private sector into the field of food management and food processing. This has to be rectified to unleash a revolution in the areas of value-addition to food commodities.

The legal impediments restricting the entry of big private players to marketing, storage and processing facilities of agricultural commodities need to be modified. Several acts like Essential Commodities Act, Agricultural Produce Marketing Act, the Cold Storage Act, the Small-Scale Industry Reservation, etc., will have to be either abolished or modified with regard to agriculture. It was ironic to observe that it took 10 long years to de-license the dairy and sugar industries, and many others in agro-processing, including processing of groundnut and mustard oilseeds, reserved for Small-Scale Industries are still waiting.

Retail chain stores with FDIs have not been permitted as yet (as per the latest task force on FDIs) by the Government of India. The bureaucratic procedures are so cumbersome in the country that they discourage the entry of private sector and even mar the spirit of some positive policy directions. Large investments in the retail chain sector, processing and storage of agricultural commodities could be attracted, if legal environment is made transparent, friendly and attractive providing a level playing field to the private sector vis-à-vis cooperatives and public sector. These call for immediate corrective measures. The government should evolve a mechanism for a regular monitoring of the impact of changes in policies and institutions, particularly with regard to smallholders and underprivileged.

Infrastructural Development

Unlike cereals, the high-value food commodities require a different set of infrastructure. These being perishable in nature should reach the consumer or processed in a short period to minimize losses. In India, the existing infrastructure for agro-processing is inadequate but demand for the processed food has been increasing. Establishment of cold chains in large numbers, good road network, and a reliable and quality power supply are some of the pre-requisites for increasing production of high-value commodities and minimizing their post-harvest losses. Even the production of these commodities needs to be modernized to increase their productivity. Adoption of hi-tech agriculture and modernization of green houses require huge investments, and therefore the role of financial institutions is becoming important in meeting the changing needs.

Investments in the basic infrastructure, specially roads and power, where private sector is reluctant to enter, will have to be made more attractive. The government programs on highways and rural roads are laudable, but power sector reforms depict a painful story of failure. Major institutional and price reforms are required in the power sector to plug leakages, raise efficiency, and generate surpluses to plough back into investments. The participation of private sector in generation, transmission and distribution of power will have to be expedited. There is an urgent need to reform power sector to provide reliable, quality and cost-effective power supply to agriculture and rural areas. The cold storage chain, an important infrastructure for high-value food commodities, cannot be established without reforms in the power sector in rural areas. Investments in the infrastructure will have a multiplier effect in terms of income and employment generation and will be enormous in the primary, secondary and tertiary sectors.

Institutional Arrangements

A strong linkage amongst production, marketing and processing is a primary requirement for the promotion of high-value commodities. The markets for these food commodities are thin, fragmented and lack basic facilities. Appropriate institutional arrangements in the form of contract farming or cooperatives can integrate production with markets. Literature showed that innovative institutional arrangements can effectively link production and markets and improve the marketing efficiency (Birthal et al 2005). The innovative institutions are involving smallholders also in production and marketing of high-value commodities. A 'silent revolution' of innovative institutions is becoming visible and is sharing the benefits of emerging opportunities with the smallholders. Such arrangements augmented the income of smallholders and generated employment opportunities for them in the rural areas.

The other advantage of new institutional arrangements is in research and extension services. Many institutions provide free extension and support services to the producers, as a part of the contract. The public extension system has been under criticism for its inefficiency in delivery of services and as a rising burden on the public exchequer (Ahuja et al. 2000; Sulaiman and Sadamate 2000), and the government is looking out for alternative cost-effective models. Institutions such as contract farming and cooperatives can be considered such models to facilitate the process of privatization of

public extension services at no cost to the public exchequer. Similarly, many private firms have established their own R&D system to undertake agricultural research, which was limited so far. The aim is to achieve the desired attributes of raw materials and acquire competitive edge. These developments in agribusiness could improve the interface between private and public sector research, and is a welcome augury.

Many contracting firms arrange for credit and insurance (in terms of risk sharing) also for producers. In the poor economies where markets for high-value food products are underdeveloped and imperfect, such schemes have the potential to ease capital constraint on the public exchequer and provide protection against risks and uncertainties.

Reforms in Financial Sector

The role of financial institutions is critical in stepping-up investments in the key areas to promote high-value commodities and their processing. High-value food commodities need more working capital, and face higher risks in both production and marketing. Though some private sector banks are participating through innovative institutional arrangements in promoting these commodities (Hegde and Pradeep 2002), the overall credit scenario in Indian agriculture sector presents a grim picture. The commercial banks are saddled with excess liquidity while farmers have to rely on informal sources of finance for almost 45 percent of their requirements and that too at interest rates much higher (normally two to three times) than charged by the commercial banks. Schemes like 'Kisan Credit Cards' are welcome steps and could increase the credit flow to agriculture manifold by facilitating credit through processors, input dealers, etc. Such schemes will revolutionize the agricultural financing if the government provides due policy support.

To harness the emerging opportunities in the high-value food segment, it is essential to create a congenial environment by strengthening vertical coordination between farmers, processors and retailers (farm-firm-fork linkages). It is important to involve the smallholders in such a transformation of agricultural systems and protect their interest through policy changes and/or institutional arrangements. Though the smallholders are efficient producers, they need reduction in their transaction costs and minimization of risks for riding the wave of globalization and becoming competitive internationally. India has to graduate from producing low-value raw commodities to high-value and processed commodities by adding value and developing brand equity through participation of smallholders and contributions from the private sector.

References

- Ahuja, V., P.S. George, S. Ray, K.E. McConnell, M.G.P. Kurup, V. Gandhi, D. Umali Deininger and C. de Haan, 2000. *Agricultural services and the poor: case of livestock health and breeding services in India*. Ahmedabad, India: Indian Institute of Management; Washington, DC, USA: The World Bank; and Bern, Switzerland: Swiss Agency for Development and Cooperation.
- Barghouti, S., S. Kane and K. Sorby. 2003. Poverty and agricultural diversification in developing countries. Washington, DC, USA: The World Bank (Memio).
- Birthal, P.S., P.K. Joshi and A. Gulati. 2005. Vertical coordination and high-value commodities: implications for smallholders. MTID. International Food Policy Research Institute, Washington, DC. (memio)
- Chengappa, P.G., L. Achoth, A. Mukherjee, B. M. Ramachandra Reddy and P. C. Ravi, 2003. Evolution of food retail chains in India. Paper presented in a joint FICCI-ICRISAT-IFPRI International Workshop on *Agricultural Diversification and Vertical Integration in South Asia*, 5-6 November 2003, held in 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* (eds. G.H. Peters and Joachim Von Braun). Proceedings of twenty-third International Conference of Agricultural Economists. Brookfield, Vermont, USA: Ashgate Publishing Company.
- Dorjee, K., S. Broca, and P. Pingali. 2002. Diversification in South Asian agriculture: trends and constraints. In International Workshop in *Agricultural Diversification in South Asia*, MoB-NCAP-IFPRI, Paro.
- Government of India. 2001. Report of the Special Group on *Targeting ten million employment opportunities per Year*. Planning Commission, New Delhi.
- Government of India. 2003. *Indian economic survey: 2002-2003*. New Delhi: Akalank Publications.
- Gulati, Ashok and Tim Kelly. 1999. *Trade liberalization and Indian agriculture*. New Delhi, India: Oxford University Press.
- Hegde, B., and R. Pradeep. 2002. End-to-end integration in agriculture sector: a banking perspective. Paper presented in an International workshop on *Agricultural Diversification in South Asia*, jointly organized by MoA, Bhutan, NCAP and IFPRI, Paro, Bhutan, 21-23 November 2002.
- 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): 829-832.
- Joshi, P.K., M. Asokan, K.K. Datta and P. Kumar. 2000. Socio-economic constraints to legumes production in rice-wheat cropping systems in India, pp. 176-184. In *Legumes in rice and wheat cropping systems of the Indo-Gangetic Plain* (eds. Johansen, C., J.M. Duxbury, S.M. Virmani, C.L.L. Gowda, S. Pande, and P.K. Joshi). Patancheru, India: International Crops Research Institute for the Semi-Arid Tropics, and Ithica, New York, USA: Cornell University.
- Joshi, P.K., A. Gulati, P.S. Birthal, and L. Tewari, 2004. Agricultural Diversification in South Asia: Patterns, Determinants and Policy Implications. *Economic and Political Weekly* 39(24) June 12-18, pp. 2457-2468.
- Joshi, P.K., A. Gulati, P.S. Birthal and P. Parthasarthy Rao. 2005. Agricultural diversification and vertical integration in India: will smallholders participate? MTID. International Food Policy Research Institute, Washington, DC. (Memio).
- Kumar, P., P.K. Joshi, C. Johansen and M. Asokan. 1998. Sustainability of rice-wheat based cropping systems in India. *Economic and Political Weekly* Sep.26: A-152-157.

- Kumar, P. and Mruthyunjaya. 2002. Long term changes in food basket in India. Paper presented in an International workshop on *Agricultural Diversification in South Asia*, jointly organized by MoA, Bhutan, NCAP and IFPRI, Paro, Bhutan, 21-23 November 2002.
- Kumar, P., Mruthyunjaya and P.S. Birthal. 2003. Changing consumption pattern in South Asia. Paper presented in the International Workshop on *Agricultural diversification and vertical integration in South Asia* organized by FICCI-ICRISAT-IFPRI on 5-6 November 2003 in New Delhi.
- Minot, N., 2003. Income Diversification and poverty reduction in the northern uplands of Vietnam. Paper presented at the *Annual Meeting of the American Agricultural Economics Association*, Montreal, Canada, 27-30 July.
- Pingali, P.L. 2004. Agricultural diversification: opportunities and constraints. *FAO Rice Conference*. Rome, Italy: Food and Agricultural Organization of United Nations. 12-13 February 2004.
- Pingali, P.L. and M.W. Rosegrant. 1995. Agricultural commercialization and diversification: processes and policies. *Food Policy* 20(3): 171-186.
- Ramesh Chand. 1996. Diversification through high-value crops in western Himalayan Region: Evidence from Himachal Pradesh. *Indian Journal of Agricultural Economics* 41(4): 652-663.
- Ryan, J.G. and D.C. Spencer. 2001. Future challenges and opportunities for agricultural R&D in the Semi-Arid Tropics. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.
- Subramanian, S.R., S. Varadarajan and M. Asokan. 2000. India. In *Dynamics of vegetable production and consumption in Asia*, ed Mubarak Ali. Taiwan: Asian Vegetable Research and Development Center.
- Sulaiman, Rasheed V. and V.V. Sadamate. 2000. *Privatizing agricultural extension in India*. Policy paper 10. New Delhi, India: National Centre for Agricultural Economics and Policy Research.
- Tewari, L., K. Elumalai, Pratap S. Birthal and P.K. Joshi. 2001. Implications of globalization on small farm holders: a SWOT analysis. In the *Annual Conference of the Agricultural Economics Research Association*, 21-22 November at the Indian Agricultural Research Institute, New Delhi.
- von Braun, Joachim, 1995. Agricultural commercialization: impacts on income and nutrition and implications for policy. *Food Policy* 20(3): 187-202.
- Vyas, V.S. 1996. Diversification in agriculture: concept, rationale and approaches. *Indian Journal of Agricultural Economics* 51(4)