AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

MSSD DISCUSSION PAPER NO. 57

AGRICULTURE DIVERSIFICATION IN SOUTH ASIA: PATTERNS, DETERMINANTS, AND POLICY IMPLICATIONS

P.K. Joshi, Ashok Gulati, Pratap S. Birthal, and Laxmi Tewari

Markets and Structural Studies Division

International Food Policy Research Institute
2033 K Street, N.W.
Washington, D.C. 20006 U.S.A.
http://www. ifpri.org

February 2003

MSSD Discussion Papers contain preliminary material and research results, and are circulated prior to a full peer review in order to stimulate discussion and critical comment. It is expected that most Discussion Papers will eventually be published in some other form, and that their content may also be revised. This paper is available at http://www.cgiar.org/ifpri/divs/mssd/dp.htm

TABLE OF CONTENTS

I. INTRODUCTION 1

II. MAPPING PATTERNS OF DIVERSIFICATION 3
Measuring Diversification 4
Determinants Of Diversification 5
Data 7

III. PATTERNS OF AGRICULTURAL DIVERSIFICATION IN SOUTH ASIA 9

IV. PATTERNS OF AGRICULTURAL DIVERSIFICATION IN INDIA 14
Diversification Within The Crop Sub-Sector 17
Diversification within the livestock sub-sector 21
Diversification within the fisheries sub-sector 25

V. DETERMINANTS OF DIVERSIFICATION 28
Determinants Of Diversification In Livestock Sub-Sector 32

VI. IMPLICATIONS OF DIVERSIFICATION 35
Food Security 35
Employment 38
Export 39

VII. CONCLUSIONS AND POLICY IMPLICATIONS 41

REFERENCES 44

LIST OF TABLES

Table 1 —Extent of diversification and its sources in South Asian countries..... 10

Table 2 —Annual compound growth rates (%) of area, production and yield of 11

Table 3 —Growth performance of livestock activities and fish in South Asia 12

Table 4 —Share of individual sectors (%) in gross value of agricultural output in India at 1980-81 prices 15

Table 5 —Share of food and non-food crops in cropping pattern and value of output in India at constant prices 18

Table 6 —Share of individual commodities (%) in gross value of livestock sub-sector in India at 1980-81 prices 23

Table 7 —Temporal changes in fish production (000 tons) and diversity in India 26

Table 8 —Determinants of diversification in favour of horticultural commodities: Double-log estimates of Generalized Least Square. 29

Table 9 —Determinants of diversification in favour of livestock sub-sector: Double-log estimates of Generalized Least Square..... 34

Table 10—Per capita consumption pattern of food items (kgs/person/annum) 37

Table 11—Average labour use in vegetables, cereal and non-cereal crops 38

ANNEXURE TABLE

Annexure 1—Specification of variables and their expected signs for diversification..... 8

ABSTRACT

The South Asian countries are gradually diversifying with some inter-country variation in favor of high value commodities, namely fruits, vegetables, livestock and fisheries. Agricultural diversification is strongly influenced by price policy, infrastructure development (especially markets and roads), urbanization and technological improvements. Rainfed areas have benefited more as a result of agricultural diversification in favor of high value crops by substituting inferior coarse cereals. Agricultural diversification is also contributing to employment opportunities in agriculture and increasing exports. The need is to suitably integrate production and marketing of high value commodities through appropriate institutions. Market reforms in developing and strengthening desired institutions through required legal changes would go a long way in boosting agricultural growth, augmenting income of small farm holders and promoting exports.

AGRICULTURE DIVERSIFICATION IN SOUTH ASIA: PATTERNS, DETERMINANTS, AND POLICY IMPLICATIONS[1]

P.K. Joshi[*], Ashok Gulati[2], Pratap S Birthal* and Laxmi Tewari*

I. INTRODUCTION

Most of the South Asian economies have been undergoing a process of economic reforms since the late 1980s. They are gradually adopting trade liberalisation as a policy plank. The unfolding globalisation of agriculture, however, has thrown new challenges and opportunities to the agrarian sector in these countries. While there are apprehensions on the one hand, that the influx of subsidised cheap imports from the developed countries would adversely affect their agriculture, on the other hand, there is evidence that these countries are able to raise their agricultural export, especially of high value and labor intensive commodities. This seems to open up a window of opportunities when South Asian agriculture is experiencing shrinking size of its holdings, decelerating technological advances in staple crops, declining investment in agriculture and increasing degradation of natural resources.

Diversification of agriculture in favour of more competitive and high-value commodities is reckoned an important strategy to overcome many of these emerging

[1] The authors are grateful to Nicholas Minot for his very constructive and detailed comments on an earlier draft of this paper. The authors also benefited from C.H. Hanumantha Rao, V.S. Vyas, G.S. Bhalla, Shaukat Ali, Eugenio Diaz-Bonilla, Ruth Meinzen-Dick and R.C.A. Jain for their valuable comments on this paper during the discussion in the ICRIER-ICAR-IFPRI Conference on 'Economic Reforms and Food Security: The Role of Trade and Technology', 24-25 April 2002, New Delhi.
[*] National Center for Agricultural Economics and Policy Research, New Delhi, India.
[2] Director, Markets and Structural Studies Division, International Food Policy Research Institute, 2033 K Street NW Washington D.C. 20006 USA.

challenges. If carried out appropriately, diversification can be used as a tool to augment farm income, generate employment, alleviate poverty and conserve precious soil and water resources. Several micro-level studies support the above proposition (von Braun 1995, Pingali and Rosegrant 1995, Ramesh Chand 1996, Ryan and Spencer 2001).

A sound understanding about the patterns of agricultural diversification and the constraints it faces would help in crafting appropriate policies regarding institutional arrangements and creation of adequate infrastructure, which could benefit a large mass of small and marginal holders. This study is an attempt in this direction. Specifically the study intends to (i) examine the extent, nature and speed of agricultural diversification in South Asian countries, (ii) identify determinants of agricultural diversification, and (iii) assess implications of agricultural diversification on food security, employment and sustainable use of natural resources.

The study is confined at two levels: (i) macro-level, and (ii) meso-level. At macro-level, all seven countries namely, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, have been studied in terms of diversification of agriculture. At meso-level, more disaggregated analysis across different regions in India has been attempted.

II. MAPPING PATTERNS OF DIVERSIFICATION

The concept of diversification conveys different meaning to different people at different levels. For example, at the national level, it generally conveys a movement of resources, especially labour, out of agriculture to industry and services, a sort of structural transformation. Within agriculture, however, diversification is considered a shift of resources from one crop (or livestock) to a larger mix of crops and livestock, keeping in view the varying nature of risks and expected returns from each crop/livestock activity, and adjusting it in such a way that it leads to optimum portfolio of income.

This definition of diversification needs to be distinguished from movement of resources from low value commodity mix (crops and livestock) to a high value commodity mix (crops and livestock), as it may often be reflected in an increasing degree of specialization (reducing diversity) to high value activities, especially at the farm level. And it is precisely this movement to high value agriculture, which is of great interest to us in this paper because it indicates yet another way to augment income, besides the traditional ways of increasing yield, area or cropping intensity.

Thus, based on these various definitions, the nature of diversification can be broadly described as (i) a shift of resources from farm to non-farm activities, (ii) use of resources in a larger mix of diverse and complementary activities within agriculture and (iii) a movement of resources from low value agriculture (crops and livestock) to high value agriculture (Hayami and Otsuka 1992;Vyas, 1996; Delgado and Siamwalla 1999).

MEASURING DIVERSIFICATION

There are quite a few methods, which explain either concentration (i.e. specialization) or diversification of commodities or activities in a given time and space by a single indicator. Important ones include: (i) Index of maximum proportion, (ii) Herfindal Index, (iii) Simpson Index, (iv) Ogive Index, (v) Entropy Index, (vi) Modified Entropy Index, and (vii) Composite Entropy Index (Kelley, Ryan and Patel 1995; Pandey and Sharma 1996; Ramesh Chand 1996). Each method has some limitation and/or superiority over the other. Considering our objective of assessing the extent of diversity in crop, livestock and fisheries activities, we used Simpson Index. The index provides a clear dispersion of commodities in a geographical region. The index ranges between 0 and 1. If there exists complete specialization, the index moves towards 0. The index is easy to compute and interpret, as follows:

$$SID = 1 - \sum_{i=1}^{n} P_i^2$$

Where, SID is the Simpson Index of Diversity, and P_i is the proportionate area (or value) of ith crop/livestock/fishery activity in the gross cropped area (or total value) of output.

The nature and patterns of diversification were examined by looking into temporal changes in area, production and value of different crops, and quantity (and/or value) of livestock and fisheries activities. To estimate the speed of diversification in favour of high-value commodities, annual compound growth rates of area, production and yield of different crop/livestock activities were computed.

For South Asian countries, the SID was computed for crop sector only, while the livestock sector was assessed separately to examine its performance in different countries. The diversity was probed within the crop sector, dividing it into broad sub-sectors like cereals, pulses, oilseeds, fruits, vegetables, spices and other crops. For India, the SID was computed for entire agricultural sector comprising crop, livestock and fishery sub-sectors, as well as within each sub-sector.

Determinants of 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 hypothesized to influence the diversification include per capita income and urbanization. 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 labor), and socio-economic variables (pressure on land and literacy rate).

Generalized Least Square (GLS) technique with fixed-effect model was applied to examine how different forces have influenced crop and livestock diversification in India. The analysis is based on pooling of cross section and time series

information from major states (19 out of 28[3]) in India for the period 1980-81 to 1998-99. The GLS 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 or D_l = f (TECH, INFR, PROF, KNOW, DEMA, RAIN)

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

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 effect, few proxy variables were used in the model. For technology (TECH), these included: proportionate area under high yielding varieties of food grain crops (%), fertilizer use (kg per ha), proportion of gross irrigated area to gross cultivated area (%), mechanization (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 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

[3] 19 states in the country are major ones. Remaining 9 states are small with respect to geographical area, production and population.

profitability (PROF) related variables. Average size of land holding (ha) and proportion of small landholder in total holdings were used proxy for available resources, and rural literacy (%) for information (KNOW) related variables. On demand side (DEMA) variables, urbanization (% 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 variable in the model. The specification of variables and their expected signs are given in Annexure 1.

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.

DATA

The study covers a period of two decades from 1980-81 to 1999-2000. These two decades were divided into two periods: (i) 1980-81 to 1989-90, and (ii) 1990-91 to 1999-2000. There were two obvious reasons for studying the past two decades. First, the historical evidence showed that the impact of 'green revolution' in South Asian countries was gradually fading during the 1980s. Second, the process of economic reforms started in most of the South Asian countries in the late 1980s or early 1990s, and also most of them bound themselves to the commitments under the WTO, which is likely to have serious implications for their respective agricultural sectors. The hypothesis is that slowing down of green revolution and gradual opening up of the economy will lead to greater diversification of agriculture in favor of high value commodities.

The data for the study was collected from various published sources. For South Asian countries, the most important data source for crop and livestock was the FAO statistical database (FAOSTAT). This was complemented by the country specific statistical yearbooks. For India, the study covered more disaggregated analysis by including the states, therefore, relied heavily on the national statistical bulletins (CMIE 2001).

Annexure 1—Specification of variables and their expected signs for diversification.

Drivers	**Indicator**	**Unit**	**Expected sign**
Technology	Area under HYV of foodgrains	Food grain HYV area to total food grain area (%)	-
	Fertilizer use	Kg/ha	-
	Irrigated area	Proportionate irrigated are to the gross cropped area (%)	-
	Mechanization	No of tractors 1000/ha	-
Infrastructure	Market density	No. of markets/1000 ha of gross cropped area	+
	Road length	Square km/1000 ha of gross cropped area	+
Profit	Relative profitability	Profit from fruits and vegetables in relation to cereals, pulses, oilseeds, sugarcane	+
Resources & Information	Holding size	Proportion of small holders in total holdings (%)	+/-
	Literacy	Percent literate population in rural areas	+
Demand side	Urbanization	Urban population in percent	+
	Per capita income	Rs./person	+
Climate	Rainfall	`millimeter	-
Period	Dummy	1981-90= 0; 1991-99=1	+

In case of livestock, proportion of crossbred cattle of total cattle (%) was used as a proxy for technological advancement, with an expected negative sign for diversification.

III. PATTERNS OF AGRICULTURAL DIVERSIFICATION IN SOUTH ASIA

Agriculture is the mainstay of economic growth in South Asia. A large proportion of population depends on agriculture for income, employment and food security. Agricultural performance in South Asia is improving over time. The annual compound growth rate of agriculture was 3.7% during 1990s as against 3.2% in 1980s. Besides continuing role of high-yielding rice and wheat varieties in South Asian countries, the agricultural growth is attributed to diversification in favor of high-value commodities. South Asia is diverse in climate, soils and other agro-ecological features. Diversity permits South Asian farmers to cultivate variety of crops, rear different species of livestock and catch wide range of fish species from various sources. The Simpson Index of Diversity (SID) for South Asia was 0.64 in triennium ending (TE) 1999-2000, up from 0.59 in TE 1981-82. This shows that South Asia is gradually diversifying its crop sector in favor of high value commodities, especially fruits, vegetables (Tables 1 and 2). Among countries, Bangladesh, Bhutan and Nepal show less diversity as compared to other countries. Bangladesh has specialized in rice. More than three-fourths of the area in the country is under rice. But the remaining one-fourth area is highly diversified, which was a result of some policy initiatives taken-up in different plan periods. Nepal and Bhutan are aiming to have higher degree of self-sufficiency in basic food grain than what it is today, and therefore, concentrating more towards cereals, particularly rice, wheat and maize.

There are two sources of crop diversification. These are (i) area augmentation, and (ii) crop substitution. Area augmentation comes through utilization of fallow lands and rehabilitation of degraded lands, or increasing cropping intensity[4]. Table 1 shows that in most of the countries, crop diversification is coming from area expansion, with some exception of crop substitution in India and Sri Lanka. Incidentally, in Nepal, Pakistan and Sri Lanka, area expansion is also coming from deforestation, which is a cause of concern from environmental point of view.

Table 1—Extent of diversification and its sources in South Asian countries

Country	Simpson Index of Diversity in triennium ending			Sources of diversification (%)*	
	1981-82	1991-92	1999-2000	Cropping intensity	Crop substitution
				1991-92 to 1999-01	
Bangladesh	0.39	0.36	0.35	64.67	35.33
Bhutan	0.37	0.48	0.44	97.82	2.18
India	0.61	0.65	0.66	36.63	63.37
Maldives	0.77	0.77	0.77	83.22	16.78
Nepal	0.39	0.40	0.41	84.79	15.21
Pakistan	0.54	0.56	0.57	76.56	23.44
Sri Lanka	0.76	0.77	0.75	78.90	21.10
South Asia	0.59	0.63	0.64	42.98	57.02

Source: Computed by authors from the data derived from FAOSTAT.

* The columns were computed as follows: Gains in Cropped Area (A) = Change in Gross Cropped Area (B) + Crop Substitution (C). Since (A) and (B) are known, (C) is the residual.

[4] It was computed as follows: Gains in Cropped Area (A) = Change in Gross Cropped Area (B) + Crop Substitution (C). Since (A) and (B) are known, (C) is the residual.

To examine the nature and speed of agricultural diversification, production performance and area expansion of different commodities was assessed. Annual compound growth rates in area, production and yield of major commodity groups in South Asia during the decades of 1980s and 1990s are given in Table 2. Production performance of non-food commodities was superior to the food commodities. Among food grain group, cereals performed better than pulses. Cereal sector was specializing in favor of rice and wheat. It was because of overriding concern for food self-sufficiency in all the South Asian countries. Availability of improved and high yielding rice and wheat varieties induced specialization in favor of these crops. These replaced sorghum, millets and barley. Performance of pulses was disappointing during 1990s.

Table 2—Annual compound growth rates (%) of area, production and yield of major commodity groups in South Asian countries

Commodity group	1980-90			1991-2000		
	Area	Production	Yield	Area	Production	Yield
Cereals	-0.01	3.08	3.09	0.34	2.45	2.11
Pulses	0.04	2.37	2.33	-0.02	0.72	0.74
Oilseeds	1.72	5.46	3.68	0.95	2.05	1.09
Vegetables	1.41	3.33	1.89	2.44	2.59	0.14
Fruits	1.71	2.61	0.89	2.40	5.61	3.14
Dry fruits	1.98	3.56	1.55	3.62	4.30	0.66
Spices	1.46	4.27	2.77	0.68	2.47	1.78

These were relegated to marginal environments. With the availability of irrigation and improved varieties of rice and wheat, a large share of pulses area was shifting in favor of rice and wheat. There are some exceptions as well. For example, lentil and pigeonpea are coming-up in a big way in Nepal. Black gram and green gram and to some extent chickpea are emerging in Indian rainfed regions. In Pakistan, chickpea is gaining importance.

Different countries grow a large number of vegetable and fruit crops. Fruits (both fresh an4d dry) and vegetables have shown good performance during 1980s and 1990s. Fruits and vegetables are highly diversified in all the countries. Livestock and fisheries sectors also flourished during the last two decades (Table 3).

Table 3—Growth performance of livestock activities and fish in South Asia

Commodity group	**Annual compound growth rates (% per annum)**					
	1981-90			**1991-2000**		
	Number	**Production**	**Yield**	**Number**	**Production**	**Yield**
Milk						
Cow	2.33	4.86	2.53	2.10	5.50	3.40
Buffalo	4.11	4.84	0.73	2.53	5.10	2.57
Total	--	4.93	--	--	5.17	--
Poultry						
Chickens	9.26	10.51	1.25	5.72	5.66	-0.06
Eggs	4.43	7.19	2.76	4.76	4.49	-0.27
Total Meat	--	4.30	--	--	2.12	--
Fish	--	5.20	--	--	3.50	--

The evidence shows that agriculture is gradually diversifying in the sub-continent with some inter-country variation. Diversification was observed in favor of high value commodities. Since their share in area and production was too low in comparison to food grain crops, the extent of diversification was unnoticed. It came despite little policy initiatives and poor infrastructure in the sub-continent, therefore, its pace slowed down. It is reflected from the performance of different commodity groups, which was better during 1980s than 1990s. During 1980s, growth in production was mainly attributed to yield increase, while area expansion was the major source during 1990s. Slowing down in yield levels is ascribed to (i) technological slack, (ii) weak input delivery system, and (iii) poor infrastructure. To accelerate the pace of diversification and harness its potential benefits, there is a need to introduce appropriate technologies and create suitable institutions and infrastructure. Domestic market reform to support agricultural diversification is necessary. This calls for correcting several outdated market acts, which impede the pace of agricultural diversification in favor of high value enterprises. For example in India, the existing Agricultural Produce Market Committee (APMC) empowers the State Governments to set-up markets for agricultural development of efficient and transparent agri-marketing, the use of modern pre- and post-harvest techniques, setting-up quality standards and their enforcement. It discouraged private sector participation in developing markets and led to inefficiencies in marketing. Similarly, many processing units/products are still reserved for small-scale and cottage industry.

IV. PATTERNS OF AGRICULTURAL DIVERSIFICATION IN INDIA

Agricultural diversification in India is gradually picking momentum in favour of high value crops/livestock/fishery activities to augment incomes rather than a coping strategy to manage risk and uncertainty. However, the nature of diversification differs across regions due to wide heterogeneity in agro-climatic and socio-economic conditions. Therefore, it would be interesting to delineate the key regions and sub-sectors of agriculture where diversification is catching up fast. This section is an attempt to unfold these features and diagnose the regional patterns of agricultural diversification in India.

Crop, livestock, fisheries and forestry constitute the core sub-sectors of agriculture. Crop sub-sector is the principal source of generating income in agriculture followed by livestock sector (Table 4). There exists strong synergy in crop and livestock sub-sectors, both being complementary to each other. Fisheries sub-sector is prominent in the coastal areas, and forestry in the hilly regions.

The share of crop sector in the agricultural gross domestic product marginally declined during 1980s (from about 76.25% in TE 1981-82 to 73.65% in TE 1990-91) and then recovered slowly during 1990s (rising to 74.91% in TE 1997-98). There are two obvious reasons: (i) normal monsoon during most of the years in 1990s, and (ii) greater emphasis on horticultural crops, which led to their higher production. On the other hand, there was a quantum jump in the share of livestock sub-sector during 1980s, which escalated from about 18% in TE 1981-82 to 23% in TE 1990-91.

Table 4—Share of individual sectors (%) in gross value of agricultural output in India at 1980-81 prices

Region	Crop			Livestock			Forestry			Fishing		
	1981-82	1990-91	1997-98	1981-82	1990-91	1997-98	1981-82	1990-91	1997-98	1981-82	1990-91	1997-98
Eastern	73.90	70.65	75.84	16.83	24.44	21.36	6.65	2.35	0.89	2.62	2.56	1.92
North East	77.48	75.95	78.96	13.74	18.44	18.26	5.68	3.08	1.19	3.10	2.54	1.60
Northern	75.73	73.98	72.87	21.62	24.94	26.45	2.44	0.75	0.41	0.21	0.33	0.27
Southern	80.06	78.46	77.38	15.64	19.10	21.19	2.29	1.28	0.56	2.01	1.16	0.88
Western	75.71	71.65	73.01	18.95	23.79	24.53	4.08	3.40	1.60	1.25	1.16	0.86
All India	76.25	73.65	74.91	18.27	23.09	23.24	3.95	1.91	0.85	1.53	1.35	1.00

Later, though the value of livestock (at constant prices) during 1990s has nearly doubled, its share in agriculture remained stagnant at 23%. It was because the value of bigger crop sub-sector increased relatively higher than that of livestock sub-sector; hence masked the latter's performance. The same was true for fisheries sub-sector. The value of fisheries sub-sector has swelled by about 50% during 1990s, but its share in agricultural gross domestic product has marginally reduced to about 1% in TE 1997-98 from 1.35% in TE 1990-91. This is despite the fact that fisheries production during the decade of 1990s increased at an annual rate of 5.35%.

Regionally, the patterns, by and large, reveal shifts from crop to livestock sub-sector during 1980s and 1990s. The exceptions were eastern and northeastern regions, where the shares of both crop and livestock sub-sectors in total value of agricultural output were rising at the cost of fisheries and forestry. In the southern region also, the share of fisheries and forestry in total output during 1980s and 1990s was diminishing. The livestock sub-sector across different regions has grown as a result of growing demand for livestock products, like milk, meat, eggs, etc. The 'cooperative model' linking growers, processors and retail distribution seems to have attained a reasonable degree of success contributing to increased livestock production.

DIVERSIFICATION WITHIN THE CROP SUB-SECTOR

The crop sector is steadily diversifying in India. The SID slowly moved-up from 0.63 in TE 1981-82 to 0.66 in TE 1998-99 (Table 5). The trends showed that the non-food grain crops have gradually replaced food grain crops, with the latter going up from about 30% of area in TE 1981-82 to 35% in TE 1998-99, but in value terms it went up significantly from about 52% to 60% in respective periods. Non-food grain crops, like oilseeds, fruits, vegetables, spices and sugarcane have mainly substituted coarse cereals while in search for higher incomes.

Regional patterns in diversification of the crop sector were quite stark (Table 5). The southern region was highly diversified followed by western region. The process of diversification was modest in these regions during the decades of 1980s and 1990s. It may be mentioned that these were the only regions, which accomplished higher agricultural growth during 1990s over the preceding decade. These regions swiftly moved towards more non-cereal crops, which perhaps contributed to accelerating agricultural growth. These are relatively less developed in irrigation and largely rely on rainfall. Pulses and oilseeds are low water requirement crops, therefore find niche in these regions. Like pulses and oilseeds, these regions also witnessed substantial increase in area under fruits and vegetables. Government supported programs promoted the cultivation of fruits and vegetables. Among others, watershed program facilitated conservation of rainwater and gave higher priority for cultivation of fruits and vegetables. Among cereals, maize is picking up fast in southern region and to some extent in western region.

Table 5—Share of food and non-food crops in cropping pattern and value of output in India at constant prices

Region	Simpson Index of crop diversity		Share of food and non-food crops (%)							
	TE 1981-82	TE 1998-99	TE 1981-82				TE 1998-99			
			Food crops		Non-food crops		Food crops		Non-food crops	
			Area	Value	Area	Value	Area	Value	Area	Value
Eastern	0.50	0.53	81.63	51.73	18.37	48.27	73.83	43.04	26.17	56.96
North East	0.43	0.46	70.11	44.43	29.89	55.77	65.06	35.80	34.94	64.2
Northern	0.53	0.51	77.42	54.92	22.58	45.08	76.86	53.74	23.14	46.26
Southern	0.68	0.75	62.86	41.82	37.14	58.18	53.08	28.20	46.92	71.80
Western	0.66	0.72	71.92	44.44	28.08	55.56	61.85	36.10	38.15	63.90
All India	0.63	0.66	70.34	48.05	29.66	51.95	65.44	39.85	34.56	60.15

Maize is gaining importance to meet the growing demand for poultry feed in these regions. Among all the crops gaining in these regions, oilseeds are under serious threat in the wake of import liberalization of edible oils as the cost of imported oils, especially palmolean is much lower than the domestic price prevailing in the economy. To sustain oilseed production, technical efficiencies in their production and processing will have to be improved through better management and technology adoption.

The northern region was specializing more in favor of rice and wheat crops. 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 from the region. Over time, the region is concentrating more in cereals and only marginally diversifying in non-cereal commodities. With the availability of short duration black gram, green gram and pigeonpea, pulses are slowly regaining in this region. Other crops that are gaining importance in this region are sugarcane, vegetables and fruits. Ironically, there are reports that extensive cultivation of rice and sugarcane are causing negative externalities related to soil and water resources. The soil fertility with respect to macro- and micronutrients is declining with continuous cultivation of these crops. The water resource of the region is also depleting. The negative externalities have adversely affected the total factor productivity of rice-wheat based cropping system in this region (Kumar et al 1998). To sustain the food security, and further augment export of rice (both *basmati* and non-*basmati*), there is a need to improve the water use efficiency. The region has potential for

cultivating a variety of fruits and vegetables, but the future of these crops relies on developing appropriate infrastructure for suitably linking production and consumption.

The eastern region is the most backward region with respect to per capita income, growth in agriculture and development of infrastructure. The yield levels are comparatively low because of uncertain production environment and poor adoption of improved varieties and technologies. Overall, the region is food-based and the extent of diversification is relatively low as compared to other regions. This region is largely concentrating in rice. The humid and high rainfall makes cultivation of rice more favorable in this region. However, there is high diversity in non-rice area allocation. This region is an important vegetable growing area in the country with a share of about 44% in the total vegetable area in the country in TE 1998-99 (Government of India 2001). Cultivation of fruits is also gradually rising. This region has also emerged as oilseed producing region with crops like rapeseed-mustard, groundnut, sesame and soybean.

During the post-green revolution period, oilseeds, fruits and vegetables performed impressively in all the regions. While the success of oilseeds was largely under high tariff barriers on imports of edible oils, it was constitution of National Horticultural Board in 1984 that encouraged horticulture production by coordinating, production and processing of fruits and vegetables. Export of different fruits and vegetables also grew during the last decade as a result of emerging infrastructure facilities (cold storage and cargo handling) at international airports.

Diversification within the livestock sub-sector

Livestock sector is growing at a fast rate and therefore its share in total value of agricultural output is progressively rising in India (Birthal and Parthasarthy 2002; Birthal et al 2002). But the SID within the livestock sub-sector is modest (0.508), and also slowly decreasing. The modest SID is mainly due to a large share of milk in total value of livestock products (around 68% during the past two decades: Table 6). Remaining share of livestock products (32%) is distributed to several items like meat, poultry, wool, etc. Milk production more than doubled, from 33 to 71 million tons over the period TE 1981-82 to TE 1998-99, with an annual compound growth rate of about 4.62% during the last two decades. The growth of milk production was much higher (5.23%) during 1980s than 1990s (3.46%).

Meat and poultry sub-sectors have also registered good performance, increasing from a low of 0.80 million tons in TE 1982-83 to 2.73 million tons in TE 1991-92 and finally to 4.41 million tons in TE 1998-99, giving an annual compound growth rate of about 5.81% during the 1980s vis-à-vis just 3.90% during the 1990s. The high increase in meat production during 1980s was partly contributed by the severe drought in 1987 (often claimed to be the severest of the century) 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 higher growth of livestock sector during the 1980s. The share of poultry and goat meat in total value of meat production went up from 66% in TE 1982-83 to 77% TE 1998-99. Similarly, egg production also increased by 8.46% annually during 1980s as against

4.60% annually during 1990s. It is interesting to observe that, unlike dairy, the poultry sector grew at the instance of private organized sector, which controls roughly 80% of total poultry production in the country.

Regional patterns are dissimilar due to agro-climatic variability, food habits and status of economic development (Table 6). Diversification of livestock activities was least in the northern region and highest in eastern and northeastern regions of the country. In northern region, there is more specialization of livestock sub-sector primarily in dairy, with some emergence of poultry lately. Share of milk in total value of livestock was as high as 80% in TE 1998-99 in the northern region. The western region is also concentrating in favour of milk production. The state of Gujarat, located in the western region, witnessed the evolution of dairy cooperatives and led a revolution often called the 'white revolution'.

Southern region is showing relatively higher diversity in livestock sector as compared to northern and western regions. Milk and poultry together contributed about 81% in the total value of livestock in southern region in TE 1998-99. After milk, poultry has emerged as an important activity in the southern region.

Table 6—Share of individual commodities (%) in gross value of livestock sub-sector in India at 1980-81 prices

Region	Milk			Meat			Poultry			Miscellaneous		
	TE 1982-83	TE 1991-92	TE 1998-99	TE 1982-83	TE 1991-92	TE 1998-99	TE 1982-83	TE 1991-92	TE 1998-99	TE 1982-83	TE 1991-92	TE 1998-99
Eastern	54.63	53.65	47.14	11.96	20.24	22.08	11.91	11.38	11.19	21.50	14.74	19.59
North East	53.81	55.84	56.83	15.63	16.61	17.58	18.92	18.21	17.05	11.65	9.33	8.54
Northern	76.32	77.87	79.87	2.67	4.54	5.06	2.93	5.13	5.46	18.07	12.46	9.62
Southern	63.75	64.64	64.72	9.91	7.47	7.20	14.94	16.26	16.58	11.40	11.64	11.50
Western	69.16	73.81	74.13	5.61	3.30	3.85	6.27	6.20	7.31	18.96	16.68	14.71
All India	68.09	69.22	68.96	6.57	7.92	8.39	7.85	8.97	9.58	17.48	13.88	13.07

Note: Meat includes cattle meat, buffalo meat, sheep meat, goat meat, and pig meat.
Poultry includes poultry meat and eggs

Eastern and northeastern regions showed a highly diversified livestock sector. It is distributed between milk, meat and poultry. With few exceptions, the share of milk production is decreasing and that of meat and poultry increasing.

Livestock production brought out revolutionary changes in the country during 1980s and these continued during 1990s, though at a slower pace. In the dairy sector, the breakthrough is ascribed to the implementation of the 'Operation Flood Program' through The National Dairy Development Board (NDDB), which developed cooperative model for procuring and marketing of milk and milk products. The program established about 170 cooperative milk unions, operated in over 285 districts and covered nearly 96 thousand village level societies in different states by making nearly 10.7 million farmers their members until 1999-2000 (NDDB 2002). Realizing the success of the program, an Integrated Dairy Development Program was launched in the non-Operation Flood, hilly and backward areas in 1992-93 to enhance production, procurement and marketing of milk, and to generate employment opportunities in those areas.

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.

Strengthening the livestock sector would benefit the small farm holders in rural areas. Incidentally, the small farm holders in rural and peril-urban areas largely control the livestock sector. This sector can significantly contribute to enhancing farm income,

offering employment opportunities in rural areas and meeting the food and nutritional needs of small farm holders.

Diversification within the fisheries sub-sector

Fisheries sub-sector has also diversified over the years. The SID of fisheries sector has shown marginal improvement to 0.49 in TE 1999-2000 from 0.47 in TE 1981-82 (Table 7). It is 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% in 1960-61. Recognizing 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% in TE 1999-2000, while that of inland fisheries has risen to about 46% in TE 1999-2000 from less than 25% in 1960-61. The annual compound growth rate of inland fisheries was higher (6.54%) during 1990s than 1980s (5.27%). The marine fish production, which performed poorly during 1980s (0.12%) improved during 1990s (2.53%) due to greater impetus accorded to the fisheries sector. The inland fish potential is still higher with a well spread location of rivers, canals and reservoir.

The higher growth in inland fisheries was mainly attributed to overwhelming progress in aquaculture, both in fresh and brackish water. The share of culture fisheries in inland sector has went-up from about 43% in 1984-85 to high level of about 84% 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 good scope to expand production of culture and other products in the brackish water areas. Only 10% of the available brackish water area (12 million ha) 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.

Table 7—Temporal changes in fish production (000 tons) and diversity in India

Period	Marine fish	Inland fish	Total	Simpson Index of diversity
TE 1981-82	15 (62.50)	9 (37.50)	24	0.47
TE 1991-92	21 (60.00)	14 (40.00)	35	0.48
TE 1999-2000	29 (53.70)	25 (46.30)	54	0.49

* Figures in brackets are the percentage share in total fish production
Source: Kumar, et al (2001).

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. The outlay in the fisheries sector was raised from around 2-3% of total agricultural outlay during 1970s to over 5.5% during 1980s and 1990s. Several production and development-oriented programs were launched in the potential areas. These programs were implemented in both marine and inland areas as Development of Freshwater Aquaculture, Integrated Coastal Aquaculture and Development of Coastal Marine Fisheries. Under these programs, Fish Farmers' Development Agencies (FFDAs) were established in fresh water areas, and Brackish Water Fish farmers' Development Agencies (BFDAs) in brackish water areas. To

encourage the aquaculture, the programs 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.

Seed production is very important to sustain fisheries production. To meet this objective, more than 50 seed hatcheries at the national level were established. The results were quite rewarding: the seed production rose manifolds from only 409 million fry in 1973-74 to about 20,000 million fry in 1999-2000. To develop better infrastructure facilities, 'Fisheries Industrial Estates' were developed by grouping the cluster of fishing villages. The major accomplishment until 1998-99 was construction of 30 minor fishing harbours and 130 fish landing centres besides the major fishing harbours at Cochin, Chennai, Paradeep, Roychowk and Visakhapatnam (Kumar et al 2001).

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

V. DETERMINANTS OF DIVERSIFICATION

Agricultural diversification is influenced by a number of forces both from the supply-side and the demand-side. This section examines the determinants of diversification in crop and livestock sectors separately, and results are given in Table 8 and 9.

DETERMINANTS OF DIVERSIFICATION IN CROP SUB-SECTOR

To examine the forces, which are influencing the diversification in favor of high value commodities, a number of explanatory variables were studied. The variables were related to infrastructure development, technology adoption, relative profitability, resource endowments and demand-side factors including urbanization and income level. The estimated double-log equations of Generalized Least Square are given in Table 8.

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

Table 8—Determinants of diversification in favour of horticultural commodities: Double-log estimates of Generalized Least Square.

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)
Small landholders	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-square	0.7735	0.7722	0.7572
Adjusted R-square	0.7642	0.7637	0.7490
F-statistic	82.82***	90.00***	91.40***

Figures in parentheses are standard errors of the respective coefficients; ***, **, * significant at 1%, 5% and 10% respectively.

The technology was defined by area under high-yielding variety of cereals, irrigated area and extent of mechanization. But it was 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 favor of horticultural commodities is 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 characterized as rainfed, low resource endowed with abundant labor force and by-passed during the 'green-revolution' period.

Relative profitability of horticultural commodities with other crops is also an important determinant for diversification in their favor. The regression coefficient is significant and positive. Obviously, the higher profit of these crops would induce farmers to diversify in their favor. Fruits and vegetables are highly profitable in comparison to cereals and other crops. Relative profitability of fruits was more than 8 times higher than cereals. The corresponding figure for vegetables was 4.8. Although high profits of horticultural crops encourage their cultivation but uncertain prices and high yield instability limit their wide spread cultivation. The price instability is more in case of fruits and vegetables compared to cereals (Subramanian 2000). The high price variability of fruits and vegetables is due to poor vertical linkage between production, marketing and processing. This calls for developing appropriate institutional arrangements for minimizing the price uncertainty. Some scattered success stories are available for strengthening farm-firm linkages. These are contract farming by Pepsi and Hindustan

lever for potato and tomato, and cooperative societies under the banner of '*Safal*' for fruits and vegetables. Contract farming is becoming popular in many developing countries. But it is still based on informal arrangements. This area needs legal changes to encourage effective role of processing industries to give further impetus to agricultural diversification. There is evidence that well managed contract farming has proven effective in linking the small farm sector to sources of extension advice, mechanization, seeds, fertilizer and credit, and to guaranteed and profitable markets for produce (FAO 2001).

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

Rainfall is another variable, which was 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 is limited in higher rainfall areas. Obviously, high rainfall areas specialize towards rice, while farmers go for diversification in medium and low rainfall areas to increase income and minimize risk.

Demand-side factors such as urbanization 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 favor of high value crops as they help maximize profits and minimize 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.

DETERMINANTS OF DIVERSIFICATION IN LIVESTOCK SUB-SECTOR

The results of Generalized Least Square for livestock sub-sector are given in Table 9. Technological progress in the crop sub-sector has strong influence on the diversification of livestock sub-sector. Irrigated area, one of the proxy variables for technological progress, was significant with negative effect on expansion of livestock sub-sector.

Farmers' resource endowment (particularly the size of land holding) was captured by the proportion of small holders in the total holdings in the region. The regression coefficient was highly significant and positive, indicating the prospects of livestock activities are higher on small farm holdings. Livestock activities are often well integrated with crop activities and generate regular income and quick returns to the small holders.

Rural literacy, which is a proxy for level of knowledge, is significant with negative sign. Obviously, higher literacy is indicating shift from agriculture (including livestock) to other job opportunities.

Relative profitability of livestock in comparison to crop sector was also found significant with positive relationship for the growth of livestock activities.

Infrastructure development also plays crucial role in influencing the prospects of livestock sub-sector. Road network and markets were included in the model to represent the infrastructure development. These variables were significant and have positive bearing on the growth of livestock.

The two demand-side variables, per capita income and urbanization showed a positive and significant influence on the growth of livestock activities. The rising per capita income and growing urbanization are raising the demand for livestock products in the consumption basket leading to diversification in the livestock sector. (Kumar and Mathur 1996).

Annual rainfall was significant with a positive sign indicating that higher rainfall areas have more inclination towards livestock activities. This may be due to availability of green fodder from fallow areas. This is unlike the crop sector, where diversification was more in low rainfall areas. This has important implications for designing appropriate strategies for promoting livestock sub-sector.

Table 9—Determinants of diversification in favour of livestock sub-sector: Double-log estimates of Generalized Least Square.

Explanatory variable	Dependent variable: Index of gross value of livestock at 1980-81 prices		
	Equation 1	Equation 2	Equation 3
Irrigation	-0.1993*** (0.0214)	-.0294 (0.0332)	-
Relative profitability	0.2009*** (0.0222)	-	0.1736*** (0.0288)
Roads	-	0.0534* (0.0292)	-
Markets	0.0368 (0.0260)	0.0906*** (0.0312)	-
Rural literacy	-0.2049*** (0.0479)	-	-0.0672 (0.0545)
Small landholders	0.6790*** (0.0705)	-	0.5689*** (0.0760)
Urbanization	0.1114** (0.0482)	-	0.0569 (0.0455)
Income	0.1521 *** (0.0239)	-	0.2033*** (0.0216)
Rainfall	-0.0029 (0.0148)	0.0524** (0.0221)	-
Time dummy : 1981-90=0; 1991-99=1	0.2479*** (0.0255)	-	-
R-square	0.7472	0.0637	0.5299
Adjusted R-square	0.7376	0.0448	05188
F-statistic	78.45***	3.37***	47.67***

VI. IMPLICATIONS OF DIVERSIFICATION

Several benefits of agricultural diversification are reported in the literature. In the short run these are (i) shifting consumption pattern, (ii) improving food security, (iii) increasing income, (iv) stabilizing income over seasons, (v) generating employment opportunities, (vi) alleviating poverty, (vii) improving productivity of scare resources (e.g. water), (viii) promoting export, (ix) improving environmentally sustainable farming systems through conservation and enhancement of natural resources (Jha 1996; Ramesh Chand 1996; Vyas 1996; Delgado and Siamwalla 1999; and Ryan and Spencer 2001). These short-run benefits have implications for the prospects of long-run growth in agriculture, regional equity and sustainable farming systems. The benefits are more clearly captured at micro-level. In the present study, we have assessed implications of diversification at macro-level on (i) improving food security, (ii) generating employment opportunities, and (iii) promoting export.

FOOD SECURITY

Food security at the national and household level is an important issue in the context of agricultural diversification. Producing additional food is a major challenge when population and incomes are rising, and natural resources degrading. There are apprehensions that shift in crop portfolio from food to non-food crops may lead to food insecurity. Incidentally, the diversification in majority of the states in India was coming as a result of expansion in cropping intensity. The crop substitution was also taking place, which was diverting area in favour of high-yielding cereals from low-yielding inferior

cereals. Rice, wheat and maize gained while sorghum and millets lost the area. The high-yielding nature of food grain crops has improved their availability. The production trends reveal that the per capita daily availability of food grains has increased from 448.56 grams in TE 1981-82 to 475.4 grams in TE 1999-2000. Similarly, the per capita daily availability of milk has substantially gone up from 128 grams in 1980-81 to 214 grams in 1999-2000 (Government of India 2002).

Interestingly, the consumption basket is changing over time. The food consumption is shifting from cereals to non-cereals in both rural and urban areas (Table 10). The per capita cereal consumption in rural and urban areas has declined, while those of milk, milk products, vegetables and fruits have increased significantly (Kumar 2002). Most remarkable increment in consumption was witnessed in case of fruits.

The available evidence clearly reveals that diversification of crop and livestock sectors has not only increased production of non-cereal commodities, but also raised their consumption pattern. A more favourable environment for diversification towards high-value commodities will not only ease the pressure of storing huge surplus of rice and wheat but also accelerate growth of agricultural sector through high-value commodities.

Table 10—Per capita consumption pattern of food items (kgs/person/annum)

Item	1977	1987	1993	1999
Rural				
Rice	86.5	88.1	85.4	81.0
Wheat	49.4	61.6	53.5	53.9
Coarse cereals	56.7	29.8	24.1	17.7
Total cereals	192.6	179.5	163.0	152.6
Pulses	8.7	11.5	9.2	10.1
Milk and milk products	24.6	58.0	51.4	50.5
Edible oils	2.7	4.3	4.6	6.0
Vegetables	24.7	50.8	53.2	66.0
Fruits	2.6	10.3	9.8	17.0
Meat, eggs, fish	2.7	3.3	4.1	5.0
Sugar and gur	13.5	11.0	9.2	10.1
Urban				
Rice	67.6	68.1	64.2	62.5
Wheat	64.6	60.4	57.4	55.4
Coarse cereals	14.8	10.6	7.7	7.1
Total cereals	147.0	139.1	129.3	125.0
Pulses	11.7	12.2	10.5	12.0
Milk and milk products	39.7	64.9	68.3	72.4
Edible oils	4.8	6.8	6.3	8.6
Vegetables	39.7	66.4	63.1	70.0
Fruits	5.9	18.8	20.1	19.0
Meat, eggs, fish	4.8	4.9	6.3	6.8
Sugar and gur	17.1	12.3	11.8	12.0

Source: Kumar (2002)

EMPLOYMENT

Generating employment avenues in rural areas is critical. The question is how diversification of crop sector can generate additional employment opportunities in the rural areas. Some information was collated from labor use in production of different crop activities (Table 11). It may be noted that labor use for cultivation of non-cereals is substantially higher than cereals (except rice).

Table 11—Average labour use in vegetables, cereal and non-cereal crops (man days per ha) in India

Vegetables		Cereals and non- cereals	
Crop	**Labour use (man days/ ha)**	**Crop**	**Labour use (man days/ ha)**
Potato	200	Rice	105
Onion	125	Wheat	55
Cabbage	110	Sorghum	55
Cauliflower	120	Pearl millet	50
Eggplant	70	Cotton	100
Tomato	195	Sugarcane	190

Source: Derived from several sources (i) Subramanian et al (2000) and Government of India (2000).

Area shift from cereals to vegetables would generate substantial employment opportunities in rural areas. Rough estimates suggest that 1 ha shift in area from wheat to potato would generate 145 additional man-days. Similarly, 1 ha area shift from coarse cereals (sorghum and pearl millet) to onion would generate 70 man days more employment opportunities in rural areas. In case of substitution from coarse cereals to other vegetables (for example cabbage, cauliflower, eggplant, tomato, lady finger), it is expected to generate 70 mandays/ha additional employment. A marginal shift in area from wheat and coarse cereals in favor of high-value crops can thus generate enhanced employment opportunities. Generating additional employment in rural areas has welfare and equity implications.

EXPORT

Indian exports during the decade of 1990s grew at an annual rate of 10.1%, as against 7.4% during 1980s (Government of India 2001). The exports of agricultural commodities during 1990s, however, grew at an annual rate of 8.1%, as against only 3.3% during 1980s. However, share of agriculture in total exports has declined from 24% during 1980s to 18% in 1990s.

A large share in agricultural export was contributed by diversification of crop and livestock sectors. It was noted that diversification of agricultural commodities has promoted export of many non-traditional items. Historically, there was virtually no export of fruits, vegetables, and livestock and fish products. The exports of these commodities, as well as rice, have remarkably picked up during 1990s. For example,

exports of rice went up from 440 thousand tons in TE 1981-82 to 656 thousand tons in TE 1991-91 and reached to 3145 thousand tons in TE 1997-98. India's share in world rice trade went up to more than 10% in 1990s, up from a mere 3.7% in 1980-81. Similarly, exports of fruits and vegetables more than doubled during the last two decades (from US$ 110 million in TE 1981-82 to US$ 262 million in TE 1999-2000. The exports of fish shot up from $320 million in TE 1981-82 to $1125 million by TE 1999-2000. More progress was registered in processed fruits and juice. Further, exports of milk, milk products, eggs and fish products have also made entry into the export markets. The, exports of milk and milk products increased from US$ 1.1 million in TE 1981-82 to US$ 1.7 million in TE 1991-92 and reached a peak of US$ 3.2 million in TE 1999-2000. Exports of eggs, although too erratic, increased from a low of US$ 0.4 million in TE 1981-82 to US$ 25.3 million in TE 1999-2000. It may be noted that the production of all these commodities increased substantially during 1990s, which led to their entry into export markets.

The progress in export of non-traditional items was quite impressive during the decade of 1990s as compared to 1980s. This implies that diversification of agriculture can substantially contribute to exports provided a congenial environment through infrastructure development and institutional innovation is created. It must be supported by appropriate domestic policies and legal changes, which encourage development of new institutions for linking production, marketing and processing.

VII. CONCLUSIONS AND POLICY IMPLICATIONS

The study diagnosed the status of agricultural diversification in South Asian countries. Detailed investigations were carried-out for India to examine the determinants of diversification. The results of the study revealed that agricultural sector in South Asia is gradually diversifying in favor of high-value commodities, namely fruits, vegetables, livestock and fish products. Much of the diversification came, if at all, with only little support from the governments. It was because food security issues are still critical in the sub-continent and government policy is still obsessed with self-sufficiency in cereals, which presumably contributes to a large share of area still being allocated to cereal crops. Countries like Bangladesh, India and Sri Lanka have achieved food self-sufficiency at the national level, but the emphasis is still focused towards increasing production of rice and wheat. Countries, like Bhutan, Nepal and Pakistan, which are still deficit in food grain production making serious attempts in augmenting their production.

Despite focusing efforts towards food grain production, a silent revolution is witnessed in high-value commodities. Production of fruits, vegetables, livestock and fish products have increased remarkably in most of the South Asian countries. Due to their low share in gross value of agricultural output, the silent revolution was unnoticed. The production of these commodities was demand-driven, which is unlike the supply-driven 'green revolution'. During 1980s, production increase was attributed to the rise in their yield levels. During 1990s, production increase came from area augmentation.

In Indian context, the determinants for high-value commodities (horticultural and livestock) were studied. Markets and roads were the key determinants, which were influencing the status of diversification. Other important determinant was the technology absorption in the region. Higher the technology adoption of cereals (particularly irrigation) less was the diversification in favor of high value commodities. Diversification in favor of horticultural and livestock commodities was more pronounced in rainfed areas, which were by-passed during the 'green revolution' but now could take advantage of agricultural diversification. The rainfed areas are becoming a hub of non-cereals due to their low water requirement and abundant labor supply. The evidence confirmed that the regions, which were diversifying in favor of non-cereals, have accomplished better growth performance as compared to those specializing in cereals. Besides, relative profitability of high-value commodities in relation to other crops also played important role in determining status of diversification. This calls for further strengthening R&D efforts for improving the productivity in a sustainable manner. Most important is that the high-value commodities are more with small farm holders.

The study also highlighted the implications of diversification on food security, employment generation and export earnings. The macro-level information showed that the food security was not adversely affected as a consequence of agricultural diversification. Similarly, the high-value crops have substantial potential for generating employment opportunities. Most of the high-value crops are high labor requirement crops. Incidentally, the small and marginal farmers have abundant labor, which can be

effectively utilized for production of high-value commodities. The high value commodities have also witnessed good performance in the international trade.

To speed-up the process of agricultural diversification of high-value commodities, the South Asian countries need to take series of measures to reform institutional arrangements, which can appropriately integrate production and markets. Among others, the immediate measures include ensuring markets, developing roads, creating appropriate infrastructure and encouraging private sector participation for value addition and processing. Domestic market reform is a pre-condition for agricultural diversification in favor of high-value enterprises. The most intricate puzzle is how to ensure greater participation of small and marginal landholders in the process of agricultural diversification for sharing benefits of globalization. They are moving in favor of high-value commodities but this group of farmers has high transaction cost due to tiny marketable surplus, which negate their higher production efficiency. Future research may be initiated to assess how appropriate institutional arrangements would convert weaknesses of small farm holders' into opportunities. It is expected that contract farming, cooperatives and group actions may lead to better opportunities for small farm holders to augment their farm income. These types of institutions may overcome risk and uncertainty and establish strong vertical linkage between production, marketing and processing.

REFERENCES

Birthal, Pratap S. and Parthasarthy Rao, P. (eds.) 2002. *Technology options for sustainable livestock production in India*. New Delhi and Patancheru: National Centre for Agricultural Economics and Policy Research and International Crops Research Institute for the Semi-Arid Tropics.

Birthal, Pratap S., Kumar, Anjani, and Tewari, Laxmi (eds.) 2002. *Livestock in different farming systems in India*. New Delhi: Agricultural Economics Research Association.

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

Delgado, C.L., and Siamwalla, A. 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.

FAO (Food and Agricultural Organization of United Nations). 2001. *Contract farming: partnerships for growth*. Rome: Food and Agricultural Organization of United Nations

Government of India. 2000. *Cost of cultivation of principal crops in India*. Ministry of Agriculture, Department of Agriculture and Cooperation, Government of India, New Delhi, India.

Government of India. 2001. *Indian economic survey: 2000-2001*. New Delhi: Akalank Publications.

Government of India. 2002. *Agricultural statistics at a glance*. Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi.

Hayami, Y., and K. Otsuka. 1992. Beyond the green revolution: agricultural development strategy into new century pp. 35. *In Agricultural technology: policy issues for the international community* (eds. Jock R. Anderson). Washington, DC, USA: The World Bank.

IASRI (Indian Agricultural Statistics Research institute). 2001. Agricultural research data book 2001. New Delhi: Indian Agricultural Statistics Research institute.

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.

Kelley, T.G., Ryan, J.G., and Patel, B. K. 1995. *Applied participatory priority setting in international agricultural research: making trade-offs transparent and explicit*. Agricultural Systems 49: 177-216.

Krishnan, M., and Birthal, P.S. (eds.) 2000. *Aquaculture in India: retrospect and prospect*. New Delhi: National Centre for Agricultural Economics and Policy Research.

Kumar, Anjani, Joshi, P.K., and Birthal, P.S. 2001. *Fisheries sector in India: an overview of performance, policies and programs*. In the International workshop on 'Strategies and Options for Increasing and Sustaining Fisheries Production to Benefit Poor Households in Asia', from 2025 August 2001. ICLARM, Penang, Malaysia.

Kumar, P. 2002. Estimates on per capita consumption in rural and urban areas (Personal communication).

Kumar, P. and Mathur, V.S. 1996. *Structural changes in the demand for food in India*. Indian Journal of Agricultural Economics 51(4): 664-673.

Kumar, P., Joshi, P.K., Johansen, C, and Asokan, M. 1998. *Sustainability of rice-wheat based cropping systems in India*. Economic and Political Weekly Sep.26: A-152-157.

National Dairy Development Board. 2002. Annual Report 2001-02. National Dairy Development Board, Anand, India.

Pandey, V.K. and Sharma, K.C. 1996. *Crop diversification and self sufficiency in foodgrains*. Indian Journal of Agricultural Economics 51 (4): 644-651.

Pingali, P.L., and Rosegrant, M.W. 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 Spencer, D.C. 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., Varadarajan, S., and Asokan, M. 2000. India. *In Dynamics of vegetable production and consumption in Asia* (ed. Mubarak Ali). Asian Vegetable Research and Development Center: Taiwan.

Tewari, L., Elumalai, K., Birthal, Pratap S., and Joshi, P.K. 2001. Implications of globalization on small farm holders: a SWOT analysis. In the Annual Conference of the Agricultural Economics Research Association on 21-22 November at the Indian Agricultural Research Institute, New Delhi.

von Braun, J. 1995. *Agricultural commercialization: Impact 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): 636-643.

MSSD DISCUSSION PAPERS

1. *Foodgrain Market Integration Under Market Reforms in Egypt*, May 1994 by Francesco Goletti, Ousmane Badiane, and Jayashree Sil.

2. *Agricultural Market Reforms in Egypt: Initial Adjustments in Local Output Markets*, November 1994 by Ousmane Badiane.

3. *Agricultural Market Reforms in Egypt: Initial Adjustments in Local Input Markets*, November 1994 by Francesco Goletti.

4. *Agricultural Input Market Reforms: A Review of Selected Literature*, June 1995 by Francesco Goletti and Anna Alfano.

5. *The Development of Maize Seed Markets in Sub-Saharan Africa*, September 1995 by Joseph Rusike.

6. *Methods for Agricultural Input Market Reform Research: A Tool Kit of Techniques*, December 1995 by Francesco Goletti and Kumaresan Govindan.

7. *Agricultural Transformation: The Key to Broad Based Growth and Poverty Alleviation in Sub-Saharan Africa*, December 1995 by Christopher Delgado.

8. *The Impact of the CFA Devaluation on Cereal Markets in Selected CMA/WCA Member Countries*, February 1996 by Ousmane Badiane.

9. *Smallholder Dairying Under Transactions Costs in East Africa*, December 1996 by Steven Staal, Christopher Delgado, and Charles Nicholson.

10. *Reforming and Promoting Local Agricultural Markets: A Research Approach*, February 1997 by Ousmane Badiane and Ernst-August Nuppenau.

11. *Market Integration and the Long Run Adjustment of Local Markets to Changes in Trade and Exchange Rate Regimes: Options For Market Reform and Promotion Policies*, February 1997 by Ousmane Badiane.

12. *The Response of Local Maize Prices to the 1983 Currency Devaluation in Ghana*, February 1997 by Ousmane Badiane and Gerald E. Shively.

MSSD DISCUSSION PAPERS

13. *The Sequencing of Agricultural Market Reforms in Malawi*, February 1997 by Mylène Kherallah and Kumaresan Govindan.

14. *Rice Markets, Agricultural Growth, and Policy Options in Vietnam*, April 1997 by Francesco Goletti and Nicholas Minot.

15. *Marketing Constraints on Rice Exports from Vietnam*, June 1997 by Francesco Goletti, Nicholas Minot, and Philippe Berry.

16. *A Sluggish Demand Could be as Potent as Technological Progress in Creating Surplus in Staple Production: The Case of Bangladesh*, June 1997 by Raisuddin Ahmed.

17. *Liberalisation et Competitivite de la Filiere Arachidiere au Senegal*, October 1997 by Ousmane Badiane.

18. *Changing Fish Trade and Demand Patterns in Developing Countries and Their Significance for Policy Research*, October 1997 by Christopher Delgado and Claude Courbois.

19. *The Impact of Livestock and Fisheries on Food Availability and Demand in 2020*, October 1997 by Christopher Delgado, Pierre Crosson, and Claude Courbois.

20. *Rural Economy and Farm Income Diversification in Developing Countries*, October 1997 by Christopher Delgado and Ammar Siamwalla.

21. *Global Food Demand and the Contribution of Livestock as We Enter the New Millenium*, February 1998 by Christopher L. Delgado, Claude B. Courbois, and Mark W. Rosegrant.

22. *Marketing Policy Reform and Competitiveness: Why Integration and Arbitrage Costs Matter,* March 1998 by Ousmane Badiane.

23. *Returns to Social Capital among Traders,* July 1998 by Marcel Fafchamps and Bart Minten.

24. *Relationships and Traders in Madagascar,* July 1998 by M. Fafchamps and B. Minten.

MSSD DISCUSSION PAPERS

25. *Generating Disaggregated Poverty Maps: An application to Viet Nam*, October 1998 by Nicholas Minot.

26. *Infrastructure, Market Access, and Agricultural Prices: Evidence from Madagascar*, March 1999 by Bart Minten.

27. *Property Rights in a Flea Market Economy*, March 1999 by Marcel Fafchamps and Bart Minten.

28. *The Growing Place of Livestock Products in World Food in the Twenty-First Century*, March 1999 by Christopher L. Delgado, Mark W. Rosegrant, Henning Steinfeld, Simeon Ehui, and Claude Courbois.

29. *The Impact of Postharvest Research,* April 1999 by Francesco Goletti and Christiane Wolff.

30. *Agricultural Diversification and Rural Industrialization as a Strategy for Rural Income Growth and Poverty Reduction in Indochina and Myanmar,* June 1999 by Francesco Goletti.

31. *Transaction Costs and Market Institutions: Grain Brokers in Ethiopia*, October 1999 by Eleni Z. Gabre-Madhin.

32. *Adjustment of Wheat Production to Market reform in Egypt*, October 1999 by Mylene Kherallah, Nicholas Minot and Peter Gruhn.

33. *Rural Growth Linkages in the Eastern Cape Province of South Africa*, October 1999 by Simphiwe Ngqangweni.

34. *Accelerating Africa's Structural Transformation: Lessons from East Asia,* October 1999, by Eleni Z. Gabre-Madhin and Bruce F. Johnston.

35. *Agroindustrialization Through Institutional Innovation: Transactions Costs, Cooperatives and Milk-Market Development in the Ethiopian Highlands*, November 1999 by Garth Holloway, Charles Nicholson, Christopher Delgado, Steven Staal and Simeon Ehui.

36. *Effect of Transaction Costs on Supply Response and Marketed Surplus: Simulations Using Non-Separable Household Models*, October 1999 by Nicholas Minot.

MSSD DISCUSSION PAPERS

37. *An Empirical Investigation of Short and Long-run Agricultural Wage Formation in Ghana*, November 1999 by Awudu Abdulai and Christopher Delgado.

38. *Economy-Wide Impacts of Technological Change in the Agro-food Production and Processing Sectors in Sub-Saharan Africa*, November 1999 by Simeon Ehui and Christopher Delgado.

39. *Of Markets and Middlemen: The Role of Brokers in Ethiopia*, November 1999 by Eleni Z. Gabre-Madhin.

40. *Fertilizer Market Reform and the Determinants of Fertilizer Use in Benin and Malawi*, October 2000 by Nicholas Minot, Mylene Kherallah, Philippe Berry.

41. *The New Institutional Economics: Applications for Agricultural Policy Research in Developing Countries, June 2001* by Mylene Kherallah and Johann Kirsten.

42. *The Spatial Distribution of Poverty in Vietnam and the Potential for Targeting*, March 2002 by Nicholas Minot and Bob Baulch.

43. *Bumper Crops, Producer Incentives and Persistent Poverty: Implications for Food Aid Programs in Bangladesh*, March 2002 by Paul Dorosh, Quazi Shahabuddin, M. Abdul Aziz and Naser Farid.

44. *Dynamics of Agricultural Wage and Rice Price in Bangladesh: A Re-examination*, March 2002 by Shahidur Rashid.

45. *Micro Lending for Small Farmers in Bangladesh: Does it Affect Farm Households' Land Allocation Decision?,* September 2002 by Shahidur Rashid, Manohar Sharma, and Manfred Zeller.

46. *Rice Price Stabilization in Bangladesh: An Analysis of Policy Options,* October 2002 by Paul Dorosh and Quazi Shahabuddin

47. *Comparative Advantage in Bangladesh Crop Production,* October 2002 by Quazi Shahabuddin and Paul Dorosh.

MSSD DISCUSSION PAPERS

48. *Impact of Global Cotton Markets on Rural Poverty in Benin,* November 2002 by Nicholas Minot and Lisa Daniels.

49. *Poverty Mapping with Aggregate Census Data: What is the Loss in Precision?* November 2002 by Nicholas Minot and Bob Baulch.

50. *Globalization and the Smallholders: A Review of Issues, Approaches, and Implications,* November 2002 by Sudha Narayanan and Ashok Gulati.

51. *Rice Trade Liberalization and Poverty,* November 2002 by Ashok Gulati and Sudha Narayanan.

52. *Fish as Food: Projections to 2020 Under Different Scenarios,* December 2002 by Christopher Delgado, Mark Rosegrant, Nikolas Wada, Siet Meijer and Mahfuzuddin Ahmed.

53. *Successes in African Agriculture: Results of an Expert Survey,* January 2003 by Eleni Z. Gabre-Madhin and Steven Haggblade.

54. *Demand Projections for Poultry Products and Poultry Feeds in Bangladesh*, January 2003 by Nabiul Islam.

55. *Implications of Quality Deterioration for Public Foodgrain Stock Management and Consumers in Bangladesh,* January 2003 by Paul a. Dorosh and Naser Farid.

56. *Transactions Costs and Agricultural Productivity: Implications of Isolation for Rural Poverty in Madagascar.* February 2003 by David Stifel, Bart Minten, and Paul Dorosh.