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Agricultural Diversification in Andhra Pradesh, India: Patterns, Determinants and Implications

P Parthasarathy Rao, PK Joshi, Shravan Kumar and Kavery Ganguly

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International Food Policy Research Institute
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Authors

P Parthasarathy Rao Principal Scientist, Global Theme Institutions, Markets, Policy and Impacts (GT IMPI), ICRISAT, Patancheru 502 324, Andhra Pradesh, India

PK Joshi Director, National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi (formerly Research Fellow, International Food Policy Research Institute, IFPRI, New Delhi Office)

Shravan Kumar Scientific Officer, GT IMPI, ICRISAT, Patancheru 502 324, Andhra Pradesh, India

Kavery Ganguly Research Associate, IFPRI, New Delhi Office

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Executive Summary

This paper examines the process of agricultural diversification towards high-value commodities (HVCs) in the Indian state of Andhra Pradesh (AP), while focusing on some policy and institutional issues in the process of diversification. The study postulates three hypotheses: (1) the agricultural sector in Andhra Pradesh is gradually diversifying towards HVCs; (2) the demand side factors are driving the production of HVCs, while the lack of adequate infrastructure and market support, and the high-risk in production and marketing (including prices) impede their supply; and (3) the current policies and institutions are constraining the investments for creating the required infrastructure and for promoting the agro-processing sector.

Agricultural diversification is viewed as a shift in production portfolio away from staple cereals towards high-value food commodities such as fruits, vegetables, milk, meat, eggs and fish. Based on the aggregate share of these commodities in the total value of agricultural production, the districts are clustered into *high-, medium-* and *low*-diversification zones. The findings show that traditional commercial crops such as oilseeds, pulses and spices are grown mainly in the low diversification zone, typically under low rainfall conditions. The incidence of poverty is high in this zone and also the infrastructure facilities are inadequate. In the medium-diversification zone paddy is the dominant crop due to the availability of irrigation, credit, and infrastructure facilities. As expected, the HVCs occupy a major share of agricultural output in the high-diversification zones that are close to the HVCs demand centers characterized by high population density and a higher share of urban population in the total population. This is despite the zone being characterized by low and erratic rainfall and a low level of agricultural intensification.

Evidence from the field surveys in some selected districts of Andhra Pradesh indicate higher returns for non-traditional or high-value crops such as flowers and vegetables, compared to traditional commercial crops such as cotton and oilseeds. The water use efficiency in high-value crops such as flowers, vegetables and chickpea, is high compared to paddy and sugarcane. The employment potential of HVCs is also higher compared to traditional crops.

There are, however, a number of factors that influence the spread of HVCs. These include availability of credit, post-harvest infrastructure and marketing, cold chains, quality-testing laboratories. Unless these facilities are streamlined to support the needs of stakeholders on the supply chain, diversification towards HVCs would remain restricted. For instance, the processing industry is plagued by a number of bottlenecks on the supply side – non-availability of raw materials, poor quality, small size of the units and obsolete technology, regulations and policy hurdles, high taxes, lack of post-harvest infrastructure and food standards testing laboratories. Vertical coordination or contract farming for high-value commodities is in a nascent stage in the state and only a small proportion of HVCs' production is covered under such innovative arrangements (hybrid seed production and broiler production being the only exceptions). Results indicate that contract farming has helped in improving the marketing efficiency and integrating smallholders on the supply chain. The boom in the poultry production and the gherkin exports from Andhra Pradesh is an outcome of contract farming.

In recent years, the state government has taken a number of initiatives to promote HVCs and improve infrastructure and marketing efficiency. An important step was to modify the existing AP Markets Act (Agricultural Produce and Livestock) 1966, by including provisions from the Model Marketing Act 2003

evolved by the central government. Another initiative was the establishment of Agri-Export Zones (AEZs) to promote exports of horticultural products. Presently, there are five AEZs covering gherkins, mangoes and its products, grapes, vegetables and chilies. The state government has also come out with a policy on 'food processing' to streamline procedures for the establishment and functioning of processing industries. The main thrust of the policy, besides others, was to develop food parks and agri-export zones, and to give clearances to food processing industries under the single-window system. However, implementation of all these measures/policies is far from adequate.

The recent expansion in the retail sector owing to the reduction of control in the investment and the entry of large corporate players into the food processing and outlet chain has changed the game to a great extent. On one hand, massive investments made by corporate giants like Reliance, Spencer's, Subhiksha and many other regional players have opened up new markets for fresh and processed high-value commodities, on the other, the absence of coordinated supply chains, and the lack of strong backward linkages pose challenges for sustainable and inclusive growth. In the long run, the consolidation of the marketing and retail chain will reduce transaction and marketing costs but there is a need to put in place various measures to ensure that the smallholders are not left out.

Timely intervention through reforms in the agricultural sector (supported by investments in infrastructure), strengthening institutions by promoting private sector participation at the ground level, would help revitalize the agricultural sector through sustainable diversification. The study proposes strategies that include: (1) amendment of age-old marketing- and processing-related acts; (2) strengthening and reorientation of the institutions related to markets, credit and agricultural research; (3) investment in infrastructure such as cold storage facilities, roads and ports and (4) involvement of agri-business in promoting HVCs.

1. Introduction

Andhra Pradesh was in the limelight during the late 1990s for taking bold initiatives to improve the quality of governance and accelerate economic growth. The state also became one of the front-runners in the field of information technology in India. During the same period, it also had the dubious distinction of recording the highest number of suicides by farmers, the highest number of indebted households, large-scale rural-urban migration, increase in the number of agricultural laborers, and the highest incidence of child labor in India[1]. This paradoxical situation was mainly due to the slowing down of agricultural growth and the deteriorating health of the agricultural sector. The main concerns were declining investment and rising input subsidies in agriculture and deceleration of productivity growth (Hanumantha Rao and Mahendra Dev 2003).

Background

The agriculture sector is the principal source of livelihood for over 70 percent of the total population[2] in Andhra Pradesh. It contributes about one-fourth of the state's gross domestic product. Though the state attained the status of 'a food surplus state, 11% of its population (≈8.8 million) continued to be poor in 2004-05[3]. The agricultural sector is dominated by small and marginal farmers. Their share in total holdings increased from 65% in the 1970s, to 81% in 2000, which makes these holdings unviable for domestic and global competitiveness[4]. The question therefore is: how can the burgeoning number of smallholders be a part of the transition in the agricultural sector?

The agriculture in the state is characterized by less fertile lands and low irrigation potential (with the exception of the coastal region), and acute land degradation. The state contributed roughly 7% to the national gross domestic product and 7.5% to the national agricultural gross domestic product in 2003–04. Further, consistent with the theory of economic development, the share of the agricultural sector in the state Gross State Domestic Product (GSDP) declined from more than 40% in the early 1980s, to around 24% in 2005. On the other hand, the share of the services sector increased from around 33% to 51%, mainly due to phenomenal growth in the information technology sector (Figure 1.1).

Despite a declining share of the agricultural sector in the state income, several changes have taken place in it, which merit a critical examination. The importance of food grains and traditional commercial crops is on the decline, while the share of HVCs, including horticulture, fisheries and livestock, has been rising (Figure 1.2).

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1 During the 5-year period between 2001-02 and May 2006, a total of 2410 suicides by farmers were reported in Andhra Pradesh (Social Watch India 2007). Regarding child labor, 25.1 percent of rural children in the age group of 10–14 are workers, compared to the national average of 9.3 percent (NSSO 2000). As per an NSSO survey, 82 percent of the households in Andhra Pradesh were indebted in 2003, compared to 48.6 percent at all-India level (NSSO 2003).

2 In 2001, the total population of Andhra Pradesh was 76.21 million.

3 Poverty estimates are based on Mixed Recall Period (MRP). Estimates based on Uniform Recall Period (URP) method show that 15.8 percent of the population is below poverty line. However it is observed that urban poverty in Andhra Pradesh is higher than rural poverty. 20.7 percent (28 percent) in urban areas compared to 7.5 percent (11.2 percent) in rural areas as per MRP (URP) methods, respectively (Poverty Estimates for 2004-05, Press Information Bureau, Government of India, March 2007).

4 The average size of holdings declined from 2 ha in 1982, to 1.4 ha in 2000. The area operated by small and marginal farmers increased from 30% in 1982 to 43% in 2000 (GoAP 2003c).

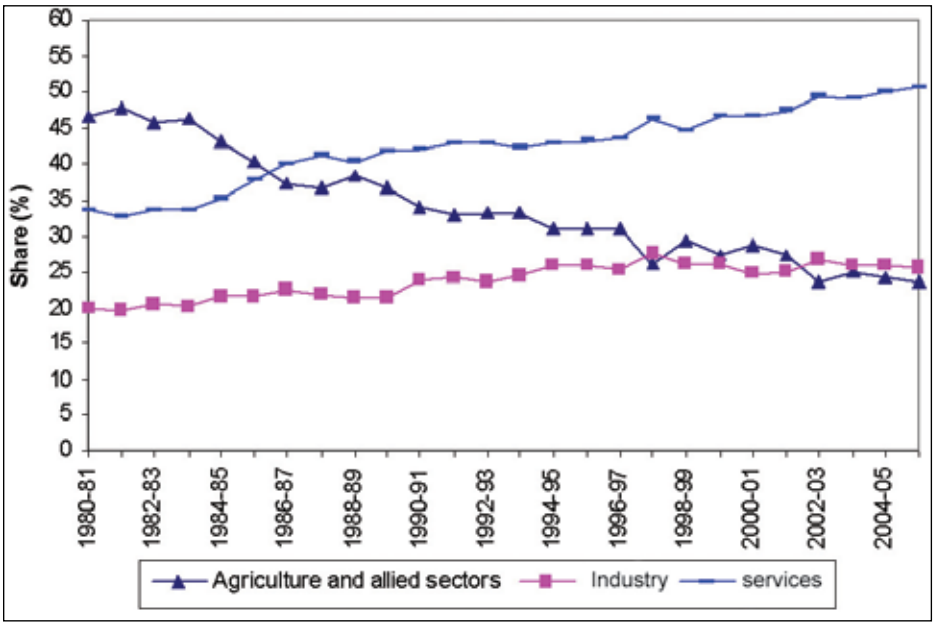
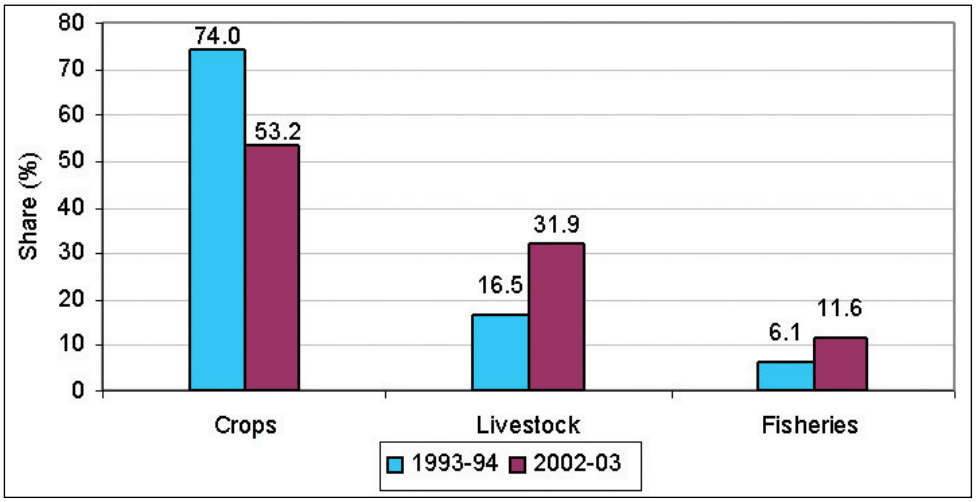


Figure 1.1: Relative shares of selected sectors to GDP, Andhra Pradesh (at 1993-94 prices).



Source: Directorate of Economics and Statistics (2003b).

Figure 1.2 Share of agriculture sub-sectors in the agricultural GDP, Andhra Pradesh (at 1993-94 prices).

The agricultural sector of the state, however, is confronted with serious problems such as the growing number of farmer suicides, rising costs of production, declining farm profits, deteriorating quality of soil and water resources, and growing number of smallholders that highlight the urgent need to revitalize the agricultural sector. It is therefore, important to explore alternative options to accelerate agricultural growth, reduce disparities and improve the quality of life of the rural people. In 1999, the state put forward a road map – *Andhra Pradesh Vision 2020* – to turn the state into the foremost state in the country in terms of growth, equity and quality of life. It envisioned a strong and vibrant agricultural sector by achieving an average annual growth rate of 6%, from a mere 2.6% during 1980–2000 (GoAP

1999). Several high-potential areas were identified: dairy, fruits, vegetables, poultry, fisheries and agro-processing. These are considered as high-value commodities (HVCs), and potential sources for augmenting income, generating employment opportunities, and promoting exports.

There are opportunities for accelerated growth of high-value commodities. Rising population, increasing incomes, growing urbanization, unfolding globalization, and changing tastes and preferences are causing rapid increases in demand for these commodities (Kumar et al. 2003). New opportunities are opening up for their exports. In 1998, the less-developed countries accounted for about 35% of the world exports of fruits and vegetables (Bonilla and Reca 2000), which increased to 43% in 2004 (World Bank 2007). In India too, the share of HVCs in agricultural exports increased from 21% in 1990 to 36% in 2000, with animal products, fish, fruits and vegetables dominating the export basket (GoI 2005). Given these trends, Andhra Pradesh can harness the emerging opportunities to revitalize its agriculture.

Objectives and hypotheses

The overall objective of the study is to (1) document current trends in agricultural diversification towards HVCs; (2) identify the major factors driving agricultural diversification; (3) analyze present policies and prevailing institutions promoting or impeding agricultural diversification; (4) assess the role of innovative institutions in promoting HVCs; and (5) suggest strategies and policies for revitalizing the agricultural sector through the production of high-value and processed commodities.

The study postulates three hypotheses: (1) the agricultural sector in Andhra Pradesh is gradually diversifying towards HVCs; (2) the demand side factors are driving the production of HVCs, while the lack of adequate infrastructure and market support, and the high-risk in production and marketing (including prices) impede their supply; and (3) the current policies and institutions are constraining the investments for creating the required infrastructure and for promoting the agro-processing sector.

Organization of the study

The next chapter provides a brief account of the performance of the traditional crop sector in the state, followed by the significance of agricultural diversification, and its implications for agriculture in the state. Chapter 3 presents the drivers of agricultural diversification and their relative importance. Chapter 4 presents an account of the supply chains for HVCs, and analyzes the emerging innovative institutions that are enhancing marketing efficiency and involving smallholders. Chapter 5 assesses the status of food processing and retailing in the state. Chapter 6 lists out the key constraints to promoting high-value agriculture, and related activities such as processing and retailing. Finally, we propose a road map for agricultural diversification toward HVCs in Andhra Pradesh.

2. Agricultural Diversification

Defining agricultural diversification

Agricultural diversification is a process of a gradual movement out of subsistence food crops (particularly staple foods) toward diversified market-oriented crops that have a larger potential for returns to land. This process is triggered by the availability of improved rural infrastructure, rapid technological advancements in agricultural production, and changing food demand patterns Hence, this process of diversification towards high-value crops is likely to accelerate agricultural growth and usher in a new era of rural entrepreneurship and generate employment opportunities. Experiences from most Southeast Asian countries, and some scattered examples from the South Asian countries, reveal that diversification toward HVCs leads to the development of innovative supply chains and opens new vistas for augmenting income, generating employment and promoting exports (Shanmugasundaram 2004, Barghouti et al 2003, Pingali and Khawaja 2004, Deshingkar et al. 2003, Pokharel 2003, Wickramasinghe et al. 2003, Goletti 1999). It is also observed that food and income security improved in regions where agricultural diversification took place in favor of horticulture activities, animal husbandry, and aquaculture (Dorjee et al. 2002, Barghouti et al. 2003, Shanmugasundaram 2004). There appears immense scope for diversification of agriculture towards high-value commodities in South Asian countries (FAO 2003).

This chapter discusses the manner in which the production portfolio is changing toward high-value commodities in Andhra Pradesh, map the nature and pattern of diversification, analyzes past performances and draws implications for smallholders who comprise about 80% of the farmers in the state[5].

Performance of the agriculture sector

The agriculture sector in Andhra Pradesh is witnessing a gradual transformation wherein high-value commodities are gaining importance. During the 1980s, the shift from a cereal-based system toward commercial commodities such as oilseeds, cotton and sugarcane helped achieve a growth of about 3.5% a year (Subrahmanyam and Satya Sekhar 2003). The transformation continued during 1990s, but more towards high-value commodities such as fruits, vegetables, milk, meat, poultry and fish. The agriculture sector also started tumbling during this decade due to consecutive droughts and decelerating crop yields (Table 2.1).

Despite adverse weather and technological conditions, high-value commodities performed impressively and rescued the sector to a large extent. For instance, during 1998–99 to 2003–04, while the growth in the crop sector was negative to the tune of -3.8%, the overall annual growth in the agricultural sector was 1.5% due to a more than 10% growth in the livestock and fisheries sectors (Figure 2.1). Within the crop sector too horticulture and floriculture grew at 3 and 21% a year.

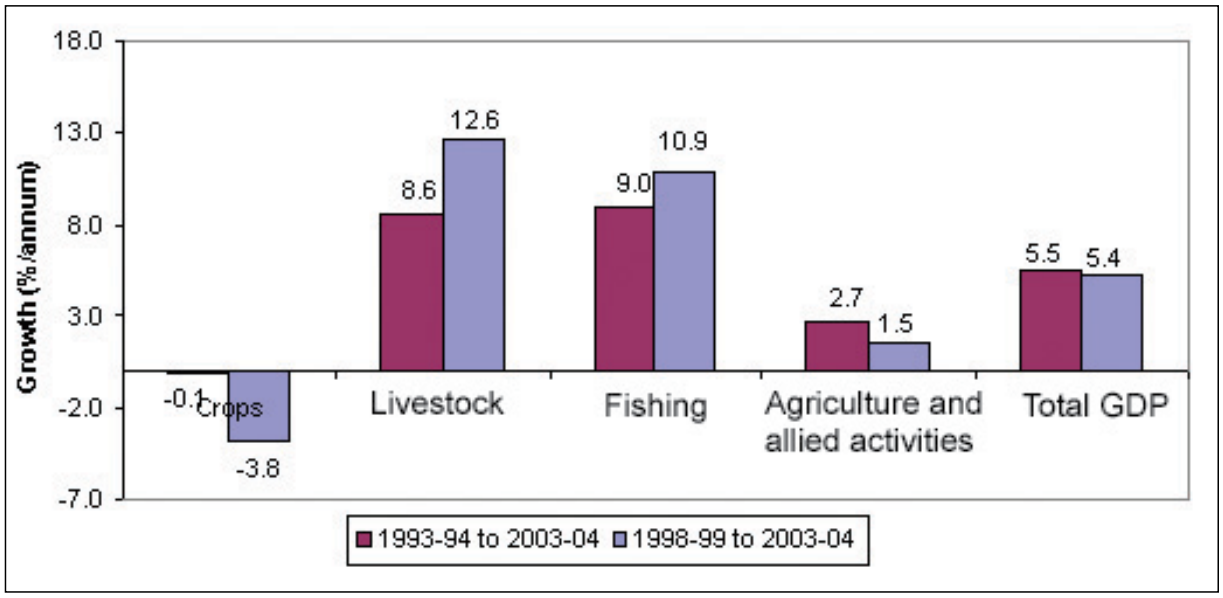
5 For details of databases used and methodology, see Appendix A.

Table 2.1 Annual compound growth[a] rates (%) for yields of major crops; Andhra Pradesh, 1980–2002.

Crop	1980–91	1991–2002
Paddy	2.0	0.0
Sorghum	1.2	2.3
Pearl millet	0.3	0.5
Maize	0.8	3.2
Finger millet	0.5	0.3
Chickpea	8.1	5.8
Pigeonpea	1.3	2.9
Groundnut	1.8	-2.4
Sesamum	0.2	-2.0
Castor	4.7	5.5
Sunflower	–	0.8
Sugarcane	-1.1	-2.6
Cotton	-1.8	-1.5

a. Growth rates were calculated using the exponential growth rate, $Y = b_0 (e^{b\ 1t})$, linearized as $\ln Y = \ln (b_0) + b_1 t$, where ln Y = natural logarithm of variable Y, t = time period (years), and b_1 = growth rate of Y.

Source: ICRISAT district level database.



Source: Directorate of Economics and Statistics (2003b).

Figure 2.1 Annual compound growth rates of agriculture sub-sectors and total GDP, Andhra Pradesh (at 1993–94 constant prices).

Relative importance of high-value commodities

As alluded to earlier, the consumption patterns are shifting towards high-value commodities and this phenomenon is driving gradual diversification of the production portfolio. In Andhra Pradesh, share of HVCs in total value of agricultural output (at constant 1993-94 prices) has increased from 29.1% in Triennium Ending (TE) 1982-83 to 33.1% in TE 1992-93 and reached 50.3% in TE 2002-03 (GoI 2006). During the same period, agriculture at all-India level diversified but the rate of diversification was less than that in Andhra Pradesh; share of HVCs in the total value of agriculture increased from 37% in TE 1982-83 to 48.1% in TE 2002-03.

The changes in production portfolio were more pronounced during 1990s. In Andhra Pradesh, livestock (including poultry, meat and dairy) and fisheries have come up in a big way; raising their share in the value of agricultural output from 17.8% in TE 1982-83 to 24.5% in TE 1992-93 and 40.7% in TE 2002-03 (Table 2.2). Horticultural crops (including floriculture) are also flourishing; their value (at 1993-94 prices) increased from Rs 16.5 billion in TE 1982-83 to Rs 28.4 billion in TE 2002-03.

Table 2.2 Composition of the value of agricultural commodities (percent of total value); Andhra Pradesh (at 1993-94 prices).

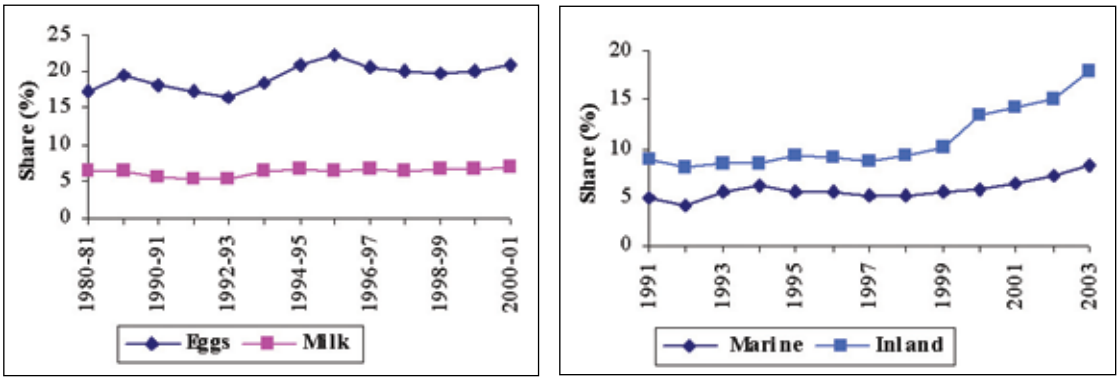
Commodities	TE 1982-83	TE 1992-93	TE 2002-03
Paddy	29.1	25.8	19.1
Coarse cereals[a]	5.3	2.7	2.3
Pulses	3.2	3.5	3.7
Oilseeds	8.9	13.1	6.9
Total sugar	5.2	4.2	3.3
Cotton	3.5	4.9	4.3
Chilies	2.0	2.9	3.0
Turmeric	0.7	0.9	1.2
Tobacco	2.3	1.9	0.8
Fruits & vegetables	11.3	8.7	9.6
Milk	8.9	9.5	12.9
Meat	4.3	7.1	12.1
Eggs	1.2	1.5	3.6
Other livestock	Neg.	2.6	2.1
Total livestock	14.5	20.7	30.7
Fish	3.3	3.8	10.0
High-value commodities[b]	29.1	33.1	50.3
Total value (in million Rs)	145,827	202,421	296,334

a. Coarse cereals include sorghum, pearl millet, maize and finger millet

b. High-value commodities include fruits, vegetables, fish and livestock

Source: GoI 2006.

The state also performed much better in HVCs compared to other states. Figure 2.2 shows changes in the share of Andhra Pradesh in national production of eggs, milk and fish. Its share in fish production (both inland and marine) increased significantly (from 6.6% in 1991, to 13.3% in 2002-03), in poultry meat, from around 17% in 1982 to 25% in 1998. All this was achieved in the face of numerous technological and institutional hurdles on the supply side, as well as the lack of concerted policy initiatives toward augmenting HVC production. It is only in the case of fruits that the share of Andhra Pradesh declined marginally from 14% in 1982, to 12% in 2001.



Source: Government of India, Basic Animal Husbandry Statistics 1999. Economic Survey 2003-04 Government of Andhra Pradesh.

Figure 2.2 Share of high-value commodities: Andhra Pradesh to all-India.

Spatial pattern of HVCs

Based on the share of HVCs in total value of agricultural production at constant prices, three distinct clusters of districts emerged in the state as shown below:

Zone 1: High-diversification zone: districts with more than 40% share of HVCs in the total value of agricultural production; include Srikakulam, Cuddapah, Mahabubnagar, Chitoor, Visakhapatnam and Hyderabad.

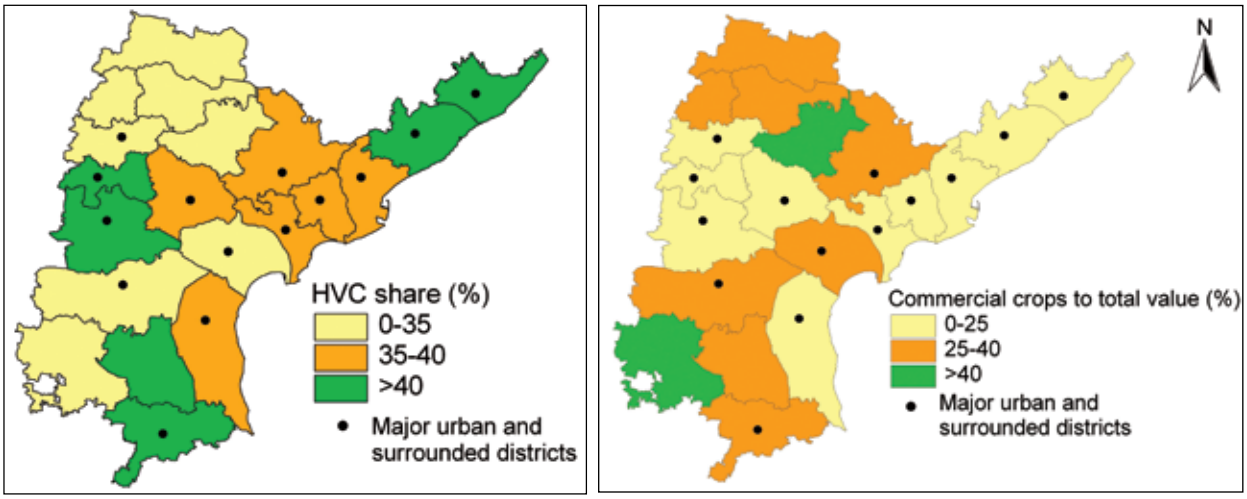
Zone 2: Medium-diversification zone: districts with 35–40% share of HVCs; include West Godavari, Nellore, Khammam, Krishna, Nalgonda and East Godavari.

Zone 3: Low-diversification zone: districts with less than 35% share of HVCs; include Nizamabad, Warangal, Adilabad, Guntur, Karimnagar, Anantapur, Kurnool and Medak[6].

A spatial view of these zones is shown in Map 2.1. The high- to medium-diversification districts are spread across the state, but mainly covering North Coastal districts, Southern Telangana, and two districts in the Scanty Rainfall region. Spread of HVCs is in stark contrast to the spread of commercial crops (oilseeds, cotton and sugarcane that are mainly concentrated in the Scanty Rainfall region and Northern Telangana).

Socioeconomic and demographic traits, and infrastructural development vary from one diversification zone to another (Appendix Table A2.1). Demographic indicators such as population density and urban

6 Data for Prakasham, Rangareddy and Vijayanagaram districts are included in their parent district. Ranga Reddy in Hyderabad, Prakasham in Guntur, Nellore in Kurnool and Vijayanagaram in Visakhapatnam.



Map 2.1: Spatial distribution of HVCs and commercial crops, Andhra Pradesh, 1999-2001.

population are significantly higher in the high-diversification zone (Zone 1). Average rainfall is lowest in Zone 1 compared to the other zones. Agricultural intensification, as reflected in input use, is lower in Zone 1 than in the medium-diversification zone (Zone 2). For example, in Zone 1, the irrigated area, HYV area, fertilizer use and tractor use are lower than the state average, and much lower than those in the medium-level diversification zone (Zone 2). Thus, Zone 2 represents an intensive agriculture system, ie, high-input agriculture with paddy dominating the cropping pattern. The overall development of infrastructure facilities is poor in the low-diversification zone (Zone 3) and the density of roads and markets is generally lower in this zone, than in Zones 1 and 2.

Credit availability from institutional sources is highest in Zone 2 and lowest in Zone 1, implying that much of the credit from the formal sector goes to intensive agriculture or to the better-endowed and irrigated areas. Thus, the non-availability of institutional credit could be a constraint to the further expansion of agricultural diversification.

In the high-diversification zone, HVCs (mainly milk, fruits and poultry) account for 51% of the total value of production (Table 2.3), while in the medium-diversification zone, HVCs (mainly fruits and milk) account for 37% of the value of production. Among traditional commodities, it is paddy that accounts for about 38% of the total value of agricultural production. In the low-diversification zone, HVCs (mainly milk, followed by poultry) account for only 27% of the value of production. Rice, followed by commercial commodities (such as oilseeds, sugarcane, cotton, spices), and are important in the low-diversification zone.

Amongst HVCs, share of milk production in the total value of agricultural output ranges within a narrow band from 13.4% (in the low-diversification zone) to 16.7% (in the high-diversification zone). A strong network of cooperatives and growing demand are the main reasons for the increasing importance of milk production. The importance of milk in the production portfolio in all the zones also indicates a strong crop-livestock interaction in the state.

Table 2.3. Composition of the value of agricultural commodities (percent of total value) by level of diversification; Andhra Pradesh, 1999–2001 (1980–82 constant prices).

	HVC-based diversification zone		
Commodities	High (Zone 1)	Medium (Zone 2)	Low (Zone 3)
Paddy	16.0	38.2	25.0
Coarse cereals	3.4	1.0	6.3
Pulses	3.1	3.2	5.4
Oilseeds	9.3	1.2	9.0
Sugarcane	8.0	4.7	2.7
Cotton	1.4	2.5	7.1
Chilies	2.3	4.5	8.0
Turmeric	1.8	0.3	4.8
Tobacco	0.7	3.6	1.9
Foodgrains & commercial[a] crops	**49.4**	**62.5**	**73.4**
Fruits	16.0	14.7	3.5
Vegetables	2.9	1.2	2.2
Horticulture crops	18.9	15.9	5.7
Milk	16.7	14.2	13.4
Bovine meat	0.7	0.6	0.7
Ovine meat	1.8	0.7	1.4
Pig, poultry meat, eggs	12.4	6.2	5.4
Total livestock	31.6	21.6	20.9
High-value commodities[b]	**50.6**	**37.5**	**26.6**
Total value (million Rs)	21,160	33,112	34,107

a. Commercial crops include oilseeds, sugarcane, cotton, chilies, turmeric and tobacco.
b. High-value commodities include horticulture crops and livestock.
Source: ICRISAT district level database.

Between 1982 and 2001, HVCs contributed more than 50% to the change in the total value of agricultural output. In the high-diversification zone, the contribution of HVCs was about two-thirds while in the low-diversification zone, food grain commodities and commercial crops accounted for the bulk of the change (62.6%). In the medium-diversification zone too, HVCs contributed to more than half of the change in the value of agricultural production (Table 2.4). These contributions to change are also reflected in the higher growth rate of HVCs in Zone 1 (6.1% per annum) than in others.

Table 2.4 Sources of change in the value of production by level of diversification; Andhra Pradesh, 1982–2001 (1980–82 constant prices).

Commodities	HVC-based diversification zone			
	High (Zone 1)	Medium (Zone 2)	Low (Zone 3)	Total (All zones)
Paddy	9.6	31.1	23.0	22.7
Coarse cereals	-4.0	-2.1	-0.8	-2.1
Pulses	3.8	4.3	7.7	5.5
Oilseeds	0.8	-1.2	7.5	2.6
Sugarcane	6.7	2.2	0.0	2.5
Cotton	2.2	4.3	8.5	5.4
Chilies	3.1	6.1	13.5	8.2
Turmeric	3.1	0.5	9.1	4.4
Tobacco	0.4	-0.4	0.1	0.0
Foodgrains & commercial[a] crops	**26.8**	**48.0**	**62.6**	**48.4**
Fruits	21.6	18.4	4.3	13.8
Vegetables	3.7	1.2	3.5	2.7
Horticultural crops	**25.3**	**19.6**	**7.8**	**16.5**
Milk	24.9	20.4	18.5	20.7
Bovine meat	1.1	0.8	1.0	1.0
Ovine meat	1.8	0.8	1.6	1.3
Pig, poultry meat, eggs	20.1	10.3	8.5	12.0
Livestock	**47.9**	**32.3**	**29.6**	**35.1**
High-value commodities[b]	**73.2**	**52.0**	**37.4**	**51.6**

a. Commercial crops include oilseeds, sugarcane, cotton, chilies, turmeric and tobacco.

b. High-value commodities include horticultural crops and livestock.

Source: ICRISAT district level database.

A disaggregated analysis of high-value commodities

Horticulture

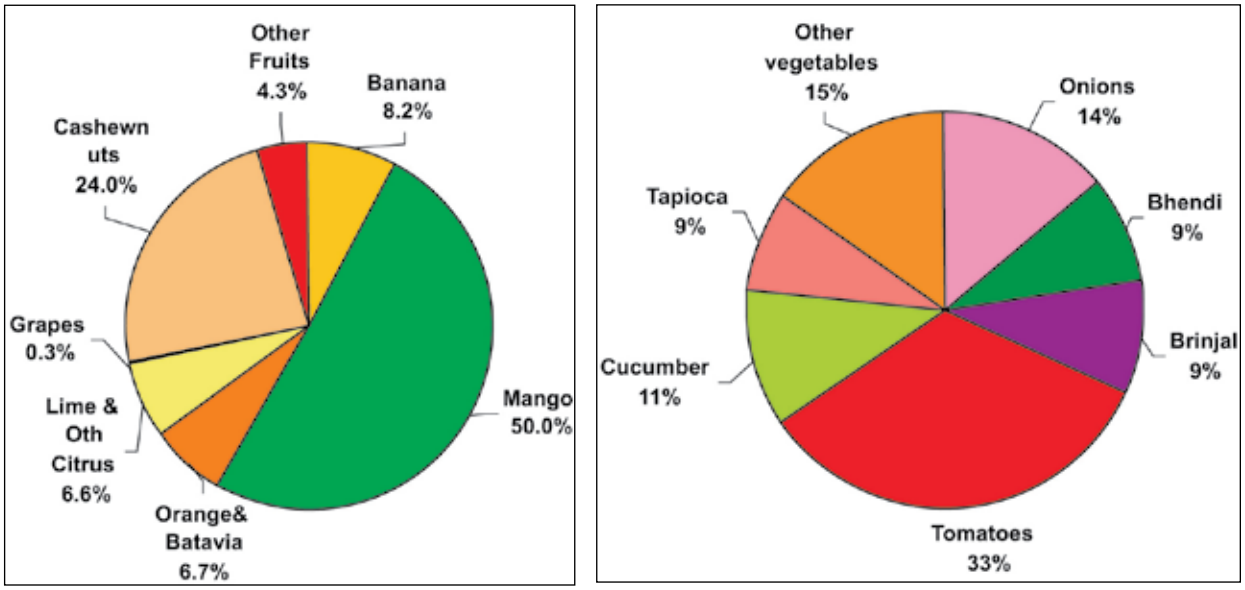
Andhra Pradesh is an important fruit- and vegetable-growing state, accounting for 11% of fruit production, and 3.4% of vegetable production in 2000-01 in the country. But its share in selected fruits and vegetables ranges from 11 to 50% (Table 2.5). The state's fruit production increased from 4.8 million tons in 1992–93, to 5.6 million tons in 2000–01, at an annual growth rate of 2.1%. The increase in production was mainly due to rapid growth of area under fruits (5.3%). Fruit production would further increase once the new orchards reach their high-bearing stage, and the old orchards are rejuvenated.

Table 2.5 Area and production of major fruits and vegetables in Andhra Pradesh, 2000–01.

Fruits/vegetables	Area ('000 ha)	Production ('000 tons)	Share in all-India (%)	
			Area	Production
Fruits				
Mango	306.2	2,449.5	20.1	23.9
Banana	32.6	819.7	6.8	5.1
Grape	1.6	31.8	3.5	3.0
Sweet orange (musambi)	41.5	625.4	51.5	53.9
Lemon	40.7	488.5	24.8	35.5
Cashew	130	75	18.1	16.17
Total fruits	5,003.4	5,604	11.5	11.0
Vegetables				
Onion	28	514	6.2	10.9
Sweet potato	1.9	25.5	1.7	2.5
Eggplant	22.2	444.3	4.7	5.8
Tapioca	21.5	166.1	8.5	2.4
Tomato	79.8	798.2	17.4	11.0
Total vegetables	250	3,148	4.0	3.4

Source: CMIE 2002.

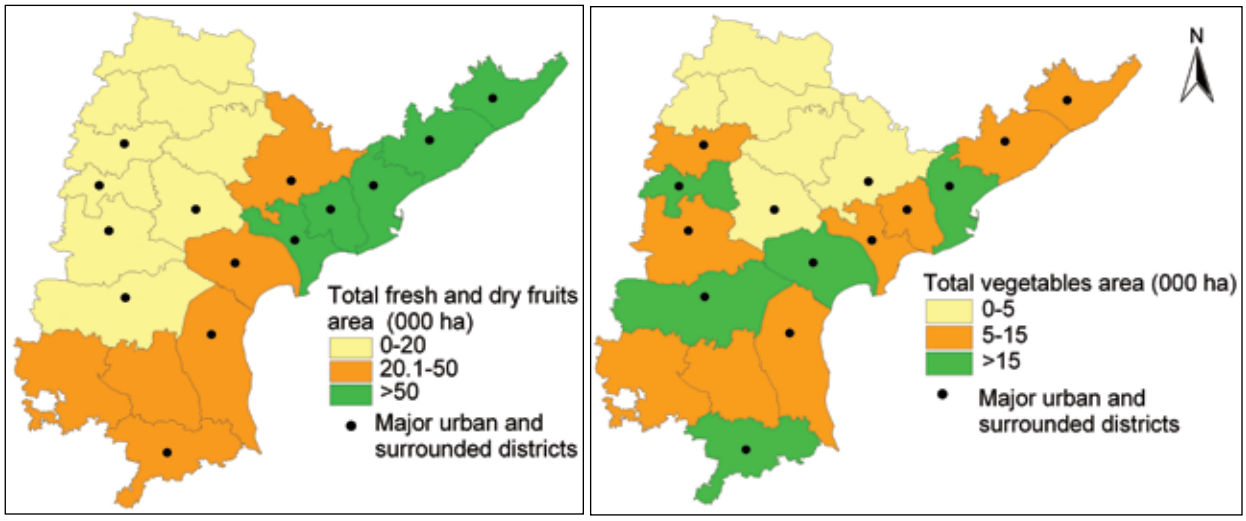
Mango is the dominant fruit crop in the state, accounting for about 50% of the total area under fruits (Figure 2.3). In recent years, papaya and lemons have also gained importance. During 1990–91 to 2000–01, area under papaya increased at an annual rate of about 23%, mainly because of its (1) fast growing demand in urban areas, (2) short gestation period, and (3) high, early and sustained source of income. Lemon is another crop that is modestly spreading in the state, its area is increasing at an



Source: GoAP (2001).

Figure 2.3 Major fruit and vegetable crops in Andhra Pradesh, TE 2001.

annual growth rate of 5.3%. Cultivation of grape is also expanding due to the export promotion and infrastructure facilities provided under the Agricultural Export Zone. The spatial distribution of fruits is shown in Map 2.2. The major fruit growing districts are Srikakulam, East Godavari, West Godavari and Krishna.



Map 2.2: Spatial distribution of fruits and vegetables area, Andhra Pradesh, 1999-2001.

Vegetable production in the state increased from 1.4 million tons in 1992–93, to 3.1 million tons in 2000–01 (annual growth rate of 11%). The area under vegetable cultivation too increased by 6.1% per annum. Apart from the growing demand for vegetables, availability of improved seeds from the private seed sector was the main reason for increase in area and production of vegetables. Tomatoes account for 33% of the total vegetable area, followed by onions, which occupy 14% (Figure 2.3). The area under these vegetable crops is growing faster than under any other vegetable. The spatial distribution of vegetables is shown in Map 2.2. The major vegetable growing districts are Chittoor, Kurnool and Medak.

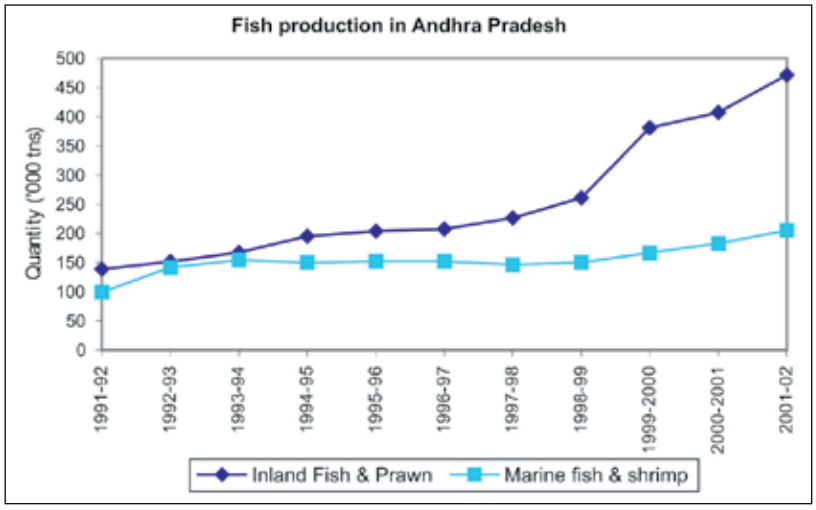
The district-wise shares of area and production of major fruits and vegetables are shown in Tables A2.2 and A2.3. There is considerable regional specialization in the production of selected fruits, especially papaya, grape, orange and cashew. Vegetable production is more widespread, but tomato, onion and tapioca are concentrated in a few districts.

Fisheries

Andhra Pradesh is one of the leading states in the fisheries production. The fisheries industry ranks first in the country in coastal aquaculture and freshwater prawn production, and second in inland fish production. In 2002, the state produced 200 thousand tons of marine fish and 580 thousand tons of inland fish, accounting for 8% and 18% respectively of the country's total production. The sector is providing direct and indirect employment to over 1.4 million fishermen, and is an important source of foreign exchange (GoAP 2002).

The growth of the fisheries sector in Andhra Pradesh was more rapid than the growth of other sectors of the economy. Between 1993 and 2003, total fish production increased at an annual growth rate of 9.5%. Inland fish production grew at a much faster rate (14%) than marine fish production (4%). The corresponding figures for all-India are 5.6% for inland fish, and 0.7% for marine fish. The impressive growth in the quantity and value of inland and marine fish is shown in Figure 2.4, and the district-wise production and growth rates are presented in Table 2.6. The spatial distribution of production is also shown in Map 2.3. The major inland fish and prawn producing districts are Nellore, Krishna and West Godavari, while the major marine fish and prawn producing districts are Nellore, Srikakulam and Visakhapatnam.

The state is a major exporter of marine products to both domestic and international markets. The Kolleru Lake area in West Godavari and Krishna districts is a major distribution centre for fish exports to eastern and northeastern states in India. The state contributed about Rs 25,000 million by way of



Source: Unpublished data from Commissioner of Fisheries, Andhra Pradesh

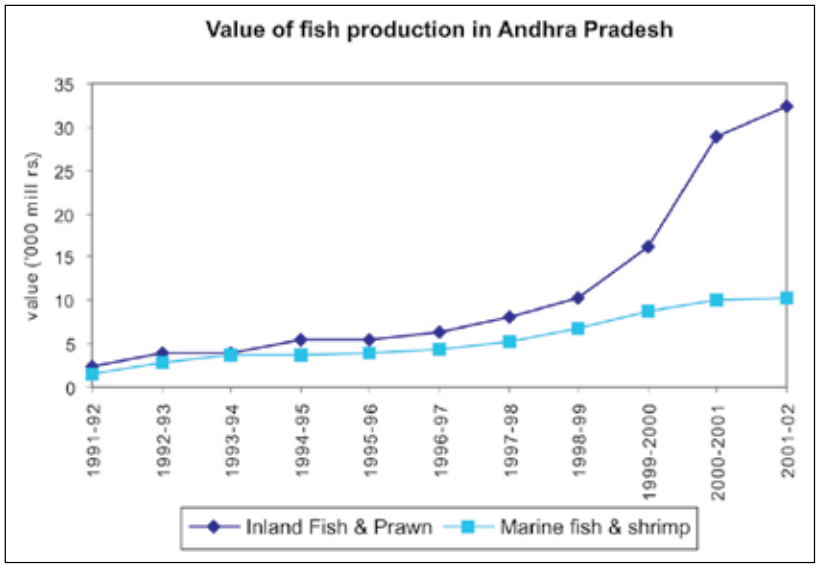


Figure 2.4 Trends in fish production, Andhra Pradesh..

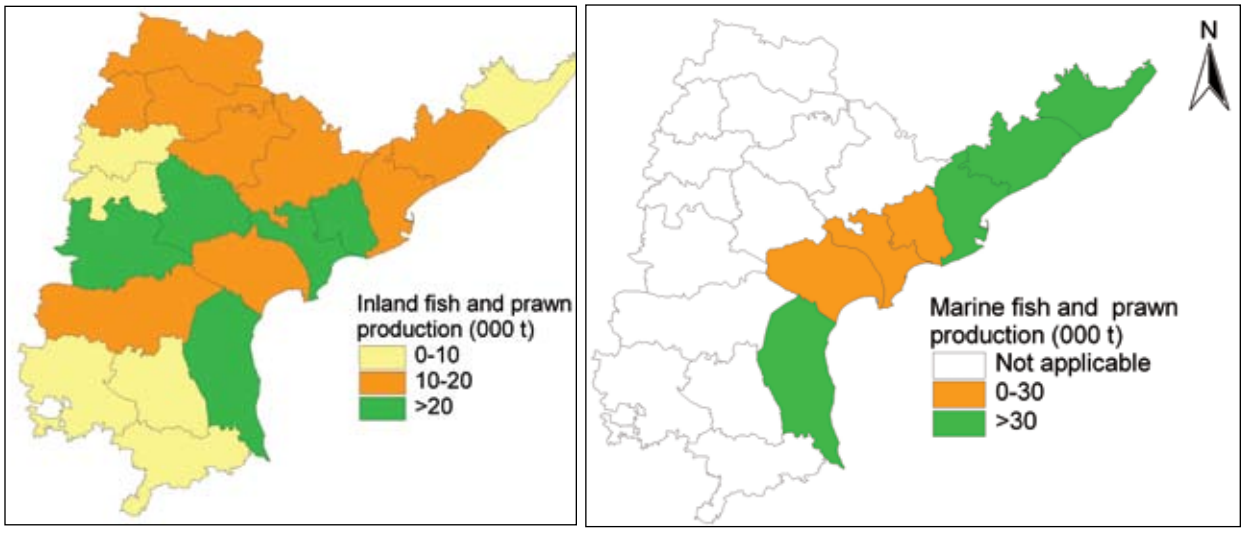
marine product exports, nearly 40% of the total marine product exports from the country in 2003–04. Japan and the United States of America are among the major export markets for Andhra Pradesh.

Table 2.6 Growth in inland and marine fish production in Andhra Pradesh by district.

	Inland fish		Marine fish	
District	Production (000 metric tons) (1999–2001)	Growth (%) (1993–2001)	Production (000 metric tons) (1999–2001)	Growth (%) (1993–2001)
Nizamabad	12.7	9.7	— [a]	—
Warangal	11.0	-0.9	—	—
Adilabad	13.1	26.5	—	—
Guntur	13.2	18.7	18.6	-10.6
Karimnagar	13.9	4.7	—	—
Anantapur	3.8	-8.9	—	—
Kurnool	10.7	33.3	—	—
Medak	10.3	0.5	—	—
West Godavari	95.1	24.7	3.2	27.0
Nellore	31.3	2.7	49.6	-0.6
Khammam	14.6	34.5	—	—
Krishna	91.7	56.2	11.9	10.4
Nalgonda	36.2	19.4	—	—
East Godavari	17.5	42.9	27.6	12.0
Srikakulam	5.7	-9.6	32.2	17.6
Cuddapah	2.3	-11.4	—	—
Mahbubnagar	18.7	6.8	—	—
Chittoor	2.7	-21.3	—	—
Visakhapatnam	7.9	-14.5	40.1	11.2
Hyderabad	7.2	22.9	—	—
Andhra Pradesh	**419.6**	**13.9**	**183.2**	**4.3**

a. Not applicable.

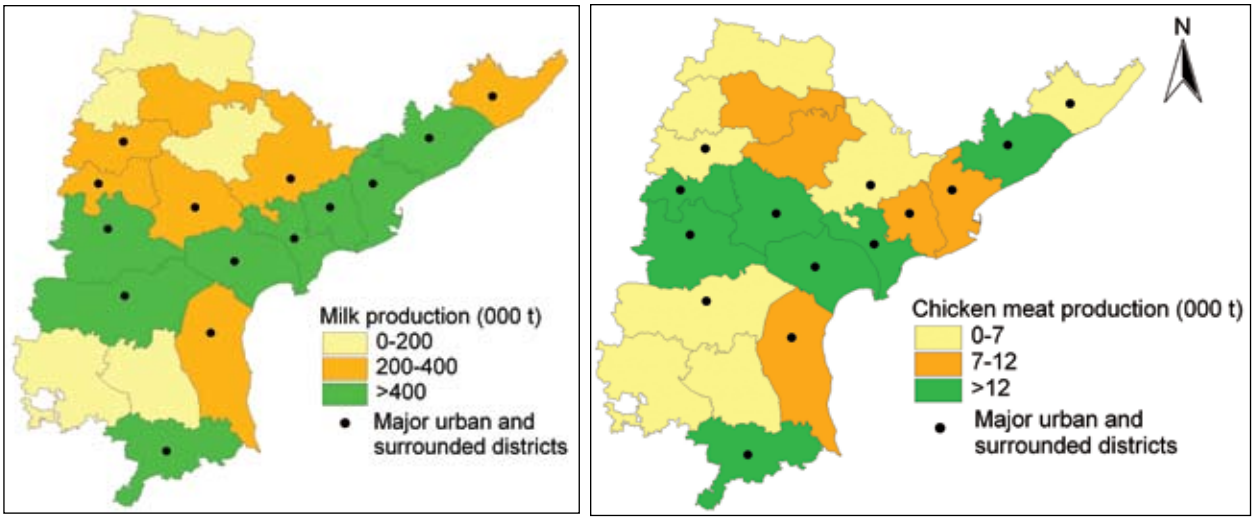
Source: Commissioner of Fisheries, Andhra Pradesh



Map 2.3: Spatial distribution of fish and prawn production Andhra Pradesh, 2001-02.

Dairy

Andhra Pradesh is the fifth largest producer of milk in the country, accounting for 7.6% (6.58 million tons) of the total milk produced in the country in 2002–03. Between 1990–91 and 2002–03, milk production in the state grew by 6.6% per annum, compared to 4.1% at the all-India level. As a result, per capita availability of milk increased from 121 g/day to 260 g/day between 1991 and 2005-06[7]. This spectacular increase in milk production came as a result of faster growth of buffalo population in the state. Buffalo milk accounts for 70% of the total milk production. District-wise milk production and share of buffalo milk are given in Table A2.4. The spatial distribution of milk production is shown in Map 2.4. Milk production is relatively higher in the coastal districts and a few districts in southern Telangana.



Map 2.4: Spatial distribution of milk and chicken meat production Andhra Pradesh, 2002-03.

Poultry

Andhra Pradesh is known as the poultry capital of India. The poultry industry is one of the fastest growing industries in the state. Between 1992 and 1999, broiler production grew at 11.3% per year. Poultry meat accounts for more than 50% of total meat production in the state (0.398 million tons; Table A2.4). Egg production too grew impressively at 13% per year between 1993 and 2004, as against 6% at the all-India level. In 2004, the state produced 15,804 million eggs, accounting for 35% of total egg production in the country. The annual per capita availability of eggs in the state increased from 64 in 1993, to 199 in 2004. The comparable figures at the all-India level are 27 eggs (1993) and 42 eggs (2004). Poultry meat and egg production is closely related to urbanization; the poultry sector is expanding far more rapidly in urban and peri-urban areas than in the hinterlands. The spatial distribution of poultry meat production is shown in Map 2.4. From the regional perspective, the districts belonging to Telangana dominate poultry meat production.

7 The all-India average availability of milk was 241 g/day in 2005-06.

The state is a major exporter of eggs to neighboring states such as Tamil Nadu, Maharashtra, Karnataka and Madhya Pradesh. It also accounts for one-fourth of egg exports from India (60 million eggs out of 220 million in 2001), mainly to countries in the Middle East. A small quantity of egg powder is also exported to these countries. The state also exports poultry meat, mainly to Asian countries.

It is quite evident from the above analysis that Andhra Pradesh has been proactive in adopting agricultural diversification as a strategy to accelerate agricultural growth. The poor performance of traditional crops and changing food basket have set the stage for increased production and export of high-value commodities particularly fruits, milk and poultry. Apart from the increase in their share in state agricultural domestic product and export earnings, the state has witnessed larger implications in terms of higher incomes, increased employment opportunities and lower pressure on natural resources.

Impact of agricultural diversification on farm economy

Based on surveys undertaken in four districts – Rangareddy, Nalgonda, Mahabubnagar and Kurnool – the implications of diversification on income, employment and natural resources were assessed. The findings are discussed below:

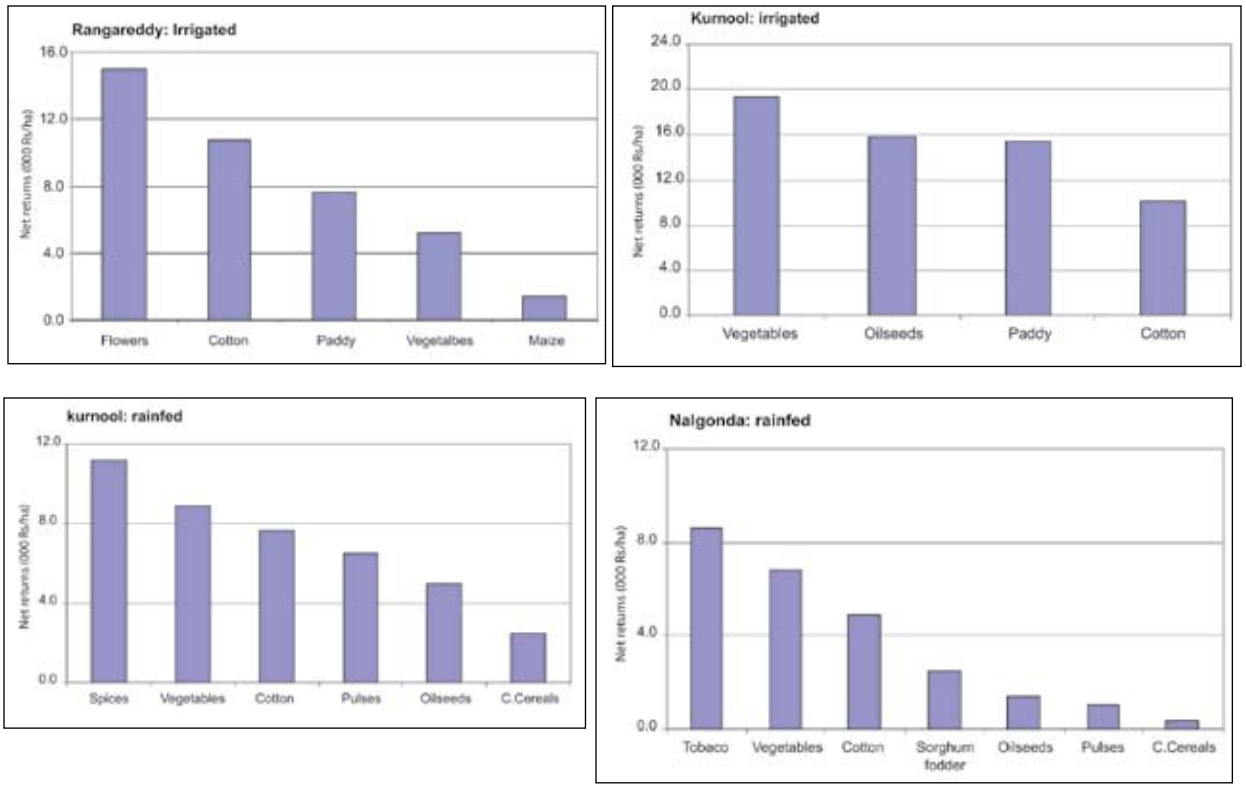
Profitability

Unit cost of production and net returns of important crops in Andhra Pradesh from the data available under the *comprehensive cost of cultivation scheme* reveal that for a number of major crops grown in the state (paddy, groundnut, cotton, etc), the unit costs are high despite high yields due to higher input costs. The state has the lowest unit cost of production and also higher yields than other states only for maize, green gram and black gram. High-value commodities are not included in the cost of cultivation studies. Hence, a cost of cultivation survey was conducted as part of the baseline surveys under the rural livelihood project that included returns to all crops, including fruits and vegetables. The findings from the study are given below.

High-value commodities such as vegetables were more profitable than traditional crops (oilseeds, pulses, cotton, etc) in Kurnool district under rainfed and irrigated conditions and rainfed conditions in Nalgonda district (Figure 2.5). In Rangareddy district, flowers where most profitable under irrigated conditions. (For details of villages and methodology refer to Appendix A). Shrimp farming yields 8–13 times higher returns as compared to paddy and groundnut crops (Ratna Reddy et al. 2004). The tiger prawn is the most remunerative shrimp type, followed by *Scampi.*

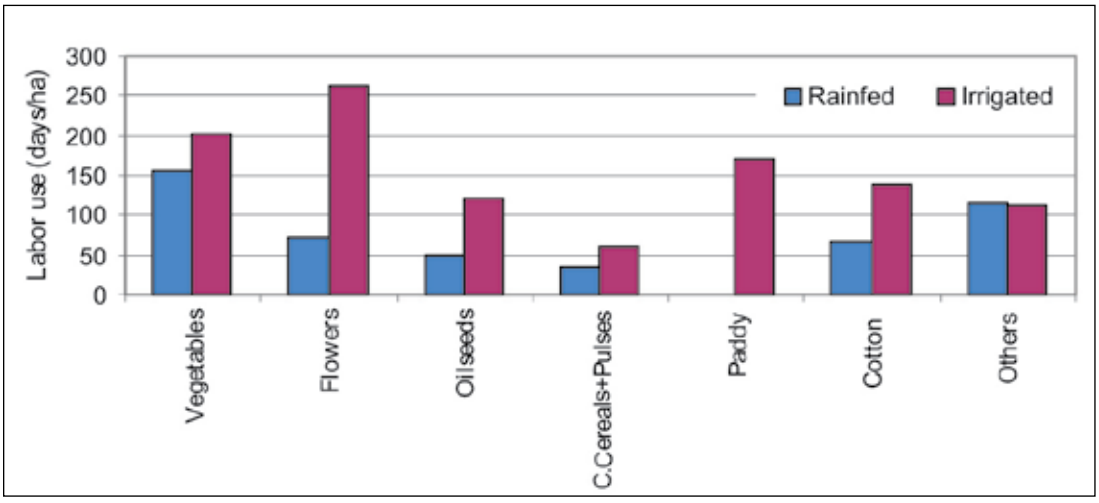
Employment

HVCs are labor-intensive on the entire production to supply chain. Labor requirement per unit of output or per unit of land was found to be high for vegetables, fruits and flowers (Joshi et al. 2003, Deshingkar et al. 2003). The data on labor days available for the four districts in Andhra Pradesh reveals a similar trend (Figure 2.6). On an average, under rainfed conditions, labor use is highest for vegetables (156 labor days/ha), followed by flowers, cotton and oilseeds. Under irrigated conditions, labor use is highest for flowers (264 labor days/ha), followed by vegetables, paddy, cotton and oilseeds. Thus, both for rainfed and irrigated crops, HVCs such as vegetables and flowers provide greater opportunities for employment.



Source: Baseline survey data, 2002-03.

Figure 2.5 Net returns for selected crops in sample households; Andhra Pradesh, 2002–03.



Source: Baseline survey data (2002-03).

Figure 2.6 Labor use (days/ha) for selected crops: average of sample households; Andhra Pradesh, 2002–03.

On the flip side, higher wages act as a deterrent to cultivation of HVCs as indicated by the regression results for vegetable production (discussed in Chapter 3). Despite high returns, high per hectare cost of production of vegetables, fruits and flowers, compared to the traditional crops, and long gestation period (in the case of certain species) tend to discourage cultivation of high-value commodities. For example, gestation period for fruits varies from 2 years to 7 years, and for some species of flowers it is 1 to 3 years. The availability of institutional credit from formal sources would be essential for the success of HVCs, particularly for smallholders.

Shrimp farming has the potential to generate greater employment opportunities and increase income levels. A study conducted by CIBA (1996) reported that the establishment of shrimp farms in Nellore district of Andhra Pradesh led to a 2 to 15% increase in employment, and 6 to 22% increase in income of farm laborers. According to the Fisheries Commissioner of Andhra Pradesh (Aquaculture Authority 2001), scientific shrimp farming generates maximum employment opportunities – 650 work-days/ha/year (against 225 work-days/ha/year through other agricultural operations).

Sustainable use of natural resources

Water requirement is growing at an alarming pace. Agriculture in the state is confronting three main water related problems: (1) declining water table due to increasing number of wells; (2) waterlogging and soil salinity due to mismanagement of surface irrigation; and (3) land degradation due to aquaculture.

The water table in the state has been consistently falling due to expansion of area irrigated through groundwater. Though the irrigated area marginally increased from 35% in the early 1980s to 42% in 2000, the increase largely came from groundwater irrigation[8] (bore-wells). The shift to groundwater has led to overexploitation of water resources and depletion of water table in several areas. As production from dry lands has become highly uncertain, farmers seek to manage the risk of drought by digging new wells/bore-wells at an exorbitant cost and at a considerable risk of failure. To cite an example, as many as 200 bore-wells were dug in Mahbubnagar district at a cost of Rs 2.74 million, but the success rate was only 42%. Even smallholders attempted to drill bore-wells after borrowing heavily (Rao et al. 2005).

Secondly, about 150,000 ha in the state are affected by waterlogging and soil salinity in surface irrigated areas (predominantly growing rice and sugarcane) largely concentrated in the Coastal Andhra region. These problems have emerged due to the injudicious use of water and inadequate drainage. Since water rates are subsidized, farmers invariably cultivate high-water requirement crops such as rice, without proper drainage, which causes salt buildup in the soil and a rise in the water table (GoAP 2003a). The adverse effects of these problems are a decline in the productivity of important crops and resources, and a fall in farm incomes. Therefore, alternative production systems with lower water requirement will help minimize these land- and water-related problems.

There is a need to identify water-saving crops to check the fall in water table and manage surface water more judiciously; HVCs could play an important role in this context. It was found that the water requirement in the state was high for blue water crops such as paddy and sugarcane (Shiferaw et al. 2003), in contrast to other crops such as flowers, vegetables, cotton and chickpea. Consequently,

8 The share of groundwater in the total irrigated area increased from 21% in the early 1980s, to 42% in 2000, while that of surface irrigation declined both for tank and canal irrigation.

water productivity of HVCs was highest (with low water requirement), while it was lowest for high-water demand crops such as paddy and sugarcane. In reality, paddy, which occupies about a quarter of the irrigated area, uses up more than 60% of water (Table 2.7).

Table 2.7 Farmers' irrigation decisions and water productivity relationships[a]; Rangareddy district, Andhra Pradesh, 2002–03.

Crop	Area cultivated (ha)	Area irrigated (ha)	Percentage of total area irrigated	Intensity of water use (hours/ha)	Net returns (Rs'000 /ha)	Net water productivity (Rs/hour)	Actual irrigation (hours)	Percentage of total water applied
Cotton	0.17	0.02	3.66	26.19	10.23	391	0.473	0.49
Flowers	0.15	0.07	13.74	71.96	26.45	368	4.875	5.01
Chickpea	0.11	0.04	8.61	21.24	7.20	339	0.902	0.93
Vegetables	0.24	0.15	30.49	76.92	13.41	174	11.562	11.88
Turmeric	0.05	0.05	10.15	94.38	15.59	165	4.723	4.85
Maize	0.26	0.01	2.02	56.61	9.03	160	0.563	0.58
Wheat	0.03	0.03	6.41	109.01	5.36	49	3.446	3.54
Paddy	0.11	0.11	22.72	530.96	11.07	21	59.473	61.13
Sugarcane	0.01	0.01	1.47	1541.94	22.58	15	11.143	11.45
Total	1.13	0.49	100				97.29	100

a. Estimates based on average cropping and irrigation decisions of sample farmers (n=120)

Source: Shiferaw et al. (2003).

The third water-related problem relates to the degradation of fertile agricultural land due to excessive aquaculture. Although the state's shrimp farming boom raised farm incomes substantially, it led to many environment-related problems like: (1) diversion of farm land to shrimp farming; (2) pollution of water bodies; (3) degradation of land and salinization of soil, leading to reduced agricultural production; and (4) deterioration in drinking water quality (Aquaculture Authority 2001). Land area around shrimp ponds were reported to have become unsuitable for growing crops, and, as a consequence, the livestock population fell due to fodder and water shortage. Large-scale abandonment of agricultural production became common around shrimp ponds. It was also reported that farmers who were inclined to shift from shrimp farming to crops had to abandon their lands for at least 2 years, to minimize the adverse effects of shrimp farming. Finally, in 1996, the Supreme Court of India intervened and delivered a judgment for compliance, to stem the range of problems generated by the expansion of aquaculture (Box 2.1).

Box 2.1 Supreme Court Judgment on Aquaculture

The problems due to excessive aquaculture became so severe in the 1990s, that, following a public interest litigation (PIL), the Supreme Court of India had to intervene and deliver a judgment in 1996 to reduce the environmental implication of shrimp farming. As directed by the Court, the *Aquaculture Authority* was set up in 1997 under the Environmental Protection Act (1986). The main function of the Authority is to ensure that no shrimp culture pond is set up within the Coastal Regulation Zone and within a range of 1,000 m of the two important lakes, Chilika and Pulicat. The Authority implements the precautionary principle and the *polluter pays principle* in coastal shrimp culture, and gives approval to farmers after ascertaining the quality and fertility of the crop land being converted. The Authority has framed guidelines for sustainable shrimp farming, and had made important recommendations: (1) preparation of master plans and setting up of aquaculture estates with adequate forward and backward linkages; (2) advice to farmers on forming local associations or farmers groups for resolving conflicts in water usage, stakeholder participation and community-based participatory approach in aquaculture development, decision-making and policy planning; (3) continuous monitoring of the environment to promote practical and economically viable farming and management practices that are environmentally responsible and socially acceptable; (4) legislation to regulate the construction of shrimp farms in mangrove areas, other sensitive areas, and in agricultural lands; and (5) establishment of effective national institutional arrangements, and policy, planning and regulatory frameworks in aquaculture and other relevant sectors in order to support aquaculture development.

The Authority's guidelines have helped check the indiscriminate use of agricultural land for shrimp farming and have paved the way for sustainable shrimp culture.

Source: Aquaculture Authority, 2001.

3. Drivers of Agricultural Diversification Toward High-Value Commodities

The higher economic growth and consequent rise in incomes are translating into higher demand for high-value commodities (Dorjee et al. 2002, Joshi et al. 2004). In India, the per capita income increased at an annual rate of 4.2% in the 1990s. Similarly, the urban population increased at an annual rate of 3%. According to UN projections, by the end of 2030, about 41% of India's population will live in urban areas (UN 2002). Globalization of agriculture under the WTO regime is also becoming an important driving force for diversification toward HVCs. Globalization also leads to changes in diets and food preferences, which no longer conform to local/traditional habits (Pingali and Khawaja 2004). These trends indicate that the demand for HVCs would grow much faster than ever before. Given their high expenditure elasticities (Kumar et al. 2007), the future growth in agriculture is likely to be driven by HVCs (Joshi et al. 2007). In Andhra Pradesh, the per capita income rose by 4.1%, close to the all-India average growth. Urban population increased by about 1.5% per year between 1990 and 2001, which is much lower than the all-India average. In this chapter, the factors that determine the promotion of high-value agriculture in Andhra Pradesh are examined.

Growing demand

The plate is changing towards high-value commodities such as fruits, vegetables, milk, meat, fish and eggs, thereby generating larger demand for these products. Over the last 20 years, there has been a considerable decline in the consumption of cereals, particularly coarse cereals, and an increase in consumption of high-value commodities. At the all-India level, monthly per capita consumption of cereals declined from 14.9 kg (11.6 kg) to 12.1 kg (9.9 kg) in rural and urban areas, respectively. The growing demand for HVCs is not only confined to the urban population, but also visible for the rural population (Mahendra Dev et al. 2004). The share of food expenditure on different food commodities reveals similar trends, both at the all-India and state level (Table 3.1). For instance, in Andhra Pradesh, the share of HVCs in total food expenditure increased from 20.2% in 1977–78, to 35.9% in 2004-05 for rural consumers and from 26.6% to 34.4% for urban consumers. Such changes in consumption patterns clearly reveal that food security is no longer restricted to the availability of cereals, but includes a diversified food basket that includes milk, meat, fruits, vegetables, fish and processed commodities (Hanumantha Rao 2000).

Table 3.1 Share (%) of food expenditure on major categories.

Food item	India				Andhra Pradesh			
	1977–78[a]	1987–88	1993–94	2004-05	1977–78	1987–88	1993–94	2004-05
				Rural				
Total cereals	51.0	41.0	38.3	33.1	55.9	41.8	41.2	35.2
Pulses, pulse products	5.9	6.3	6.0	5.6	4.9	6.7	6.4	6.0
Milk, milk products	12.0	13.5	15.0	15.4	7.2	8.4	8.9	10.6
Edible oils	5.6	8.8	7.0	8.4	5.2	8.4	8.3	8.7
Meat, eggs, fish	4.1	5.1	5.3	6.0	6.3	7.3	7.6	7.8
Vegetables, fruits	7.7	10.7	12.4	14.5	6.7	10.8	11.2	13.4
Other food items	13.7	14.6	16.0	17.1	13.8	16.6	16.4	18.4
Total food	100	100	100	100	100	100	100	100
				Urban				
Total cereals	34.1	26.5	25.7	24.0	42.7	33.8	34.2	29.5
Pulses, pulse products	5.9	6.0	5.6	5.0	5.8	7.0	6.3	5.4
Milk, milk products	15.9	17.0	17.9	18.6	11.2	13.2	12.8	14.0
Edible oils	7.8	9.4	8.0	8.1	6.4	9.5	8.3	7.6
Meat, eggs, fish	5.7	6.4	6.2	6.4	7.0	8.2	7.3	7.4
Vegetables, fruits	10.6	13.9	14.1	15.8	8.4	12.7	14.5	13.0
Other food items	20.0	20.8	22.5	22.1	18.5	15.6	16.6	23.1
Total food	100	100	100	100	100	100	100	100

Note: [a]1977–78 = NSS 32nd Round; 1987–88 = 43rd Round; 1993–94 = 50th Round; 1999–2000 = 55th Round; 2004-05 =61st Round.

Source: Various NSS Rounds on Consumer Expenditure Surveys published by the National Sample Survey Organization, Government of India.

Urbanization

In order to probe the hypothesis that urbanization promotes high-value agriculture in Andhra Pradesh, districts were delineated into two categories: (1) urban and urban-surrounded districts, and (2) hinterland districts. Districts with more than one million urban population were classified as *urban* districts; and districts surrounding the urban districts were classified *as urban-surrounded* districts. The rest of the districts were classified as *hinterland* districts. The share of HVCs in urban and urban-surrounded districts is expected to be higher than in districts located in hinterlands[9].

As expected, in the urban and urban-surrounded districts, HVCs account for 39% of the total value of agricultural production. In contrast, HVCs account for only 27% in the districts located in the hinterlands (Table 3.2). In the hinterlands, traditional commercial crops and coarse cereals account for a larger share besides paddy. On the other hand, paddy accounts for a large share in all urban, urban-surrounded, and hinterland district groups, perhaps indicative of the fact that wherever irrigation is available, paddy is mainly grown to take advantage of input subsidies and an assured procurement price.

9 With the help of ArcView®, the urban and urban-surrounded districts were superimposed on the spatial map of the overall HVC share in the total value of agricultural production, and secondly for each individual HVC across districts in Andhra Pradesh. (See Map 2.1, 2.2 and 2.4).

Table 3.2 Composition of the value of agricultural commodities (% of total value) by level of urbanization; Andhra Pradesh, 1999–2001 (1980–82 constant prices).

	District group	
Commodity	Urban & urban-surrounded	Hinterland
Paddy	28.5	25.1
Coarse cereals	2.6	7.4
Pulses	4.3	3.2
Oilseeds	4.2	13.0
Sugarcane	5.4	2.1
Cotton	2.9	7.8
Chilies	5.3	5.2
Turmeric	0.9	7.6
Tobacco	2.8	0.4
Foodgrains & commercial[a] crops	**61.0**	**72.8**
Fruits	11.9	6.2
Vegetables	2.2	1.2
Horticultural crops	**14.1**	**7.4**
Milk	15.4	11.2
Bovine meat	0.6	0.8
Ovine meat	1.1	1.8
Pig, poultry meat, eggs	7.7	6.0
Livestock	**24.9**	**19.8**
High-value commodities	**39.0**	**27.2**
Total value (million Rs)	68,973	19,408

a. Commercial crops include oilseeds, sugarcane, cotton, chilies, turmeric and tobacco.

Vegetable production is concentrated close to the demand centers, and area under vegetables is high in urban and urban-surrounded districts. Milk production is important in all districts of the state, with a few exceptions. But the share of milk production is higher in urban and urban-surrounded districts. The share of poultry production in the total value of production is highest in Hyderabad and surrounding districts. Thus, the results of spatial and tabular analysis, though not conclusive, indicate close correspondence between urbanization and selected high-value commodities such as vegetables and meat. Contrast, the bulk of fruit area is concentrated in the North Coastal districts and in the Scanty Rainfall region, which suggests that agro-climatic factors, rather than urbanization, have influenced fruit production. This is because fruits have specific niches based on agro climatic or soil characteristics. However, fruit cultivation is gradually spreading to non-traditional areas due to the availability of improved varieties.

Infrastructure development (such as highways and ports) also influences promotion of agricultural diversification toward HVCs. Since Andhra Pradesh is an important exporter of HVCs (fisheries, milk, poultry products), their production often takes place close to highways and ports that link these markets. Since the major ports are located close to urban centers, export demand for HVCs is also a driving force in urban and urban-surrounded districts. For instance, the state enjoys a marketable surplus of 75% for fish, 70% for eggs, and 43% for milk (NCAER 2003). There are no clear figures on how much of this surplus is exported. Horticulture, dairy, poultry, rice and fisheries account for nearly 60% of Andhra Pradesh's total domestic exports, with the major destinations being Maharashtra, Karnataka, Tamil Nadu, Kerala and West Bengal. Similarly, for international exports, primary commodities such

as fish, horticulture, dairy and poultry account for roughly 40% of the value of total exports from the state, with the major destinations being Australia, Bangladesh, European Union, Japan, United States of America and United Arab Emirates (World Bank 2005).

Per capita income

Rising incomes play an important role in increasing the production of high-value commodities. To test this aspect, districts were arranged according to per capita income, and then divided into three income groups by taking a third of the districts in each group. Per capita income in the state ranges from Rs 7,000 to Rs 9,000 in the low-income group; Rs 9,001 to Rs 11,000 in the medium-income group; and Rs 11,001 and more in the high-income group. As expected, the production of HVCs is highest in medium- and high-income group districts, and lowest in low-income group districts (Table 3.3).

Table 3.3 Composition of the value of agricultural commodities (% of total value) by level of income; Andhra Pradesh, 1999–2001 (1980–82 constant prices).

Commodity	Per capita income distribution (Rs.)		
	Low (7,000–9,000)	Medium (9000–11,000)	High (>11,000)
Paddy	26.2	26.8	29.7
Coarse cereals	6.5	2.6	2.5
Pulses	4.4	2.9	4.8
Oilseeds	8.4	9.8	1.3
Sugarcane	2.2	4.7	6.5
Cotton	7.2	2.8	2.8
Chilies	5.0	4.3	6.4
Turmeric	3.7	2.2	1.6
Tobacco	1.2	2.4	2.9
Foodgrains & commercial[a] crops	**67.4**	**62.0**	**62.4**
Fruits	6.3	13.5	11.3
Vegetables	2.5	1.7	1.9
Horticultural crops	**8.8**	**15.2**	**13.2**
Milk	14.5	14.2	14.7
Bovine meat	0.8	0.6	0.5
Pig, poultry meat, eggs	6.5	6.7	8.5
Livestock	**23.8**	**22.8**	**24.5**
High-value commodities	**32.6**	**38.0**	**37.6**
Total value (million Rs)	24,075	30,648	33,658

a. Commercial crops include oilseeds, sugarcane, cotton, chilies, turmeric and tobacco.

Source: GoAP (2004).

The correlation between urbanization and per capita income is 0.50. However, it should be noted that consumption, and not production, should be associated with income. The state has a vibrant intra-state trade in agricultural commodities, besides its inter-state and export trade as discussed earlier. Thus, there would be a wide gap between production and consumption in any district[10].

10 Data on consumption by districts is not readily available.

Supply-side factors

Supply-side factors are equally important for spread of HVCs. On the supply-side, agro climatic, technological, institutional and infrastructure variables are important drivers. In a study Parthasarathy Rao et al. 2004, found that HVCs are negatively associated with factors promoting intensive agriculture – irrigation, mechanization, high input use and improved cultivars. The effect of rainfall was positive in general, and infrastructure facilities such as roads and markets promote diversification towards HVCs.

Labor wages and credit availability are other important factors. Since HVC production requires more labor (days/ha), high wages may be a deterrent to HVC production. Similarly, as some HVCs require a higher investment during the initial stages, availability of institutional credit is an important driving factor.

Regression results

The spatial and tabular analysis discussed above provides some clue about the key factors driving production of HVCs. However, specific factors cannot be pinpointed with this analysis; nor does it reveal the relative importance of these factors. To get a better handle on the factors driving HVCs, simple correlation coefficients between different variables (explanatory and dependent) were computed using district-level as the unit of observation (Table A3.1). Multivariate analysis was also carried out, using models based on OLS, Tobit[11] and Seemingly Unrelated Regression Equation (SURE) technique following Zellner (1962).

For estimating the above-mentioned models, the dependent variables were defined as shares of HVCs in the total value of agricultural production, and included: (1) share of all HVCs, (2) share of fruits, (3) share of vegetables, (4) share of milk (cattle and buffalo separately), (5) share of ruminant meat, and (6) share of monogastric meat. The independent variables included a set of demand-side and supply-side factors. A list of variables included in the models and their means and standard deviations are given in Table A3.2. The underlying hypothesis is that demand-side factors exert a greater influence in promoting agricultural diversification toward HVCs. It is also hypothesized that higher wages and poor infrastructure adversely affect agricultural diversification toward HVCs.

The results of OLS estimates for all HVCs indicates that urbanization, rainfed area covered under watershed program, and districts with larger share of smallholders were positively related and significant (Table 3.4). Although wage rate and proportion of poor are negatively associated with production of HVCs as expected, they are not significant.

11 The modified version of the Tobit model is best suited to deal with a truncated dependent variable that is bound between given maximum and minimum values (Gujarati 1995). In the model used for this study, the dependent variable is the share of HVCs in the total value of agricultural production that ranges between 0 and 1. However, only OLS estimates are reported here, since the estimates obtained using the Tobit model were similar to those from the OLS mode.

Table 3.4 Factors determining diversification: all HVCs, model results; Andhra Pradesh, 1999–2001.

Variable	Estimated elasticity	t-ratio
URBAN	0.16	2.56**
SMFARM	0.85	2.23***
WSCOV	0.19	3.80***
WAGEM	-0.46	-1.04
POVERTY	-0.09	-1.02
CONSTANT		0.90
R^2	**0.58**	

***, ** Significant at 1% and 5% probability level, respectively.

Fruits and vegetables: Among the individual HVCs, fruit production is positively associated with rainfall and negatively with irrigation. Fruits thus find niches in high-rainfall regions, but away from districts having intensive agricultural systems with high irrigated area. The availability of an agro-processing industry is an important factor driving fruit production. Farm wages are negatively associated with fruit production since these are labor-intensive crops (Table 3.5). Vegetable production is positively associated with urbanization, and negatively with farm wages. For vegetables, rainfall and irrigation do not have significant bearing on their production implying that these are grown in all types of agro-climatic situations.

Table 3.5 Factors determining diversification: fruits and vegetables, model results; Andhra Pradesh, 1999–2001.

	Fruits				Vegetables			
	OLS		SURE		OLS		SURE	
Variable	Elasticity	t-ratio	Elasticity	t-ratio	Elasticity	t-ratio	Elasticity	t-ratio
CONSTANT		2.27		3.47		2.66		2.58
URBAN	-0.7	-3.11***	-0.9	-3.11***	0.7	3.69***	1.0	3.46***
WAGEM	-1.5	-1.64	-3.1	-3.75***	-4.1	-2.8***	-3.5	-3.09***
TERMLN	0.4	1.37	0.0	-0.35				
FVCOLPR	0.5	5.93***	0.6	6.65***	0.1	1.17	-0.1	-0.77
POVERTY	-0.7	-2.78***	-1.0	-2.59***	0.0	-0.01	0.3	0.78
NRAIN	1.3	1.65	1.7	2.35***	-0.4	-0.58	-0.2	-0.26
IRRI	-0.6	-2.28***	-1.0	-2.73***	-0.3	-1.17	-0.2	-0.44
Number of observations	20		20		20		20	
R^2	**0.49**				**0.70**			

*** Significant at 1% probability level.

Milk: Milk production is not concentrated in urban districts implying a more scattered production across different zones of the state (Table 3.6). However, cow milk production is significantly related to watershed programs in rainfed areas. These programs contribute to improved fodder production and consequently to higher milk production. This was found to be the case in an ICRISAT consortium led watershed program in Kothapally village in Andhra Pradesh. In the watershed village, dairy activity expanded over time, compared to the surrounding villages without a watershed program. This is mainly due to better soil moisture conservation and fitting of fodder crops in the cropping system along with

Table 3.6 Factors determining diversification: milk, model results; Andhra Pradesh, 1999-2001.

	Cow				Buffalo			
	OLS		SURE		OLS		SURE	
Variable	Elasticity	t-ratio	Elasticity	t-ratio	Elasticity	t-ratio	Elasticity	t-ratio
CONSTANT		-1.79		-2.27		5.93		4.30
URBAN	-0.1	-0.40***	-0.1	-0.71	-0.1	-1.06	0.0	-0.27
ROAD	1.3	1.76	1.1	1.91	-0.7	-2.69***	-0.4	-1.45
WSCOV	0.6	4.00	0.7	5.61***	0.0	0.34	-0.1	-1.29
CREDIT	0.2	1.53	0.3	2.03	0.1	2.18	0.1	1.21
POVERTY	0.7	2.37***	0.7	2.70***	-0.3	-1.67	-0.1	-0.90
Number of observations	20		20		20		20	
R^2	**0.79**				**0.25**			

*** Significant at 1% probability level.

the other crops (Subramaniam et al. 2006). Also, farmers are in a position to be better organized to sell milk in areas covered under the watershed programs. The availability of credit for agri-allied sectors positively influenced milk production.

It was also observed that cow milk production is higher in districts having a relatively high proportion of poor people, with the regions being characterized by poor agro-climatic endowments and infrastructure. In these regions, much of the draft power is provided by bullocks and hence cows perform multiple functions. Surprisingly, for buffalo milk production none of the variables were significant. However, credit is positively associated (though not significant) and is an important factor since buffaloes are more expensive and reared mainly as a source of additional income.

Meat: Ruminant meat (bovine, sheep and goat) is significantly associated with the availability of grasses from common grazing lands, and their production is concentrated in districts with a large proportion of the poor. Consequently, it is negatively associated with intensive agriculture (ie, irrigated agriculture). Availability of credit is negatively associated, implying that ruminant meat production is concentrated in districts with lower access to credit (Table 3.7).

On the other hand, poultry and pig meat are largely driven by urbanization and infrastructure variables such as roads. Credit showed a significant but negative influence on production of poultry and pig meat. This is puzzling and rather difficult to explain. One possible explanation for the negative influence may be that pig meat production is concentrated in less endowed regions, while much of the credit is directed towards better-endowed regions. The possible reason for the negative influence of credit on poultry production may be growing popularity of contract farming, where producers directly get inputs from the contracting firm and do not opt for organized credit.

Table 3.7 Factors determining diversification: ruminant meat, and poultry, pork and eggs, model results; Andhra Pradesh, 1999-2001.

	Ruminant meat				Poultry, pork, eggs			
	OLS		SURE		OLS		SURE	
Variable	Elasticity	t-ratio	Elasticity	t-ratio	Elasticity	t-ratio	Elasticity	t-ratio
CONSTANT		2.58		2.18		-2.09		-2.71
URBAN	-0.2	-2.00	-0.1	-0.62	1.1	7.89***	1.2	7.26***
CPR	0.5	2.45***	0.3	2.94***				
POVERTY	0.1	1.16	0.3	1.83	0.2	1.16	0.3	1.35
CREDIT	-0.2	-2.84***	-0.3	-3.29***	-0.4	-4.87***	-0.6	-4.97***
NRAIN	0.0	-0.10	0.1	0.49	0.4	0.66	0.6	1.27
IRRI	-0.6	-3.29***	-0.4	-2.60***	-0.4	-1.68	-0.1	-0.61
ROAD					1.2	1.79	1.0	1.86
WAGEM					-0.1	-0.07	0.3	0.41
IMPPOU					0.7	3.58***	0.6	3.32***
Number of observations	20		20		20		20	
R^2	**0.76**				**0.83**			

*** Significant at 1% probability level.

In short, urbanization from demand-side is an important driver for production of HVCs, with the exception of fruits and milk. This is because the production of fruits is more scattered due to agro climatic factors while milk production thrives on the cooperative network. From the supply-side, the important drivers are processing industry infrastructure, farm wages, credit and agro climatic factors. Surprisingly, road networks, which was an important driver at the all-India level (Parthasarathy et al. 2000), was not significant in Andhra Pradesh, perhaps due to less variability in density across different regions and districts in Andhra Pradesh.

4. Modern Supply Chain and Vertical Coordination

Supply chains

Fruits and vegetables

Unlike food-grains, high-value commodities are highly perishable, subject to greater production failure, market risk and price fluctuations. Therefore the supply chain of HVCs is different from that of other agricultural commodities, particularly in providing time, form and space utilities. Absence of assured markets well connected with suitable infrastructure leads to volatility in supplies and consequently prices. Prices of fruits, vegetables, broilers and eggs were reported to fluctuate considerably on a given day and between seasons. While the market infrastructure is well established for food-grains, markets for HVCs are not developed, and are generally congested and unhygienic (Sharan 1998). Regulated market yards[12] for fruits and vegetables are very few, and cover only a few districts in the state[13].

The existing supply chains of vegetables and fruits involve a number of intermediaries that add to market inefficiency and reduce the farmers' share in the consumer's rupee. See Appendix B for more detailed information on the marketing of horticultural commodities in Andhra Pradesh. In the case of vegetables and fruits, the following two supply chains are predominant:

Vegetables:

- *Supply chain 1*
  Producer → Commission agent → Wholesaler → Retailer → Consumer
- *Supply chain 2*
  Producer → Commission agent → Primary wholesaler → Secondary wholesaler → Retailer → Consumer

Fruits:

- *Supply chain 1*
  Producer → Pre-harvest contractor → Commission agent → Wholesaler → Retailer → Consumer
- *Supply chain 2*
  Producer → Commission agent → Wholesaler → Retailer → Consumer

Owing to the number of intermediaries in the supply chain, transaction and marketing costs increase, resulting in lower marketing efficiency. Commission agents exploit farmers by charging a higher commission than the stipulated amount. In Andhra Pradesh they charge 8–10% as against the official rate of 4% (Table 4.1). Even in the wholesale markets, farmers have no bargaining power, since

12 In the erstwhile Hyderabad State (under the Nizam), market yards were established since 1930 with the enactment of the Hyderabad State Agricultural Produce Markets Act of 1930, and the Madras Commercial Crops Act of 1933. In 1966, the new state of Andhra Pradesh enacted the Agricultural Produce Marketing Act 1966, integrating the earlier laws. In 2001, 870 markets were functioning under 295 agricultural market committees. Out of these, 125 market committees are located in the Telangana region, and 170 in the Coastal Andhra and Rayalaseema regions. The markets in the Telangana region are traditionally better organized than those in the Andhra and Rayalaseema regions.

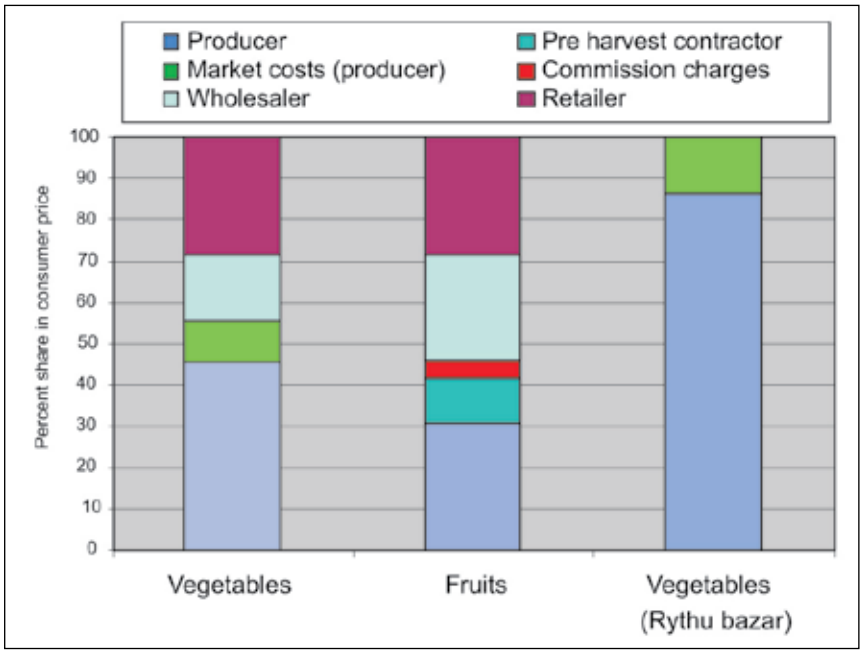
13 Fruit markets are located in the major city/town centers of the state—Hyderabad, Warangal, Vijayawada, Rajahmundry, Nellore and Chittoor. Vegetable markets are greater in number, covering more districts, but they are concentrated in the Telangana region.

most of the farmers take loans/advances from commission agents and are forced to sell the produce to them. All this adds up to the cost and results in lowering the producer's share in the consumer's rupee. In the case of vegetables, the producer's share varies from 40 to 56% depending on the supply chain and the crop (Figure 4.1). Similarly, for fruits, the producer's share in the consumer's rupee varies from 28 to 42%. The fruit producer's share is higher in supply chain 2 than in supply chain 1 because of more intermediaries in supply chain 1. The marketing efficiency index is higher in Chain 2 than in Chain 1[14].

Table 4.1 Marketing charges in Andhra Pradesh markets, 2003–04.

Market fee	Trader license fee (Rs/year)	Market charges (Rs/unit)	Commission charges
1% All commodities	Category A Rs 125	Weighing Rs 0.50 to 0.75	1 to 2% All crops (except fruits & vegetables)
0.5% Fish	B Rs 75	Unloading Rs 0.50 to 0.75	4% Fruits & vegetables
	C Rs 50	*Hamal* (porters) Rs 0.50 to 0.75	
	D Rs 25	Cleaning Rs 0.75 to 1.00	
		Loading Rs 0.50 to 0.75	

Source: GoI (2002).



Source: Market survey data, 2006.

Figure 4.1 Price spread of fruits and vegetables in wholesale markets.

14 Marketing Efficiency Index (MEI) is calculated as follows:
MEI =V/I, where V = value of the goods sold (consumer's price); and I = total marketing cost and marketing margin. The ratio of the value of goods marketed to the marketing cost is taken as a measure of efficiency. The higher the ratio, the higher the efficiency, and vice versa.

Livestock and their products

Regulated markets for live animals and milk are not efficient due to the lack of effective regulation and proliferation of middlemen in the market. In the case of milk, cooperative societies have been formed to protect the interests of small producers. But their functioning is often questioned owing to political intervention. The societies are also misused and mismanaged to benefit a few. Lack of professional management, overstaffing, and government interference are some of the reasons for their poor performance. While the Milk and Milk Products Ordinance (MMPO) last amended in March 2002 has allowed the entry of the private sector in dairy processing to increase market competition, there is a need to implement the relevant provisions of the MMPO to ensure food safety, quality and hygiene. Mutually Aided Cooperative Societies, on the lines of cooperative companies, are being planned in Andhra Pradesh; these societies will be free from government interference since they will not depend on government resources to transact their business.

There is very little information on markets for live animals. Some scattered evidence indicate livestock markets inefficient and lacking in infrastructure and other marketing facilities (Vitonde et al. 2004). In the case of broiler and egg marketing, a number of studies have highlighted the proliferation of middlemen. (Sujatha and Eshwaraprasad 2004, Raju and Sasibhushana Rao 2004, Naidu and Susheela 2004). Domination by middlemen deprives producers of their rightful share in the consumer's rupee. Seasonal fluctuations in prices and weak bargaining power of producers in times of excess production are other constraints that make their marketing risky. For eggs, seasonal variation in demand and breakage of eggs in transportation, and lack of grading are additional problems.

Innovation in marketing: *Rythu bazaar* (farmers' market)

To overcome marketing problems and exploitation of farmers by middlemen, the Government of Andhra Pradesh in 1999 introduced the concept of *Rythu Bazaar* (farmers' market), in which farmers can sell their produce directly to consumers, avoiding middlemen. The main aim of the *Rythu Bazaars* is to ensure remunerative prices to farmers and provide fresh vegetables to consumers at reasonable prices. There are 107 *Rythu Bazaars* in Andhra Pradesh, and 33 of them have permanent structures.

On an average, 20,000 to 25,000 tons of vegetables are sold in *Rythu Bazaars* every week, the annual turnover being 1.1 million tons. The government has estimated that a farmer participating in the *Rythu Bazaar* earns an additional income of approximately Rs 25,000 per annum.

To better understand the functioning of these bazaars and to quantify the benefits derived by the producers, two *Rythu Bazaars* located in Hyderabad were surveyed. Between 350–500 farmers sell vegetables daily, and they come from the nearby *mandals* (administrative units below district). Each farmer sold on an average 200 kg to 250 kg of vegetables per day. The estate officer of the market fixes prices of vegetables – 25% above the wholesale market price, and 25% below the local retail price. The producer's shares in the consumer's rupee for selected vegetables in these markets are shown in Table 4.2. The price spread is less than in the wholesale vegetable markets. In the *Rythu Bazaars*, the producer's share in the consumer's rupee is 82–90%, compared to 40–56% in the traditional supply chain (Figure 4.1). Transport costs (around 5–10%) and other implicit costs (labor wages foregone, etc) are also factored into the marketing costs.

Table 4.2 Price spread for selected vegetables in the *Rythu Bazaars* of the Mehdipatnam and Erragadda localities of Hyderabad, Andhra Pradesh, 2004.

	Mehdipatnam					Erragadda			
	Tomato	Greenchilies	Cabbage	Eggplant	Potato	Tomato	Carrot	Cabbage	Okra
Price received by producer (Rs/100 kg)	600	1,000	700	600	700	600	900	700	900
Costs incurred by producer[a] (Rs/100 kg)	103	99	110	109	105	105	106	113	104
Net price received by producer (Rs/100 kg)	497	901	590	491	595	495	794	587	796
Consumer price (Rs/100 kg)	600	1,000	700	600	700	600	900	700	900
Producer's share in consumer price (%)	82.8	90.1	84.3	81.8	85.0	82.5	88.2	83.9	88.4

Note: [a]Costs incurred by producer = transport cost + other hidden costs.
Source: Market survey data 2004.

Farmers now complain that middlemen have gradually started appearing in the *Rythu Bazaars*. There is a need to evolve mechanisms that allow only the producers in the market. Farmers have also suggested that provision of cold storage facilities in the *Rythu Bazaars* would help them in storing their unsold produce for the following day. Efforts could be made to involve the private sector for the development of cold storage facilities in the markets. Establishment of farmers' associations would facilitate group action in marketing, transportation and installation of low-cost cold storage facilities.

Vertical coordination/contract farming initiatives in HVCs

The supply chain needs to be compressed in order to reduce marketing and transaction costs, market inefficiencies, and market risks. Smallholders may shy away from production of HVCs if the markets are inaccessible, prices are volatile, and risks are high. At the same time, the corporate sector might not venture into agribusiness mainly due to the difficulty in procuring the right quantity and quality of raw materials at reasonable prices from the established markets (Asokan and Singh 2003). The *Rythu Bazaar* model would be successful near the urban centers, but farmers away from urban centers might not take advantage of such bazaars, given the problems in marketing, export and processing of HVCs. To overcome such problems and involve farmers in HVCs, alternative institutional arrangements are emerging. Among different forms of marketing arrangements, contract farming has been in India as well as in Andhra Pradesh for quite sometime and has given mixed results of successes and failures.

The concept of contract farming is not new in India, but it is still in its infancy for HVCs. Growing consumer demand for high-value food items has unleashed new opportunities of diversifying the production base, switching from traditional grains towards horticulture and livestock, both fresh and processed. Many states in India are responding to these changing consumption patterns and have been initiating innovative methods of strengthening the back-end supplies. This has set the stage for linking farmers with agro-processors and retailers through contract farming. Several corporate firms, both at the national as well as regional level (Heritage Foods Private Limited, Reliance Fresh, ITC and Choupal Fresh), have entered the agribusiness sector, venturing into HVCs for their wholesale operations, processing, retail chains and export. Different models of contract farming are emerging

depending on the commodity and region. A list of companies and commodities covered under contract farming are given in Table A4.1. Contractual agreements can be of various types: one, contracts under which only sale and purchase conditions are specified, two, contracts under which the corporate firm supplies the farmer with agricultural inputs, technical assistance, access to farm machinery, etc, either free of cost or at subsidized rates and the final produce is bought at a contracted price and third, corporate firms invest the capital and technical know-how in the field and the farmer provides land and labor. Such models of contract farming have been tried and tested in the high-value sector and have yielded mixed results. While in the first two models, the farmer bears the risk of production failure or price volatility, in the third model, he does not bear any risk nor is party to any profits. In a majority of the models, purchase price is predetermined at the time of entering into a contract. However, in some cases, although prices are predetermined, they are subject to change depending upon market prices at the time of purchase[15]. Contract farming offers a number of benefits to farmers, such as higher returns, lower marketing and production costs, assured markets, and shared risk in production (Birthal et al. 2005).

Past experiences reveal that in the advent of price volatility either farmers have refused to sell the produce to processors/retailers (when market price exceeded contracted price) or the latter have not turned up to pick up the produce (when the contracted price exceeded the market price). Also in case of crop failure, farmers have had to bear the brunt without any support from processors/retailers. The above areas of concern that lead to break down of agreements should be covered by the quasi-legal provisions in order to protect the interest of smallholder farmers.

Contract farming in Andhra Pradesh

In Andhra Pradesh, contract farming is in a nascent stage and covers only a small proportion of the area and a few commodities. In 2005, oil palm occupied the largest area (38,000 ha) under contract farming, followed by cocoa (8,500 ha) and gherkins (3,500 ha). The boom in the poultry sector was a result of contract farming where the risks, particularly marketing risks, are borne by the industry. Table 4.3 lists the major contract farming projects in the state.

Table 4.3 Contract farming projects in Andhra Pradesh.

Contracting agency/firm	Crop	Area (ha)	District covered
Sical, Godrej, Palmtech Markfed	Oil palm	38,000	East & West Godavari
Cadbury India	Cocoa	8,500	East & West Godavari
BHC Agro	Vegetables	417	Chittoor
Global Green, Capricorn Foods	Gherkins	3,333	AEZ-Gherkins districts
Dabur India	*Amla* (Indian gooseberry)	417	Across state
Venkateshwara Hatcheries	Broiler birds	50–75 farms	Around Hyderabad

Source: Department of Horticulture, Government of Andhra Pradesh, 2004.

15 For barley, although the purchase price by the company is predetermined, there is scope for increasing the price depending on the market price. Under the Apachi model, the purchase price of cotton is not fixed in advance as the prices fluctuate due to domestic and international market forces. The contract allows the farmer to sell his commodity at the prevailing market prices during the time of negotiation. The co-coordinating agency has the first right to negotiate, but in the event of disagreement about price during negotiation, the farmer groups can call for tender/auction and sell to the highest bidder (MANAGE 2003). Other models include indexing the price with market price at the time of harvest or purchase, etc.

Most recently, the entry of Reliance Fresh and ITC Choupal Fresh in agri-food retailing, particularly in fresh fruits and vegetables markets has resulted in an increase in area under contract farming. These corporate firms procure a part of their daily requirements from the farmers and are in the process of building agri-hubs that cater to their procurement, storage and marketing operations. ITC Choupal Fresh model is based on their e-choupal initiative that provides critical information related to production and price, and an assured market for the final produce, enhancing the returns to the farmers and their share in the consumer price. The company has plans to expand its farm linkages to cover more than 1200 acres by the close of 2007-08 and also add 13 more Choupal Fresh stores to the existing 7 in Hyderabad. Presently, Reliance Fresh has its collection centers spread across the state and the farmers are free to bring their produce to these centres and bag a good price. Heritage Foods Private Limited has adopted the custom farming business model, disinter-mediating the supply chain and pass on the real benefits to the farmers and the customers. Under this model, areas suited for particular crops are identified and are divided into clusters, wherein they tie up with the farmers. There is no contractual obligation between the firm and the farmers. The firm provides key inputs, knowledge and assured markets for their produce.

The state government is keen to promote contract-farming initiatives for diversification and faster growth of the agricultural sector. In recent years, the government has taken up a number of initiatives—such as the *Contract Farming Policy for the Development of Horticulture Crops*—to support and promote contract farming in the state (Appendix C). The government took a bold step to amend the existing AP (Agricultural Produce and Livestock) Markets Act 1966, based on the Model Act on Agricultural Produce Marketing developed by the Ministry of Agriculture, Government of India (Appendix D). The Model Act is an attempt to overcome some of the major bottlenecks in the present marketing system, and its main thrust is to promote competitive marketing from the farm to the consumer's plate.

Once the Model Marketing Act is effectively implemented, it would enable compulsory registration of all contract farming sponsors, recording of contract farming agreements, and resolution of disputes arising out of such agreements. Under the Act, new markets would be established by the private sector and other legal entities, and farmers would be free to sell their produce in any market. Moreover, the Act would create competition between existing and new markets to ensure better facilities to the producers. The Act has the provision to exempt market fee on produce covered by contract farming agreements. Also, it is expected to promote public-private partnerships in the management of agricultural markets.

Case studies of vertical coordination/contract farming in Andhra Pradesh

This section analyzes three models of contract farming in the state: (1) gherkins for export; (2) broilers for domestic market and (3) grapes for export and domestic market. The following case studies provide some insights into the functioning of contract farming in the state, and draw lessons for up-scaling to other agricultural commodities.

Case study 1: Gherkins for export

A non-traditional crop in Andhra Pradesh, gherkin is mainly produced for export after processing. The crop has a good international market and a negligible yet growing domestic market. The crop is mainly exported to Russia, America, Australia and Europe. Roughly 60 to 70% of the produce is exported to

Russia. The major players in gherkin exports are Global Green and Capricorn Foods. Global Green is one of the leading exporting firms, with a turnover of about 2,000 containers (14.5 tons/container) per year. The company has 6 years of experience in this business[16]. Under the contract farming model adopted, Global Green provides technical guidance and inputs (seed, fertilizer and pesticides) to farmers on credit, and the farmers in turn supply quality produce to the company[17]. The firm also provides extension services such as technical guidance on agronomic practices, appropriate use of fertilizers and pesticides, and effective management to augment productivity and reduce unit cost of production to become more competitive in the global market.

Quantity and quality: Based on the export demand, the firm decides the grades[18] and prices before sowing. Prices are generally kept uniform throughout the year, but sometimes these are changed for particular grades depending upon export demand. The entire produce is purchased from farmers as long as they meet the required quality standards or grades[19]. The produce is rejected if it does not conform to the specified grades ; but the incidence of rejection is very low, ranging from 2 to 5% of the total produce. The produce is collected at the collection centers, packed in plastic crates, and transported to the processing unit at company cost. At the processing plant, the produce is subjected to a thorough quality control before it is processed and bottled. All precautions are taken to adhere to the non-tariff barriers (specially the traceability in the final product) prescribed by the importing countries.

Motivation for contract farming: The entire gherkin production in the state is under contract farming[20]. This emerged from a survey of 100 farmers in the gherkin-growing areas. The net profit from gherkin was about Rs 35,000 per ha per crop in 2002–03. The returns over variable costs were 30% higher from gherkins than from vegetable crops, which only ranged between Rs 6,800 and Rs 20,200 per ha (Dev et al. 2004). Higher returns from gherkin, and its assured market through contract farming, have induced farmers to gradually shift towards gherkin production.

The other benefits of contract farming for gherkin production include (1) employment of family labor throughout the crop period, (2) empowerment of women as the crop provides employment opportunities (about 250–300 labor days/ha/crop), and (3) reduced migration of family members due to the availability of wage employment during off-seasons. Since the crop is labor-intensive, it is ideal for smallholders. Besides, the crop starts bearing fruit early[21], and hence yields quick returns. Thus, smallholders are more inclined toward gherkin cultivation than large farmers. This has been verified from the sample, which showed that smallholders accounted for 47 percent of the gherkin-producing farmers. Medium- and large-scale farmers accounted for 30 and 23 percent respectively.

16 Global Green has two processing plants, one located at Zaheerabad in Andhra Pradesh (50 tons/day capacity), and another at Bangalore in Karnataka (30 tons/day capacity). The Zaheerabad processing plant is serviced by four production centers/growing regions located in Gadwal and Jedcherla mandals (Mahbubnagar district), Siddipet mandal (Medak district), and Vikarabad mandal (Ranga Reddy district). In Siddipet, the company has a facilitator (Mahindra Shublabh) who procures the produce on behalf of Global Green—a type of contract farming also called the 'intermediary model'.

17 Contracting firms generally supply seed, fertilizer and pesticides to the farmers on credit, and recover the loan at the time of the final payment to the farmers. If the crop fails before harvest, the firm encourages the farmers to take up another crop of gherkin, and extend the repayment period of the first crop by adjusting the returns realized in the next crop.

18 At present (2004–05), 1st Grade (18.5 mm) and 2nd Grade (26 mm) gherkins are in demand. The company offers Rs 7/kg for the 1st Grade, and Rs 3/kg for the 2nd Grade.

19 But, in order to maintain a cordial relationship with the farmer, the company invariably buys the rejected produce as well at a nominal price (ie, 50 paise per kg) and sells it in the domestic market.

20 Hence information on contract versus non-contract production of gherkin was not available.

21 Gherkin harvesting starts 35 days after sowing, and continues for the next 30 days. There could be 2–3 crops grown in a year.

Case study 2: Broiler production contract[22]

Vertical coordination is very strong and successful in the case of broiler production in Andhra Pradesh. High risks involved in broiler production, due to outbreak of diseases and fluctuating prices, led to the closure of several small-scale broiler farms in Andhra Pradesh. To check this trend, Venkateshwara Hatcheries, a leading poultry integrator based in Hyderabad, launched a contract-farming scheme for broiler production in the mid-1990s in Andhra Pradesh (and in Maharashtra and Karnataka too).

Several farmers who had earlier abandoned their broiler farms came back to business by entering into contracts with Venkateshwara Hatcheries. Under the agreement, the integrating firm supplies chicks, medicines, and feed to farmers which constitutes 75% of the total cost of broiler production. The firm also provides technical guidance, communication and transportation for acquiring inputs. The broiler producers' inputs include land with shed, water facilities, electricity connections and labor.

At the end of the production cycle, producers receive a net price (by weight) that is determined by a group of hatcheries (not the retail price). The industry price fluctuates within a narrow band and is more stable than the retail prices. Thus, the producers receive considerable price insurance. In addition, any profits due to a rise in market prices are shared with the contract farmers. The firm also covers 5% of the mortality risk. A premium of 25% is paid on the price if the feed-conversion ratio is higher than a stipulated average. Therefore, the firm bears the market risk, while the producer bears the production risk. This type of risk-sharing mechanism protects farmers, specially the smallholders, under volatile market conditions. Ramaswami et al. (2005) have estimated that contract farming in the broiler industry could shift about 88% of the risk from the farmer to the processor. Such a risk-sharing mechanism helps smallholders in improving their management strategies and minimizing production and price risks. Contract farmers also made 13% more profit than the non-contract farmers (Table 4.4). In addition, the broiler producers were able to increase their scale of operation in such a risk-free arrangement.

Table 4.4 Costs and profits in broiler production under contract and non-contract farming[a] (Rs/metric ton).

Item	Productioncost	Transactioncost	Totalcost	Netprofit
Non-contract producer	27,322	90	27,412	2,003
Contract producer[b]	808	38	846	2,255

a.Sample size was 25 contract farmers and an equal number of non-contract farmers.

b.The firm supplies free chicks, medicines and feed to the farmers.

Source: Birthal et al. (2005).

Case study 3: Grape contract for export

Grape is one of the most traded fruit in the world. Europe is the largest market with an annual trading of about 1.1 million tons (Naik 2004). The Indian grape industry has found a niche window of 30 days (15 April to 15 May) for the export market. During this period, there is no competition for Indian grapes from other countries. Before mid-April, the European market is dominated by Chilean grapes, while South Africa, Brazil and Spain compete after May.

In India, grape is becoming one of the most remunerative farming enterprises. The crop is grown in diverse agro climatic regions—subtropical, hot tropical and mild tropical regions. The hot tropical region (Andhra Pradesh, Maharashtra, northern Karnataka) is the major grape-producing region,

22 This section has been drawn mainly from Birthal et al. (2005) and Ramaswami et al. (2005).

accounting for about 70% of the country's total grape production (Shikhamany 2001). Andhra Pradesh is well placed to exploit the opportunities from the growing global grape market. The state has about 1,675 ha area under grapes, which is 3.5% of the all-India grape area during 2000–01 (CMIE 2002). Production of grape is largely concentrated in the southern Telangana region (Ranga Reddy, Medak, Anantapur and Mahbubnagar districts) of Andhra Pradesh, but 85% of the total area is concentrated in a 75-km radius around the twin cities of Secunderabad and Hyderabad.

Marketing channels: In the domestic market, middlemen dominate the business and farmers do not receive remunerative prices. Therefore, farmers are attracted to the export market due to the premium prices offered by importing countries. The following two supply chains are popular for export purposes:

- *Chain 1*
  Large farmers → Category managers → Importing countries
- *Chain 2*
  Farmers → Sponsor (contract farming) → Category managers → Importing countries

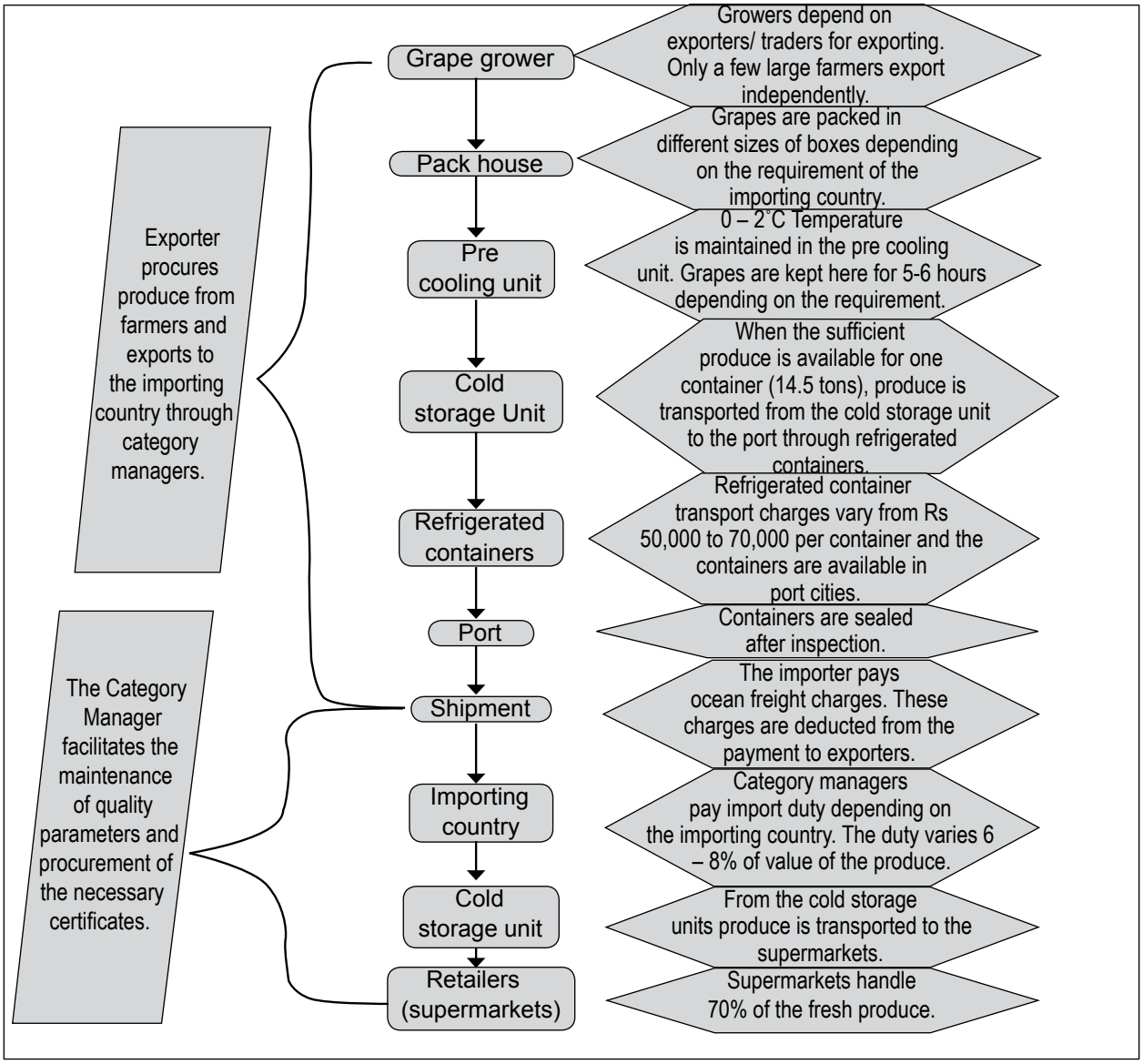
Large farmers, who have facilities like pack houses, pre-cooling and cold storage units, export directly through category managers (Chain 1). Small- and medium-scale farmers, who do not have export-related facilities and do not enjoy economies of scale, depend on the export companies and are confined to Chain 2. There is fierce competition among traders/exporters over procurement of quality grapes for export. Importing countries prescribe strict quality parameters, and exporters have to comply with the quality norms. The consignments are liable to be rejected if they fail to comply. To overcome these complexities, a few exporters have opted for the contract-farming model for grapes in order to obtain quality produce and to ensure a continuous supply. Sam Agritech, a leading exporter of grapes from Andhra Pradesh, has been using the contract-farming model since 2002. Its exports grew from 2 containers (14.5 tons per container) in 2002[23], to 22 containers in 2004, and reached 30 containers in 2005. The firm exports grapes through 'category managers' who have direct tie-ups with the supermarkets in Europe and the United Kingdom. Figure 4.2 gives details on the production-export chain starting from grape production to their marketing through category managers and supermarkets in the importing country.

The contracting firm catering to the export market is responsible for ensuring that the specified quality produce is procured and reaches its destination in the specified condition. To meet the required export standards, the grower has to adopt the appropriate agronomic practices, apply certain mechanical practices[24], and follow the postharvest management[25] guidelines as prescribed by the importing country. Grapes destined for export are graded on the basis of their physical and chemical parameters. Quality standards vary across importing countries, and are considerably different from those in the domestic market. The grape varieties grown in Andhra Pradesh for export are: Thompson Seedless, Tas-A-Ganesh, Crimson Seedless and Anab-e-Shahi. Importing countries have varying quality requirements (such as color, size, packaging, bunch weight, sugar acid, etc).

23 Sam Agritech selects farmers based on the condition of the orchard and background of the farmers. During the initial years, the company relied mostly on large-scale farmers, but it now concentrates on small-scale farmers to obtain a regular supply. Large-scale farmers do not maintain long-term agreements with the company, because they begin to export independently once they acquire the technical know-how and become well versed in the export procedures. The selection process starts after the winter pruning in the month of September. The company had a contract agreement with 10 farmers during 2005. The contract agreement is formal and written, and usually lasts for a period of 3 years.

24 For example, the preharvest practices involve the use of shade nets (which protect the fruit from direct sunlight) to meet the color specifications of importers.

25 The produce is packed in different sizes of boxes depending on the requirements of the importing country. Most of the farmers have their own pack houses in their gardens. From the pack house, the produce is taken to the precooling unit where it is kept for 5–6 days depending on the export demand. From the precooling unit, the produce is transported to the cold storage unit. When a sufficient amount of produce is available for one container (14.5 tons), the produce is sent to the port in refrigerated containers.



Source: Interview with Sam Agri Tech., during grape growers survey, 2005.

Figure 4.2 Flowchart of processes involved in the export of grapes.

Motivation for contract farming: Though the unit cost of production of contract farmers for export markets is higher (33%) than for those supplying in the domestic market, better prices ensure higher returns. Grapes produced for export markets fetch approximately 61% higher prices than those destined for the domestic market. Thus, contract farmers receive 55% higher net returns from grape production than those producing for domestic markets (Table 4.5). The cost of production for the export market is higher, due to the adoption of better management practices as well as the additional post-harvest costs incurred for packaging, pre-cooling and cold storage. To obtain the EurepGAP certification, producers of grapes for export have to follow the recommended practices, which cost 10% more than the routine cultural practices. Grape yields of the contract farmers are also usually low, since the emphasis is on quality.

Table 4.5 Cost and returns of contract and non-contract farming in grapes for export and domestic markets.

Item	Unit	Market		Percent change
		Export	Domestic	
Cost of production	Rs/kg	9.28	6.28	32.65
Yield	Ton/ha	25.0	30.0	(–) 20.00
Prices received by farmers[a]	Rs/kg	31.0 (20.0–40.0)	12.0	61.29
Gross returns	Rs/kg	21.96	12.0	45.35
Net returns	Rs/kg	12.68	5.75	54.65

a. Prices received vary from market to market. For example, price received by farmers for the UK market is Rs 40/kg. The price is Rs 33/kg for Europe, and Rs 20/kg for countries of the Middle East.

Source: Survey data from grape growers, 2005.

The farmers' share in the price paid by the consumer in the importing country ranges from 33% (United Kingdom) to 37.5% (Europe other than UK). The share of exporter and category manager is 18–19% in the entire supply chain. (Item-wise costs of grape exports are given in Table A4.2).

Besides higher returns, contract producers also benefit by the improved genetic stock and management practices, and higher returns due to participation in export markets. Contract farming provides them an opportunity to link with the global market and take advantage of liberalization and globalization.

Constraints in production of quality grapes: Grape production for export faces four broad constraints: (1) untimely rainfall, (2) water scarcity in the hot tropics, (3) high capital requirement, and (4) knowledge-intensive EurepGAP requirements. Both quality and quantity are adversely affected due to untimely rains during January and February. Rains result in high disease incidence, but importing-country norms restrict growers from spraying any fungicide during this period. As per EurepGAP norms, there should be an interval of at least 60 days between fungicide spraying and grape harvesting. Failure to respect this interval leads to pesticide residues in excess of the minimum residue level (MRL). Scarcity of water is another problem in the tropics during the flowering and fruiting stages. Apart from these problems, growers need regular training to adapt to the changing requirements of the importing countries. High capital requirement is another major problem for small-scale producers for the export market, since credit is rarely available to smallholder farmers.

Lessons drawn from innovative marketing institutions

The above discussion clearly reveals that innovative institutions, either *Rythu Bazaar* or contract farming, are compressing supply chains and improving marketing efficiency. The *Rythu Bazaar* concept is good, but it mainly benefits the farmers near the urban centers. However, through contract farming, farmers can benefit immensely even if they are away from the urban centers, and they can take advantage of the growing international markets. The contract farming models for gherkins and grapes clearly show that innovative institutional arrangements that link smallholders with the global markets can be successful. Clearly, in the absence of contract farming, it may not be possible for smallholders to take up the production of gherkins or grapes for export. These high-value crops require considerable technical skill and knowledge for complying with the production practices that help meet the standards of importing countries. Nevertheless, emerging innovative institutional arrangements make this possible through the involvement of a number of smallholders and sharing of the benefits. The level of smallholder participation in contract farming is clearly on the rise, indicating that the adoption of HVCs and the linking of farmers with domestic and global markets will eventually help in augmenting their incomes and pulling them out of the poverty trap.

5. Food Processing and Agri-Retailing Industry

India, as one of the major producers of fresh fruits and vegetables, marine products and milk, can take advantage of the growing demand for processed and semi-processed foods and enhance its processing capacity. But the organized food processing industry is at a nascent stage. At present, only 2.2% of fruits and vegetables, 6% of poultry meat, 8% of marine products, 21% of buffalo meat, and 35% of milk is processed in India, (GoI 2005b). In contrast, 70% of fruits and vegetables are processed in Brazil and the United States, 78% in the Philippines, 83% in Malaysia, and 30% in Thailand (Kaul 1997). Food processing not only contributes to the value chain but also promotes rural–urban linkages, rural industrialization, and employment opportunities (Shivkumar et al. 1999). On an average, for an investment of Rs 1 million, the agro-based industry generates employment for 140 persons, compared to employment for only 30 persons in the non-agro industries (Gandhi et al. 2001). The average raw material intensity (share of agricultural raw materials in total inputs) of food industries is around 83%, indicating a high dependence on agricultural production.

Structure of the food processing industry

Andhra Pradesh is an important food processing state, with 40% of the factories in the manufacturing sector falling under the agro-food industries category, and accounting for 10% of the total fixed capital. The comparable figures at the all-India level are 17% (agro-food factories) and 4.5% (total fixed capital) (Gandhi et al. 2001). In Andhra Pradesh, food processing accounted for about 18% of the total output from the manufacturing sector, 18% of the total employment, and 27% of total net value added (Table 5.1). The state ranks second after Maharashtra, with 10% share of total value added from the food processing industry in the country in 1999–2000.

Table 5.1 Share of food products in the output, employment and net value added in the total manufacturing sector in Andhra Pradesh.

Year	Output	Employment	Net value added
1980–81	20.93	13.42	24.76
1986–87	14.89	13.97	23.6
1991–92	16.15	19.41	26.18
1994–95	16.61	15.11	25.54
1997–98	17.82	18.28	27.36

Source: Chakravarty (2003).

In 1999–2000, there were 5,350 food-manufacturing industries in the organized sector in Andhra Pradesh, with an investment of Rs 12.1 billion (Mahendra Dev and Chandrasekhara Rao 2004). Of these, the maximum number of units were in grain milling, accounting for about 67% of the total units, followed by processing units for edible nuts, bakery products, dairy products, and fruit canning and preservation (Table 5.2). Despite this, grain milling contributed only 23% of the net value added in the food industry, compared to 25% from HVCs. At the all-India level too, within the food category, grain milling dominated, with a 44% share of the processing units, edible oils and sugar accounted for 23%, while the 'other foods' category including HVCs accounted for 33%. In terms of net value added, however, the 'other foods' category accounted for 49% of the total net value added, and for 43% of the employment in the food category. In contrast, grain milling contributed only 7% to value addition and 20% to employment.

Table 5.2 Growth rate of food processing enterprises in Andhra Pradesh.

NIC 1987 code	Item	Raw material intensity (%)	Number of Enterprises 1999–2000	Net value added (million Rs) 1999–2000	Growth rate of units	
					1984–85 to 1990–1991	1991–92 to 1999–2000
201	Manufacture of dairy products	79	94	183.2	-0.45	4.91
202	Canning and preservation of fruits	66	54	47.4	10.4	0.58
203	Processing, canning and preserving of fish, crustaceans and similar foods	79	31	345.2	-0.96	3.91
205	Manufacture of bakery products	79	110	44.8	4.80	4.27
206	Manufacturing and refining of sugar	69	—	800.4	2.07	-1.44
207	Production of indigenous sugar (boora, khandasari, gur, etc) from sugarcane, palm juice, etc.	76	—		-20.3	-1.52
210+	Manufacture of hydrogenated vegetable oils (vanaspati), ghee, etc	89	—	48.4	3.46	-4.05
211	Manufacture of vegetable oils and fats (other than hydrogenated)	86	—	219.6	8.73	2.25
215	Processing of edible nuts	89	448	261.6	62.1	5.1
216+	Manufacture of ice	46	—	6.9	-15.4	0.18
217	Manufacture of prepared animal and bird feed		70	79.4		
218	Manufacture of starch		24	42.6		
219	Manufacture of food products not elsewhere classified		—	168.1		
	All food products		5,350	4,361.2		

Source: Mahendra Dev and Chandrasekhara Rao (2004).

The trend growth rate in food processing industries in Andhra Pradesh declined from 5.1% during 1981-82 to 1990-91 to about 1.3% during 1991-92 to 1999-2000 (Dev and Rao 2004). The decline could be attributed to slowing down of grain milling, edible nut processing, and vegetable oils and fats sub-sectors, whose growth had reached a saturation point by mid-1990s. During 1990s, HVC-related sectors such as dairy products, fishing and feed manufacture (for the dairy and poultry industry) grew rapidly, reflecting their growing importance. Moreover, net value added went up in the sectors such as edible nut processing, and in HVC-related sectors such as fruits and fish processing, dairy and poultry feed, ice creams, etc. However, since these sectors took off from a low base, their growth was not reflected in the overall growth of the food processing industry.

Fruits and vegetables

Andhra Pradesh is the second largest producer of fruits and vegetables in the country. Mango, grape, banana, papaya, sweet orange, pomegranate, onion, tomato and okra have the most potential fruits and vegetables for processing. The state recently started exporting a small quantity of processed fruits and vegetables.

Most of the food processing units in the state are small-scale industrial units[26]. There are only a few medium-scale units equipped with the facilities for fruit processing and assertive packaging. The fruit processing units in the state are concentrated mainly in Chittoor district where the raw material is available. At present, only tomato and mango pulps, juices, canned fruits, jams, pickles and squashes are manufactured. The recent additions are frozen fruits, pulps, dehydrated and freeze-dried vegetables, fruit powders, fruit juice concentrates and canned mushrooms. There is ample scope for processing of fruit crops such as papaya, guava, pomegranate, banana, grape, etc., and vegetables such as gherkin, tomato, pea, tapioca, etc. See Boxes 5.1 and 5.2 for more information about processing of mango pulp and tomato.

Livestock Products

Among large ruminants, cows and buffaloes are not reared for meat. Moreover, quality of meat does not match the export standards, as the slaughter laws do not permit culling of young animals. Byproducts of slaughtered animals form an important component and can be processed into high-value added products. However, due to poor abattoir conditions and an improper recovery of 20 to 25%, byproducts are lost at the production point itself.

The poultry industry in the state is one of the fastest growing sub-sectors in the country. However, only 1% of egg production is processed into egg powder, while processed poultry accounts for less than 5% of meat production. The state has two egg processing plants that produce whole egg, yolk and albumen powder. A 4% processing tax is levied on poultry products in addition to the usual sales tax on poultry feed (Delgado et al. 2003). High taxes increase the cost of production, making the units uncompetitive in the export market. Restrictions on domestic sales also need to be addressed to make the units viable. This industry needs a fillip since the state has a surplus of egg production.

Marine products

Shrimp accounted for about 70% of the total value of marine products exported from India during 2001–02. However, the unit value realization remains low due to high cost of compliance of SPS measures. Japan (31%), United States (24%), and the European Union (19%) accounted for 74% of the value of India's marine product exports. But the stringent quality control measures prescribed by these countries under the guise of non-tariff barriers adversely affect the exports when the prescribed norms are not adhered to.

26 An industrial undertaking is considered to be a small-scale unit if its investment in fixed assets in plant and machinery does not exceed Rs 10 million. This criterion has been in force from 21 December 1999, and applies to all units, whether held on ownership terms or on lease or on hire purchase (subject to the condition that the unit is not owned, controlled or a subsidiary of any other industrial unit).

Box 5.1 Processing of mango pulp in Andhra Pradesh

The value of mango pulp exports from India increased from a low of Rs 267.5 million in 1991, to a high of Rs 2,638.5 million during 2000–01. Andhra Pradesh accounted for a third of these exports in 2000–01. The state, however, processed only 1.8% of its mango production (0.4 million tons out of the 2.4 million ton production), and exported about 40% (0.17 million tons) of the mango pulp production in 2000–01 (GoAP, 2001). Mango kernel oil, kernel flour, mango peel juice, and fried peel are other byproducts from mango processing that have commercial value and export potential. Different technologies are adopted for making mango pulp. While mango jelly is made in cottage industries under traditional technology with minimal capital investment, mango canning involves considerable capital outlay in fixed assets. A study by the National Bank for Agriculture and Rural Development (NABARD 2001) found that the net margin realized by the farmer was 21% if mango was sold to a processing unit, compared to 4.6% if it was sold to the traditional consumer. The macro impact of mango processing was also considerable with a value addition of Rs 650 million from 400 jelly units and 33 canning units.

The Chittoor district of Andhra Pradesh is an important source for the export of mango pulp in the country. The success of Chittoor in the export of processed mango products can be attributed to the successful functioning of the Agri-Export Zone (AEZ) for mangoes in Andhra Pradesh. More details on the AEZs are provided in Box 5.4. The reasons for the slow growth of the mango pulp industry are:

Lack of suitable pulp varieties; the *benishan* variety is the most common in the state.

Compliance with Hazard Analysis and Critical Control Point (HACCP). The costs for implementing the HACCP approach are higher than the returns. Financial institutions are not willing to finance the upgrading of infrastructure for HACCP compliance. Revamping the infrastructure of existing units for HACCP compliance would increase the production costs by about 40% which would make most units unviable and uncompetitive. Also, most of the processing units are small in this sector, and meeting HACCP requirements would substantially raise their costs. Mango pulp processors (exporters) are therefore targeting low-price markets (eg, countries of the Middle East) where HACCP is yet to be enforced.

Financial institutions do not provide credit, as they rate the financing of the food industry as a high-risk proposition.

High middlemen margins, taxes and packaging costs contribute to escalating prices of processed products.

Crop production issues — high incidence of pests (fruit fly), lack of uniform practices for assessing fruit maturity, uncertain yields and adoption of age-old crop management practices are basic concerns for processors.

Source: Mehta and George 2003.

Box 5.2 Tomato processing in Andhra Pradesh

Tomato is a leading vegetable crop grown in the state. The crop can be grown throughout the year. About 70% of the total tomato production of the state is used for direct consumption; 13% is processed, and 17% is wasted at different stages of the post-harvest operations. There is scope for increasing processed products, since tomato markets in some districts experience a glut during certain months immediately after harvest, when farmers do not even realize the harvesting costs. The short-term solution to such a problem is to transport tomatoes to distant markets where the demand is high.

The long-term solution would be to process tomatoes into a variety of products for different consumers. However, this demands varieties characterized by high yields and more pulp, uniform maturity, and high total soluble salt content. Growing selected varieties under contract farming is an option that can promote processing and value addition.

Source: Mahendra Dev et al. 2004.

The quality of produce is important, as processed marine products differ widely, and deteriorate rapidly in tropical conditions. It is estimated that 10% of the market arrivals are wasted due to quality deterioration in the absence of proper cold storage and transport. The infrastructure at the primary market level must be strengthened to ensure that fish farmers are able to realize better prices.

In the short run, state government needs to: enact an aquaculture seed quality control act; establish disease diagnostic centers; popularize alternative species that reduce cost of production and be in tune with the emerging demands; conduct farmer awareness camps; levy power and water charges to aquaculture on par with the agricultural sector; promulgate a comprehensive act for inland fisheries conservation, development and exploitation.

In the long run, however, the state could plan to introduce a comprehensive policy for the development of the fisheries sector, aimed at improving both production and quality through better regulation, improved infrastructure and modern technology (Appendix E).

Constraints faced by the food processing industry

The food processing industry in the state is plagued by a number of bottlenecks on the supply side. These include: (1) non-availability of raw materials in adequate quantity and of the right quality; (2) small size of the units and obsolete technology leading to diseconomies of scale, regulations, and policy hurdles; (3) high taxes; (4) lack of post-harvest infrastructure; (5) inadequate laboratories for testing and certification of food products; and (6) lack of adequate financial support for the various production and marketing processes.

India's tax levels on processed foods are one of the highest in the world. For instance, a range of taxes are levied on food products at various levels—Central Sales Tax (CST), state sales tax, octroi, *mandi* and entry tax, customs duty, etc. The net effect is a 21–23% tax on food items (GoI 2004). The comparative tax burden is 10% in the Philippines, Indonesia and Malaysia; 14–15% in the Netherlands

and the United Kingdom; and 17% in China and Ireland. High taxes add to the product costs; they impact on the prices, and consequently on the demand for processed foods.

The cost of packaging, ranging from 10 to 64% of production costs, is another major constraint facing the sector. It adds 30–70% to the cost of the processed food product. Good packaging is essential not only to preserve the freshness of the product, but also to prevent spoilage and increase its shelf life. There is, thus, a need to find cheaper and more effective packaging materials and technologies.

The regulatory overhang with more than twelve union ministries and corresponding state ministries, and the plethora of laws governing the food industry are suppressing the growth of the agro-processing sector[27]. Currently, there are about 17 laws governing the food industry, with separate laws relating to weights and measurements, packaging, adulteration, and so on. These laws are administered and implemented by different departments and/or ministries. Besides the rules and regulations framed by the central government, there are a number of regulations that come under the purview of the state government. A unified food law is in place now and it is to be seen how this is implemented at the ground level.

5.3 Food processing policy

The Food Processing Policy was a follow-up of the discussions at the Conference of State Ministers related to Food Processing held in New Delhi in November 2004. The conference focused on the need for an integrated food law, a national food processing policy, and the lowering of taxes on food products. The draft was developed for speedy development of the food-processing sector. The policy expects the food-processing sector to grow at the rate of 7.3% per year in the next 5 years.

The policy emphasizes the following aspects: (1) measures to reduce the cost of production and make processed foods affordable; (2) consolidation of the supply chain to reduce transaction costs. It is recognized that the lack of infrastructure, post-harvest losses, and multiplicity of regulatory authorities add to the costs of the processed foods; (3) increased research on packaging needs to arrive at cost-effective solutions; (4) encouragement to large food retailers or markets to procure fresh produce from farmers, and make the produce directly available to consumers; (5) improvement of infrastructure facilities for post-harvest handling, cleaning, grading, packaging, and storage; (6) upgrading of physical marketing and warehousing infrastructure and (7) state government participation in joint ventures to build and operate infrastructure facilities.

Source: Government of India, 2005.

27 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. For instance, the Prevention of Food Adulteration Act 1954 is implemented by the Ministry of Health; the Agriculture Produce (Grading and Marking) Act is implemented by the Ministry of Rural Development; the laws related to standards, and weights and measurements are under the jurisdiction of the Ministry of Civil Supplies, Consumer Affairs and Public Distribution; and the laws related to the environment are implemented by the Ministry of Environment and Forests. To set up an agroprocessing unit, an investor has to get a clearance from all the concerned departments. Such a multiplicity of laws/ministries/departments often results in conflicting approaches, lack of coordination and administrative delays.

Policies to promote food processing industries

The Government of India has formulated *a Food Processing Policy* (Box 5.3) to address some of the concerns related to the food processing industry, and has initiated a series of measures or policy initiatives that include: (1) liberalization of the import of technology and foreign technology tie-ups, (2) reduction in duties on the import of capital goods, (3) permission for equity participation, (4) hiring of foreign consultants to facilitate the flow of investment and managerial capabilities, and (5) development of agri-export zones. All food processing industries, barring those manufacturing beer, potable alcohol and wine, have been de-licensed. There is automatic approval for foreign investment up to 51%, except for a few items reserved specifically for the small-scale sector.

To ensure proper quality of processed foods, enforcement of the *Food Products Order* (FPO-1955) has been made stricter than in the past. The FPO regulates product specifications and hygiene norms in manufacture of food products. There is greater focus on quality control because of the increasingly stringent sanitary, phyto-sanitary and hygiene norms in international trade.

The pre-shipment inspection of export consignments by the Ministry of Food Processing Industries, under the *Export Inspection Act,* has helped to create greater quality consciousness among the exporters of processed fruit and vegetables.

Food processing policy in Andhra Pradesh

The state government drafted *a Food Processing Policy* in 2005 to function in synergy with the initiatives of the Ministry of Food Processing Industries, Government of India. The main objectives of the policy are to: (1) develop food parks and agri-export zones (2) harmonize various policies related to agriculture, horticulture, cooperatives, etc; (3) upgrade technology rapidly; (4) establish linkages between research, farmers and industry; (5) create a market for processed foods; (6) develop the futures market; and (7) increase the use of information technology. The ultimate goal is to offer *single-window* clearance and to put in place a *zero-inspection* regime by simplifying all procedures for inspection, pollution control, etc. The Government of Andhra Pradesh has already developed five Agri-Export Zones to promote exports from the state (Table 5.3, Box 5.4 and Appendix F).

The draft policy will cover the horticulture, agriculture, animal husbandry, fisheries, and agro-food processing sectors. In addition, it will cover the allied areas such as cold storage units, refrigerated transportation vehicles, food packaging, canning and bottling industry, and the food additives and preservatives industry.

Table 5.3 Agri-Export Zones (AEZ) in Andhra Pradesh.

Name of AEZ	Districts covered	Fruits/ products	Total estimated cost (million Rs)
AEZ Vijayawada	Krishna	Mangoes	180
AEZ Hyderabad	Ranga Reddy, Mahbubnagar and Medak	Grapes and mangoes	570
AEZ Gherkins	Ranga Reddy, Mahbubnagar, Medak, Karimnagar, Warangal, Nalgonda and Anantapur.	Gherkins	200
AEZ Chittoor	Chittoor	Mango pulp and vegetables	110
AEZ Chilies	Guntur	Chilies	–

Source: Department of Horticulture, Government of Andhra Pradesh, 2004.

The various incentives and concessions proposed under the policy include the following:

- Additional subsidy of 10% over the subsidy given by the Government of India to the food processing industry
- Electricity at a subsidized rate of Rs 1.75 per unit, for a period of 5 years for new units
- Refund of 50% of the stamp duty on land registration, etc
- Subsidy of 50% on mechanized primary processing equipment for grading, sorting, packing, washing, etc; 25% subsidy on dryers; 25% airfreight subsidy on actual airfreight incurred for the export of perishables; and a 5% interest subsidy on working capital loans up to Rs 200,000

Box 5.4 Innovations in export marketing: Agri-Export Zones (AEZs)

The Government of India announced the AEZ concept under the EXIM Policy 2001–02. There are 60 AEZs across 20 states in the country. The main objective of the AEZs is to promote agricultural exports from the country and to ensure remunerative returns to the growers in a sustainable manner. AEZs therefore aim to: (1) bring the central and state governments and local agencies in the value chain to one single point, (2) reduce transaction costs, and (3) reduce delays at all stages of the export process.

The government of Andhra Pradesh too has promoted AEZs mainly to give a fillip to exports of horticulture products. Presently, there are five AEZs covering gherkins, mango and mango products, grapes, vegetables and chilies. The estimated costs of developing the AEZs are borne by the central and state governments, and private agencies as per the Memorandums of Understanding (MOUs) signed by the parties. For example, in the Hyderabad AEZ (for grapes and mangoes), the estimated total project outlay was Rs 572 million, of which the government share is Rs. 154 million and the private entrepreneurs' share is Rs 418 million.

Farmers, agri-processors and exporters within the purview of these zones are allowed access to ongoing schemes on a priority basis, including some concessions/subsidies. The government organizes exposure visits for farmers to pack houses, and training programs for farmers on various aspects such as INM (integrated nutrient management) and IPM (integrated pest management) (Mahendra Dev et al. 2004).

The Government of Andhra Pradesh is establishing the necessary soil testing laboratories in these zones and supplying packing material such as plastic crates, etc. The AEZs would serve as catalysts for contract farming by creating the necessary enabling environment.

The Chittoor AEZ (for mangoes) is the most successful in the state and in the country. The exports from Chittoor district increased from Rs 750 million before the establishment of the AEZ, to Rs 1160 million in 2003. Besides the modernization of several units and HACCP certification, the government has exempted sales tax on all inputs and packaging material used for exports. There are a number of other demands from the processors (creation of a mango complex, cold storage and ripening sheds, concession on electricity charges, etc.), but on the whole the industry is responding well to the infrastructure facilities and policy support from the government.

Source: APEDA, 2005.

- Sales tax on inputs (other than fuel) used by the food processing industry to be adjusted against the tax payable on the sales of the finished products. Further, in respect of exports, the industries department would refund the input tax.

The new policy exempts all food processing industries from paying market cess. But the government would collect a development cess of 0.5% on the turnover of the value of finished product for exports, and the amount would be utilized to improve the infrastructure for the food processing industry.

Under the new policy, the Andhra Pradesh Industrial Infrastructure Corporation (APIIC) would form special-purpose vehicles with private agencies to develop food parks and other food processing clusters. It would draw special funds from the Industrial Infrastructure Development Fund (IIDF) and set aside some funds for effluent treatment plants, and infrastructure such as roads, and electricity, for the benefit of the food processing industry.

To strengthen backward linkages, the policy intends to promote micro-irrigation systems and contract farming, and assist in the establishment of a futures market. For forward linkages, it is expected to develop and promote electronic trade exchanges for processed food products. As per the policy, food parks would be set up as joint ventures between government agencies (eg, APIIC) and the private sector. Food processing units set up within the parks would be eligible for all concessions under the food processing policy besides additional incentives. In Andhra Pradesh, food parks are being set up for the processing of poultry products, coarse grains and spices (in the Telangana region); rice products, marine and horticulture products in the Coastal Andhra region); and for vegetable and spice products (in the Rayalaseema region).

Food retail industry in Andhra Pradesh

India is at the centre stage of the booming retail revolution and Andhra Pradesh is one of the front-runners. Although organized retailing in processed, dry and packaged foods has been there for quite some time, the scale of operations are increasing and retailing in fresh foods, particularly vegetables and fruits is taking off. The food and grocery component forms 62% of the total retail pie and 10.5% of organized retail. Although organized food and grocery retail is still a minor component of the total food and grocery retail (0.8%), this sector has been growing at a rapid pace of 30.8% over the last two years (2004-2006) (Images F&R Research, India Retail Report, 2007).

Major food retail players

Andhra Pradesh is one of the early states that amended their existing APMC legislation and allow private companies to procure directly from the farmers. It is ahead of other states in terms of the retail foray into the high-value and other FMCG products. As of March 2007, in Hyderabad, there are about a dozen retail players dealing in fresh fruits, vegetables, dairy, poultry, frozen foods and other processed staples (Table 5.4). Each has a distinct business strategy and a cross examination of some of these will provide some useful insights into understanding what the emerging benefits are, how best these can be replicated and threats which can be contained through appropriate policy dialogue.

Table 5.4 Major food retailers in Andhra Pradesh.

	Name of the Group	Format
Reliance Fresh	Reliance Industries Limited	Food and grocery retail
Trinethra (More)	Aditya Birla Group	Discount food and grocery retail
Spencer	RPG Group	Food and grocery retail
Food Bazaar	Pantaloon	Hypermarket
Food World	Dairy Farm International, Hong Kong	Supermarket
Subhiksha	Chennai based group	Discount food and grocery retail
Choupal Fresh	ITC-IBD	Fresh fruits & vegetables retail
Heritage Food Pvt. Ltd.	Owned by Chandrababu Naidu	Dairy, food and grocery retail
Jersey	Creamline Dairy Products Ltd./Creamline Nutrients	Dairy retail
Metro	German giant Metro AG	Cash-n-carry retail
Nilgiris	Nilgiris Group	Food supermarket

It might be too early to conclude which format works best as the sector is evolving and is all geared for a new look with the retailers investing heavily in end-to-end operations. The organized food and grocery retail is growing at 16 to 50%, the gains of which will first accrue to the consumers and then to the farmers (Reardon and Gulati 2008). A brief account of some of the major retailers engaged in the fresh foods market in Andhra Pradesh and Hyderabad in particular are given below.

Reliance Fresh: Reliance Industries Ltd. marked its foray into organized retailing of food products with an investment of Rs 250 billion. It started its operations in Andhra Pradesh in November 2006 with a pan India vision and has 63 retail outlets across the country. Presently there are 45 retail stores in Andhra Pradesh state of which 31 are located in Hyderabad. These neighborhood stores deal in fresh fruits, vegetables and dairy products under 'Fresh' and other grocery items under 'Select'. It has 30 procurement centers in Andhra Pradesh and they procure from local farmers as well as from other states to meet their sales requirements. Average daily sales in these stores range from Rs 150,000 to Rs 160,000 from around 800 to 1200 footfalls each day. The stores have a wide range of Stock Keeping Units (SKUs) for fruits and vegetables depending upon the quality of the produce, and are priced accordingly. Apart from the existing food and grocery convenience stores, they will venture into hypermarkets and niche retail format stores. The 'Ranger Farm' is a wholesale venture catering to the pushcart vendors and other wholesale traders. As per media reports, the company has earmarked an investment of Rs 250 billion in the retail segment, of which more than 12% will be pumped into Andhra Pradesh by 2010, given its high growth potential.

Trinethra Super Retail Ltd: Trinethra is an Indian Value Fund supermarket chain of the GW Capital Pvt. Ltd. established in 1986. It's turnover was around Rs 1.7 billion in FY-06 and has 172 outlets, of which 83 stores are in Andhra Pradesh itself. Karnataka, Tamil Nadu and Kerala are other important states where its outlets are found. It operates under the brand name of Trinethra in states like Andhra Pradesh and Karnataka and is better known as Fabmall in Kerala. These outlets offer groceries, fresh fruits, vegetables and dairy products, bakery items, frozen foods, etc. Some of them have food counters and pharmacies attached to them and other value added services such as bill payment and forex remittances. The AV Birla group acquired their management early 2008 and is set to grow with additional investment of Rs 50 to Rs 60 billion in the initial phase of take over.

Subhiksha: Retail major Subhiksha operates at four verticals- fruits and vegetables, pharmaceuticals, FMCG and telecom stores. With an investment of around Rs 3 billion, it has 450 plus stores across Andhra Pradesh, Delhi, Karnataka, Gujarat, Maharashtra and Tamil Nadu. It offers a no-frills retail price on the "Every Day Low Price" model.

ITC Choupal Fresh: ITC through its eChoupal initiative, the single largest information technology based intervention, pioneered in linking with the farmers directly. This diversified conglomerate has now marked its foray into fruits and vegetables wholesale and retail under the brand names of 'Choupal Saagar' and 'Choupal Fresh'. While Choupal Saagar is a rural hypermarket providing multiple services under one roof, where farmers can sell their produce and get the payments directly, Choupal Fresh is the urban retail outlet for fruits and vegetables (Box 5.5). These stores cater to the wholesale business in the early morning and then are open for retail footfalls. Currently there are 3 stores, one each in Hyderabad, Chandigarh and Pune. The company plans to open up 140 stores in 54 towns in the next three-four years (Business Line 2007a)[28]. The Choupal Fresh initiative is backed by rigorous extension services starting with crop demos, crop calendar, modern cultivation techniques and practices, cold chain support, etc. ITC has plans to enter into pushcart vending as well and Hyderabad is the destination to kick start this initiative. Although the initial plans were to bring the traditional push carts under the ITC banner (The Hindu 2007)[29], the alternative strategy is to cluster these vendors into groups and create a brand of their own. It is also exploring opportunities with micro finance groups to facilitate financial resources for the local vendors (Business Line 2007b)[30]. This has the potential of giving a brand image to the street vendors creating more remunerative employment opportunities and better purchasing experience to the consumers.

The race is on

The impact of the retail revolution is considered to be most profound at the two ends: traditional retailers and farmer producers at one end and consumers at the other. There is a major debate on the future of traditional *kirana*[31] stores and local vendors as organized retailers jostle to get closer to consumers. As organized retailing unfurls, how will the estimated 15 million retailers (Images F&R Research, India Retail Report, 2007), mostly the 'mom and pop' outlets position themselves? Where will the local vendors at the wet market and traditional pushcarts find themselves in the race? These are some of the issues that are at the center of debate and many fear the implications of their being wiped out. Although the traditional 'mom-and-pop' stores, local vendors and small traders are making space for modern format retail outlets, under all circumstances they are likely to co-exist for several more years. Their proximity to households, convenience of home delivery and personal interaction with consumers will help them score well. A study by Joseph et al. (2008), found that the initial adverse impact on unorganized retailers in the vicinity of organized retailers weakens overtime. The study also made a number of policy recommendations on the competitive response of the unorganized retailers to regulate their interaction with large retailers.

However, in the long run, as the fragmented and unorganized markets consolidate and become more organized, there will be a change in the profile of the existing retailers/processors and reshuffling of their activities in the supply chain. Farmer producers will benefit from better returns and consumers from lower prices that are likely to be offered by an organized value chain. While the farmers can

28 Business Line (2007a), ITC Plans more Choupal Fresh stores, KV Kurmanath, 18th January 2007.
29 The Hindu (2007), Pushcarts to get a brand name soon, V Geetanath, AP, Hyderabad, 8th February 2007.
30 Business Line (2007b), ITC set to experiment with small vendors, KV Kurmanath, 2nd December 2007.
31 Kirana refers to traditional retail shops in the neighborhood selling grocery, food items and almost all essential household items.

Box 5.5 ITC Choupal Fresh in Hyderabad

ITC under its Choupal Fresh initiative is tying up with farmers through a cluster approach. It has identified certain villages around the urban stores as feeder villages to source fruits and vegetables for daily requirements. Every village has a lead farmer who practices the modern methods of cultivation and in turn helps fellow farmers to adopt the same.

GMed is assisting ITC to develop a reliable procurement system of direct purchase from smallholder farmers through extension services in Andhra Pradesh.

During an IFPRI visit to Hyderabad, we met this smallholder farmer who has benefited from the extension services provided by ITC and is probably the one who sells the best tomatoes in the city. He is able to get higher yields as well as better quality, which fetches him a premium for his produce.

- Name: Bhupal Reddy (ITC Lead Farmer)
- Village/District: Annasagar/Medak
- State: Andhra Pradesh
- Own Land: 2 acres
- Farming for the past 20 years
- Tomato Yields: Increased from 10-15 ton/acre in traditional fields to 25-30 tons/acre in modern fields

In addition to better yields, he is able to save upon the input costs (fertilizers and pesticides) and also the commission he had to pay at the mandi.

These end-to-end operations of ITC are not guided by written/formal contracts and the farmers have the freedom to sell their produce to anyone. These are the building blocks of a credible and sustainable business partnership.

Source: IFPRI Field Visit, March 2007.

benefit from direct linkage with retailers and processors, efficiency gains from the value chain between farmers and consumers can be large[32]. Modern retailers/processors will invest heavily at the front end and devise attractive price strategies to woo the consumers. As the consumers diversify towards high-value products and the demand rises, there will be fierce competition to rein in prices. This will result in the rise of discount sale offers, home service and other attractive offers. In order to meet the growing consumer demand, the retailers/processors will have to strengthen backend operations in order to ensure a steady and smooth supply of fresh produce.

32 Estimates of these potential gains vary, but the CEO of one of the largest grocery chains in India put it anywhere between 25 and 40%, provided appropriate changes are made in the legal/institutional clauses, especially related to APMC for direct buying from farmers, and provided investments are made in infrastructure to realize this potential.

With a large, unorganized and fragmented value chain, the costs are high and gains negligible, making it difficult to envisage a profitable business proposition in high-value agriculture. Particularly, small and marginal farmers who have small surpluses and are severely resource constrained, are caught in a subsistence trap. It is important to understand that the dynamics of a high-value chain is very different from that of any traditional value chain. Unlike cereals and grains, high-value commodities such as fruits and vegetables have a relatively low shelf life and are highly perishable in nature. Fresh and processable varieties of fruits and vegetables, dairy and marine products require sophisticated logistics and warehousing facilities. Extension services that deliver information on produce, food safety, price and markets are essential for the farmers to calendar the right quality and quantity of crops. The modern retail operations will require a dynamic supply chain that can overcome the structural inefficiencies of the existing traditional chains.

Modernizing the traditional value chain is also important to remain competitive in the face of global competition. Failure to do so will affect the very survival of the commodity sector due to high costs.

6. Constraints to Diversification and Food-processing/ Retailing

The performance of HVCs and the agro-processing sector are influenced by the availability of credit, and infrastructure related to post-harvest handling and quality standards. Unless these sectors are equipped to meet the requirements of the producers and stakeholders of HVCs, the speed of agricultural diversification and agro-processing would be far below the potential.

Credit

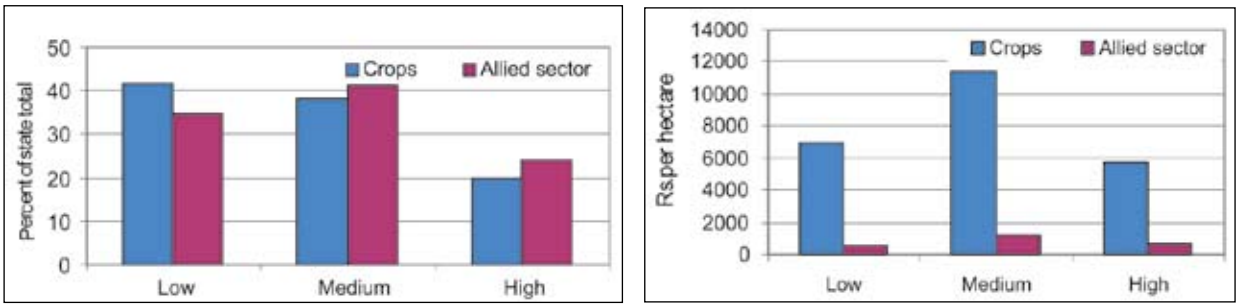
High-value commodities are capital-intensive. One of the most important constraints faced by farmers, particularly by smallholders, is the non-availability of credit to harness the potential of high-value commodities. Less than 30% of the credit requirement of farmers in Andhra Pradesh is met through formal credit. Informal sources of credit dominate the rural credit sector, with interest rates ranging from 24 to 40% (compared to 12–15% for formal sources), which add to the cost of borrowing (Rao 2004, Rao et al. 2005). Even in the formal sector, the crop sector accounts for the lions share of primary credit with only 6% going to HVCs such as dairy, poultry, fisheries and cold storage development in 2003–04. Within the crop sector, food-grains accounted for 53% share followed by oilseeds, sugarcane, cotton, etc. The share of vegetables was only 5%. For the allied sector, dairy activities accounted for 32% of credit, followed by small ruminants, poultry and fisheries. Marketing infrastructure and cold storage programs received about 13% of the allied sector credit.

One of the reasons for the lower quantum of credit from the formal sector is the prevalence of the tenancy system in the state. Tenant farmers are deprived of bank loans and crop insurance schemes. Since HVCs are credit-intensive due to high initial costs, tenant farmers opting for HVC production are forced to rely on informal sources, which compound the cost of credit and eventually affects the profitability and competitiveness of HVCs.

Regional disparity

There is considerable regional disparity in the disbursement of formal credit across the state; Crop credit per hectare is highest in the coastal districts of East and West Godavari, Krishna, and Guntur (Table A6.1). With the exception of Nizamabad, all other districts in Telangana and Rayalaseema regions show relatively low disbursement levels. Thus, while the medium-diversification districts account for 38% share of crop loans, the high-diversification districts account for only 20% (Figure 6.1). The credit flowing to allied activities such as dairy, poultry, fisheries, etc, follows a similar trend. Clearly, the coastal districts (medium-diversification zone) corner a large share of not only crop loans but also credit for allied activities.

Crop credit (including credit for vegetables) per cultivator in the state is generally low—only Rs 10,596 per cultivator—varying from a low of Rs 4,138 per cultivator in Visakhapatnam, to a high of Rs 38,274 per cultivator in Krishna. A closer look reveals that credit dispersal is positively correlated with irrigation, while the rainfed areas are starved of credit. The low average availability of credit per cultivator, particularly in rainfed areas, explains the dominance of informal sources of credit and the higher cost of borrowing.



Source: SLBC (2004)

Figure 6.1 Distribution of credit by diversification zones, Andhra Pradesh, 2003–04.

Therefore, there is a need to reorient credit toward the high-growth sectors such as horticulture, fisheries, livestock, etc, by diverting some of the credit from irrigated agriculture to the rainfed areas, since the allied activities are expanding mainly in the rainfed areas.

Cold storages

The quality of HVCs is adversely affected when shipped over long distances in the absence of appropriate transportation. The post-harvest losses of fruits and vegetables are high (Tables 6.1 and 6.2). Moreover, driven by supply and demand factors, HVC prices fluctuate considerably across seasons and also within a given season. Cold storages provide an opportunity for producers to store

Table 6.1 Post-harvest losses of fruits and vegetables at various stages in Andhra Pradesh.

Stage	Extent of post-harvest losses
Field level	10
Transport	5
Packing	2
Storage	9
Processing	4
Total	30

Source: GoAP (2003c).

Table 6.2 Post-harvest losses (%) of selected fruit and vegetable crops at the all-India level.

Crop	Extent of post-harvest losses
Banana	20–80
Mango	17–36
Citrus	20–95
Guava	10–15
Papaya	40–100
Apple	14
Grape	20–25
Tomato	5–50
Onion	25

Source: National Horticultural Board, 2004.

their products and sell them when the market conditions are more favorable. Secondly, cold storages are essential to preserve product quality over a longer period. There is a positive correlation between the number of cold storage units and the production of fruits and poultry products.

There are 235 cold storage units in Andhra Pradesh with a total capacity of 569,307 tons. The distribution of units is not uniform across districts. Guntur district accounts for about 26% of the units, followed by Hyderabad/Ranga Reddy districts (19%), and Visakhapatnam (13.6%) (Table A 6.1). These 3 districts account for about 60% (341,018 tons) of the total capacity available in the state. The availability is low in a number of rainfed districts. Cuddapah, Medak, Prakasam, Srikakulam, Mahbubnagar, and Kurnool have less than 5% of the total cold storage units and less than 3% of the total capacity available in the state.

In Hyderabad/Ranga Reddy district, cold storage units are used to store grape, apple, pomegranate, sweet orange and tamarind. The other major commodities stored are chili (Guntur district), and tamarind, potato, mango and processed tomato products (at Punganuru and Madanapalle in Chittoor district). However, the units are not fully occupied round the year as farmers' awareness about cold storage units is very poor. On the other hand, high power tariff and erratic power supply are the main problems in the maintenance of cold storage units. The use of generators escalates the cost of storage and affects product quality.

Quality standards and SPS issues

Indian exports of HVCs include fresh fruits and vegetables, processed fruits and vegetables, cut and dried flowers, seeds, spices, and cashew kernels. Exports depend not only on exportable surplus, but also on the varieties grown, their quality traits, adherence to sanitary and phytosanitary (SPS) standards, international prices, and the availability of infrastructure facilities for storage, post-harvest handling and transportation to ports.

An important constraint facing the HVC sector (both fresh and processed food) is the stringent SPS requirements imposed by developed countries, requirements that go beyond the standards stipulated in the Agreement on Agriculture (AOA) under WTO[33]. Pesticide residue and microbial contamination limits are important for fruits and vegetables, while parasite and zoonotic disease limits are important for animal products. Thus, although trade in fresh and processed food products is growing faster than exports of other products, the application of stringent food safety regulations is witnessing an increase in the number of rejections. The top three categories of food that were detained on SPS grounds by the US Food and Drug Administration (FDA) in 1999 included vegetables, fishery products and fruits (Unnevehr 2000).

Non-compliance with SPS measures can undermine the benefits of trade liberalization in the food processing sector, and can impede trade through unjustified requirements in different markets, unnecessary and costly or time-consuming tests, and duplicative conformity assessment procedures

33 Traditional non-tariff barriers, Technical Barriers to Trade (TBT), and compliance with sanitary and phytosanitary (SPS) measures are impeding the growth of exports. SPS measures are regulations on trade in foodstuffs and feed and other natural products to protect human, animal and plant health in the importing country. SPS measures are defined as any measures applied to (1) protect human or animal life from risks arising from additives, contaminants, toxins or disease-causing organisms in their food; (2) protect human life from plant- or animal-carried diseases; (3) protect animal or plant life from pests, diseases or disease-causing organisms; (4) prevent or limit other damage to a country from the entry, establishment or spread of pests (WTO 1995).

(Zarrilli 1999). During 2000–01 and 2001–02, the decline in exports from India of processed fruits and vegetables (-8%) and animal products (-6.5%) was due to the non-adherence to SPS measures imposed by developed countries under the guise of WTO (Mehta and George 2003). Certain instances of selective application of SPS measures are cited below to reveal their impact on food exports from India:

The European Union imposed a complete ban on all fish exports from India in 1997, after some consignments were found to be contaminated with *Salmonella* and *Vibrio cholerae* bacteria (FAO 2003).

Australia, China and Japan do not allow imports of Indian mangoes and grapes on the grounds that they carry certain fruit flies. Ironically, China imposed a ban on grapes for a species of fruit fly that does not exist in India. On the other hand, the US Department of Agriculture (USDA) allowed entry of fruit and vegetable consignments only after detailed tests in the production region. The Japanese stipulation of vapor heat treatment (VHT) of fruits is yet another instance of SPS becoming the key non-tariff barrier.

India was de-listed from the European Union's list of approved countries for import of egg powder into the Union because of India's non-compliance with HACCP's Residue Monitoring Plan. India consequently lost an egg powder export market of more than Rs 1,000 million due to the application of strict SPS measures. To become HACCP compliant, each processing unit had to invest around Rs 15 to 20 million (about 5% of the total investment cost). With no domestic market for egg powder, the existence of non-operating units, low capacity utilization of operational units, and their higher operating costs added up to a huge burden on the industry. No domestic agency took the responsibility of preparing the Residue Monitoring Plan for animal products including egg powder, and the matter moved from one ministry/department to another. The application of stringent food safety and animal and plant health measures consequently impose additional costs on the exporting country.

To meet the challenge of issues related to quality and SPS measures, the Government of Andhra Pradesh needs to take appropriate initiatives to ensure adherence to international standards, particularly for paddy, chilies, sugar, mango, grapes, gherkins, prawns, fish and other marine products. The government needs to set up pesticide and aflatoxin residue testing laboratories at appropriate locations, as well as facilities for HACCP, Codex standards, and risk analysis in accordance with SPS/TBT regulations. The cost of setting up these facilities or their upgrades need to be worked out for planned implementation.

7. Policy Implications

Indian agriculture is passing through a transition phase, moving away from a supply-driven mode to a demand- or consumer-driven mode. In Andhra Pradesh too, agriculture is responding to such a change in spite of numerous constraints. It is clear that agricultural diversification is offering new opportunities to the state, especially in the rainfed areas, and that it is contributing to the state's agricultural growth. The state is well positioned to take advantage of the unfolding opportunities as a result of the increasing demand for HVCs at the domestic and global markets, but it needs to evolve appropriate strategies in order to more effectively exploit the emerging trends.

Agriculture in the state is already diversifying toward HVCs. However, if this is to continue smoothly, a comprehensive strategy needs to be evolved, which involves a whole new set of technologies, infrastructure, institutions, and policies. The current agricultural policy thrust is founded on the philosophy of ensuring food self-sufficiency and does not provide much emphasis on the role of diversification towards high-value agriculture. For agricultural diversification to succeed, the real challenge lies in effectively linking the farmers, especially smallholders to the markets since they have small marketable surplus and hence incur high transaction costs. While it is necessary to provide assured markets and stable prices to the farmers, it is also important to establish backward linkages through existing institutional arrangements such as contract farming. Poor infrastructure, inadequate storage and warehousing facilities, zoning and movement restrictions of agricultural produce, lack of access to technology, credit and insurance tend to slacken the pace of production diversification and has resulted in underutilization of food processing capacity. It is time to reform the existing food processing laws and give importance to food safety issues to meet the growing international demand for processed food items. This sector will thrive on advanced infrastructural facilities such as cold storage, roads and port facilities, and will require large investments involving greater private sector participation in the form of agribusiness ventures. It will be essential to replace subsidies with investments, with the government playing the role of a facilitator.

It is therefore evident that reforms/policy changes would be crucial to meet the emerging challenges in the agricultural sector and harness the emerging opportunities. It is important to identify the key levers of change and create an enabling environment for private sector participation in high-value agriculture.

Marketing reforms

The pre-requisite to promoting HVCs is to implement the model marketing of agricultural produce act. In 2003, a Model Marketing Act (MMA)—titled the *State Agricultural Produce Marketing (Development and Regulation) Act, 2003*—was formulated by the Government of India to improve the competitiveness of the existing agricultural marketing system. The highlights of the Act included (1) setting up of new markets by private or other parties, (2) direct marketing by farmers to agro-processors, (3) provision for contract farming, and (4) futures or forward marketing. The Act was designed to ensure that market regulation would give way to market competition, thus reduce marketing costs and improve marketing efficiencies. Using this Act as a model, each state in India was required to draft its own agricultural marketing act, with possible amendments to suit its specific requirements. In this regard, Andhra Pradesh has brought about an amendment to the existing AP (Agricultural Produce and Livestock) Markets Act 1966 to include the features of the Model Marketing Act and speed up its implementation. For effective implementation of the amended marketing Act, it should be accompanied by (1) an

integrated food law; (2) a negotiable warehousing receipt system; (3) liberalization of the Essential Commodities Act (ECA–1955), to allow the free movement, storage and marketing of agricultural commodities; and (4) liberalization of the Forward Contracts (Regulation) Act (1952) to allow futures trading in agricultural commodities. These amendments have already been initiated, but the uncertainty about their continued implementation is discouraging the creation of a business environment for the promotion of agricultural diversification and agro-processing.

Until the above mentioned Acts are in place, functional steps should be taken to streamline the present marketing setup (such as checking the collection of unauthorized commission from farmers by the commission agents above the stipulated rate, and the practice of deferred payment). Grading and standardization of produce should be transparent and publicized widely. All stakeholders should be made aware of concepts such as pledge finance and negotiable warehousing receipts. If required, the necessary training programs could be organized at the district level. The aim should be to reduce the farmers' dependence on commission agents, thus giving them more flexibility in the sale of their produce.

The existing market committees should be revamped, and the funds collected as market fees should be used for improving infrastructure to meet the requirement of diversified agricultural produce. The feasibility of a market stabilization fund, particularly for fruits and vegetables, should be studied to protect farmers from low prices during gluts.

Food processing industry legislation

The food processing industry faces a number of challenges—monopoly commodity markets (leading to high cost of raw material procurement), poor infrastructure, high transaction costs, multiplicity of laws, price controls and high taxes on processed foods. For example, India is a major producer of fruits, vegetables and milk in the world. However, due to its low share in processing, less than 1% of fruits and vegetables are exported from the country. Unless the necessary steps are taken, the high potential of the horticulture sector will remain untapped.

Initiatives that could help maximize the potential of the food processing sector are: (1) provide a single-window facility to all stakeholders in the food industry, with respect to clearances, subsidies, and other schemes of the state and central governments; (2) reduce taxes on processed food in line with the taxation rates in other countries; (3) legalize contract farming agreements and register all contract production under the Agricultural Produce Marketing Act; (4) simplify procedures for arbitration in the case of disputes between growers and contracting agencies. As case studies indicate, the role of the government should be restricted to facilitation alone.

Once the enabling environment is created, and restrictions on the role of the private sector in agriculture are streamlined, we can expect the following: (1) farmers obtain access to latest technologies (2) production geared to meet quality standards, brand building, value addition, and exports, and (3) a strengthened supply chain leading to lower transaction costs. The role of the government would be restricted to facilitating the entry of the private sector in agribusiness.

Strengthening of institutions

Commodity committees

Commodity committees need to be established at state level for horticulture crops (fruits, vegetables) and other HVCs (spices, livestock, poultry, etc). The state-level committees would include representatives from all stakeholders—farmers, state and central government agencies related to horticulture crops, research departments, bankers, industry, exporters and farmers' organizations. The state-level committee would provide market intelligence and take up policy related issues with the government. Similarly, at the regional level, the commodity committee would include all the above representatives from a given region. The regional committees would create awareness among farmers on the latest technologies, package of practices and schemes and subsidies available from the government. Strategies to promote fruits and vegetables should include both short- and long-term strategies:

At the farmer level, crop-specific associations would facilitate bulking, grading and storing of produce and selling directly to processors through appropriate market linkages and to enable effective utilization of incentives from various government departments. The associations could also take corrective measures (reducing area in the case of a glut of a particular crop) and simple value addition, etc.

Short-term strategies: facilitation of exports of fruits and vegetables through appropriate grading, packing, pre-cooling, vapor heat treatment, fast-track transport, and subsidy on air/sea freight. Long-term strategies: promotion of contract farming, value addition, market intelligence for both domestic and international markets, rationalization of land leasing laws, research and development, formation of agri-export zones.

Credit

Credit is an important requirement for the production of HVCs, which are capital intensive. Banks are unable to lend to 30–35% of farmers since the farmers are either share croppers, or do not have *pattadar* passbooks (indicating legal ownership of land) or are defaulters. All farmers, including tenant farmers and women farmers, should be eligible for formal loans. Alternatively, banks could consider crop loans to tenants on a 'group guarantee' basis. Insurance premiums on commercial crops should be reduced, since high premiums detract farmers from taking insurance, and without insurance they are not eligible for loans. The Kisan credit card scheme could also be promoted in less-endowed regions that are the emerging hubs for HVCs.

The state-level agricultural subcommittee of the State-level Banking Commission (SLBC) should revisit the sectoral and regional distribution of primary credit in the state. Crop loans account for a major share of credit, and within the crop sector, paddy and irrigated crops get the lions share. This should be modified so as to cover more crops, particularly rainfed crops.

Although the allied sector is growing fast, it accounts for a small proportion of primary loans and much of it goes to the better-endowed regions, thus depriving the less-endowed regions where allied activities are more important. In a number of rainfed districts, the credit per cultivator is half to less than half of the state average. This could be because banks perceive a greater risk in lending to farmers engaged in rainfed agriculture. The vicious circle can be broken only if the state promotes a comprehensive crop or rainfall insurance scheme via the existing National Agriculture Insurance Scheme, to mitigate

the risk of rainfed farming to some extent. The coverage should include all crops including horticulture crops. The calculation of compensation should be worked out in a transparent and easily understood manner. In addition, banks should consider flexible and longer repayment schemes for rainfed farmers, and special incentives should be given to banks meeting the targets in rainfed areas.

The number of rural branches of banks should be increased, and this should be accompanied by an increase in the credit–deposit ratio of rural banks to around 80%, from the current 60% level. To the extent possible, the same interest rate should be charged for all loans for agriculture. The functioning of regional rural banks (RRB) and cooperatives needs to be improved as these institutions suffer from political interference and lack of professionalism, and often end up as loss-making units.

Water

The share of groundwater in the total irrigated water has increased substantially in the state leading to the depletion of groundwater resources. The fall in the water table is reflected in the unsuccessful attempts at digging borewells, which entail huge costs and losses to farmers, many of whom end up in perpetual indebtedness. Paddy and sugarcane account for the bulk of the irrigated water in the state. The water use efficiency (WUE) of these crops is low compared to the less water consuming crops such as fruits, vegetables, cotton, flowers, etc. Since water is reckoned to be a free resource, farmers' water use and allocation patterns do not reflect the marginal productivity of scarce water resources.

The maintenance of surface water sources should be stepped up, particularly tank irrigation through desiltation, and incentives created for their maintenance by the community. Economic incentives and water charges would be needed to regulate irrigation water. The water charges should be high enough to shift the cropping pattern to high-value and water-efficient crops.

The minimum support price (MSP) for paddy and wheat is one of the main factors responsible for inefficient water use by the farmers, since they are assured of a market and fixed prices. For several other commodities including horticulture, livestock and fish, the support prices are not operational due to their perishable characteristics.

Land

In Andhra Pradesh official records are not available on tenant farmers. But the extent of tenancy is quite high and estimates show that tenancy accounts for one third of the cultivated land (GoAP 2005). The Land Revenue Act 1999 stipulates that the names of tenants should be recorded in revenue records. But this is not happening. As the tenant farmers are not recognized effectively by the government, they are not eligible for institutional finance (GoAP 2005). The names of the tenant farmers must be recorded in revenue records as prescribed by the Land Revenue Act 1999, so that they can avail of the credit through financial institutions and other benefits targeted at farmers.

Extension services

The existing agricultural extension needs to be completely revamped and tuned to the changing scenario. The prerequisite is to change the mindset with respect to extension. Presently, the focus is on food crops and not on the emerging sectors. The Government of India's policy framework for agricultural extension (2002) will focus on increasing farm household income through diversification.

The goal is to make extension more market-driven, promote public–private partnership in extension, and withdraw public extension where farmers are willing to pay. The demand for paid services in India was higher in non-foodgrain crops, especially horticulture crops and oilseeds (World Bank 2005b).

Some of the most recent developments in the field of extension include (1) the establishment of the *Agriculture Technology Management Agency* (ATMA, a registered society of key stakeholders in a district), which serves as a focal point for integrating research and extension; (2) the *agri-clinics* scheme introduced by NABARD in 2002 which is designed to supplement the government extension system; (3) increased role of private extension by agribusiness firms, NGOs, cooperatives, input suppliers, etc. The state government should adopt or take advantage of some of these models for more effective extension.

Investment in infrastructure

There is a need for greater investment in infrastructure development, especially cold storage units, cold chains, roads, ports and agricultural research. The post-harvest losses of fruits and vegetables are very high. Their quality is also adversely affected when shipped over long distances in the absence of appropriate transportation. Also, prices of HVCs fluctuate considerably across seasons and within a given season, driven by supply and demand factors. Cold storages and cold chains provide an opportunity for producers to store their products, maintain their quality and sell them in off seasons and to distant markets when the local markets are not favorable.

In Andhra Pradesh, cold storage units are concentrated in the coastal region, while the rainfed areas have too few of them. However, the units in some areas are not fully occupied round the year as farmers' awareness about cold storage units is very poor. On the other hand, high power tariff and erratic power supply are the main problems in the maintenance of cold storage units. The use of generators escalates the cost of storage and affects product quality. The situation demands three key approaches: (1) build more cold storage units in rainfed areas, (2) educate farmers about cold storages and their utility, and (3) ensure regular power supply for cold storage facilities.

The other infrastructure constraints include road transportation, rail/air transport, ports and associated facilities. A World Bank study (NCAER 2003) reveals that the existing port facilities for HVCs in Andhra Pradesh were inadequate and pose a key constraint to their promotion. The study specifically highlighted horticulture, fisheries, poultry and rice. The first three are perishable and require controlled storage facilities. Andhra Pradesh can take advantage of having as many as nine ports by upgrading the facilities in them to meet the needs of HVCs.

Involvement of agribusiness

Involvement of private agribusiness in HVCs is important to accelerate the speed of agricultural diversification. It can be done by creating a better business environment, ensuring stable policies, and relaxing the Acts that restrict their participation. The state has already provided a good business environment, especially to the information technology sector. The same approach is needed for promoting HVCs and their processing. The participation of agribusiness would be necessary to promote contract farming, exports and investment in agro-industries and cold chains. The amendment of the marketing and food processing Acts would give a greater impetus to agribusiness participation. Examples of successful agribusiness initiatives include the production and processing of poultry, mango, grape, gherkin and fish for the domestic and export markets.

Other issues

Besides tackling generic problems, a few other issues specific to certain commodities need to be addressed for making these ventures successful. Here we highlight issues related to fisheries, and livestock and poultry:

Fisheries

Aquaculture must be treated on par with agriculture with regard to provision of services such as water, power and credit. The government has drafted a bill on aquaculture seed quality control, which, coupled with reduced antibiotic consumption, supply of pure water for processing, and setting up of laboratories for disease diagnosis, would facilitate quality control and adherence to international standards. Road linkages to landing centers are critical for quick disposal of produce. The environmental issues related to aquaculture need to be addressed since it leads to negative externalities for the environment and adversely affects the non-participating producers too.

The government should sort out the issue relating to the insurance of shrimp farming, since companies are not willing to insure shrimp farming, and banks are refusing to lend without insurance. The process for acquiring licenses from the Aquaculture Authority for brackish water shrimp unit should be streamlined. The issue of permits for freshwater aquaculture (following a Supreme Court ruling) should be addressed by the state at the appropriate level.

Livestock and poultry

The poultry sector is outside the purview of both the agriculture sector and the Companies Act. As a result, while the income from poultry is taxed, unlike agriculture, the sector is not entitled to the benefits under the Companies Act available to industrial units.

The milk sector supply chain needs to be revamped by the provision of bulk coolers and linking these with the chilling/processing plants. Institutional reforms – for example, the promotion of Mutually Aided Cooperative Societies in the state – would go a long way in improving the dairy sector. The Mutually Aided Cooperative Societies are free from government interference since they are not attached to the state-level Dairy Federation. For greater professionalism in the production and marketing of milk, the government should seriously consider the advantages of floating ‘producer companies’ or new-generation cooperatives. Producer companies would be under the purview of the Companies Act, while cooperatives are under the purview of the Registrar of Cooperatives. This initiative could be tested on a pilot basis in the regions where the cooperatives are not functioning efficiently.

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Appendix Tables

Table A2.1 Selected indicators by level of diversification; Andhra Pradesh, 2001.

Indicator	HVC-based diversification zone			
	High (Zone 1)	Medium (Zone 2)	Low (Zone 3)	Total (All zones)
Demographic				
Population density (number/km^2)	319	291	236	276
Urban population (%)	37	22	22	27
Literate rural female population (%)	35	47	34	39
Agrarian structure/farm size				
Average size of land holding (ha)	1.3	1.2	1.5	1.4
Number of small landholders (%)	82	84	78	81
Technological				
Irrigated area (% of gross cropped area)	34	59	36	42
Area under high-yielding varieties (%)	22	53	27	33
Fertilizer (kg/ha of net cropped area, NCA)	130	306	168	193
Tractor density (per 1,000 ha of NCA)	7	14	7	9
Diesel and electric pumpset density (per 1,000 ha of NCA)	129	102	126	121
Cropping intensity	117	134	117	9
Agro-climatic				
Average normal rainfall (mm)	793	1,031	847	881
Infrastructure				
Road density (km/km^2 of geographical area)	0.7	0.7	0.6	0.6
Market density (markets/10,000 km^2 of geographical area)	29	31	23	27
Livestock				
Common property resources (% of geographical area)	18	19	20	19
Feed availability (metric tons/livestock unit)	1.3	2.0	1.6	1.6
Improved poultry (%)	56	61	49	56
Improved cattle, sheep and pig (%)	9.3	2.2	1.3	4.3
She buffalo to cow (ratio)	0.9	2.8	2.0	1.8
Veterinary institutes (number/1,000 livestock units)	0.10	0.11	0.10	0.10
Artificial insemination centers (number/1,000 livestock units)	0.22	0.20	0.17	0.19
Socioeconomic				
All crop and livestock (Rs/ha of gross cropped area, GCA)	6,459	9,188	5,942	7,003
High-value commodities (Rs/ha of GCA)	3,266	3,443	1,579	2,549
High-value commodities [Rs/capita (rural)]	667	707	418	582
Credit (Rs/ha)				
Crop	5,763	11,436	6,985	7,818
Allied agricultural activities	676	1205	566	769

Sources: Directorate of Economics and Statistics (2003a, b, c, d).

Table A2.2 Distribution of fruits across districts in Andhra Pradesh, 2001–02.

District	Mango		Cashew		Banana		Orange & batavia Orange		Papaya		Grape		Total fresh fruits	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
	Percent of state area and production													
Guntur	-	-	-	-	17.5	17.3	9.0	8.6	4.9	3.6	-	-	-	-
Karimnagar	-	-	-	-	-	-	7.3	7.3						
Anantapur	-	-	-	-	-	-	23.3	34.6	48.4	49.0	4.3	4.3	-	-
Kurnool	-	-	-	-	5.0	5.0	-	-	3.9	3.5	-	-	-	-
Medak	-	-	-	-	-	-	-	-	-	-	1.5	1.5	-	-
West Godavari	6.5	6.7	29.2	29.4	14.6	14.4	-	-	-	-	-	-	6.6	6.8
Nellore	-	-	-	-	-	-	8.1	9.0	3.2	2.0	-	-	8.6	9.1
Khammam	10.3	10.7	-	-	-	-	-	-	-	-	-	-	7.3	5.3
Krishna	19.9	20.3	-	-	2.9	3.0	-	-	-	-	-	-	13.5	10.1
Nalgonda	-	-	-	-	-	-	31.5	19.9	-	-	-	-	6.4	4.0
East Godavari	6.1	6.5	22.2	22.2	22.1	20.5	-	-	-	-	-	-	6.6	7.6
Srikakulam	7.6	7.8	15.5	15.2	7.9	7.4	-	-	-	-	-	-	-	-
Cuddapah	5.2	5.5	-	-	9.4	11.7	-	-	32.1	33.9	-	-	7.1	10.9
Mahbub nagar	-	-	-	-	-	-	-	-	-	-	4.6	4.6	-	-
Chittoor	14.1	14.7	-	-	-	-	-	-	-	-	2.4	2.4	9.3	7.1
Visakha patnam	10.4	10.7	24.3	24.3	10.7	10.5	-	-	-	-	-	-	11.4	10.2
Hyderabad	-	-	-	-	-	-	-	-	-	-	86.3	86.3	-	-
Andhra Pradesh	**315.0[a]**	**2,424.8[b]**	**149.6**	**86.9**	**43.9**	**1,047.8**	**61.3**	**618.8**	**5.5**	**546.6**	**1.5**	**31.0**	**490.8**	**5,445.4**

Notes: [a]Area = '000 ha. [b]Production = '000 metric tons.

Source: Government of Andhra Pradesh.2004. Department of Horticulture. GoAP.

Table A2.3 Distribution of vegetables across districts in Andhra Pradesh, 2001–02.

	Tomato		Onion		Eggplant		Tapioca		Sweet potato		Total vegetables	
District	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
	Percent of state area and productio											
Guntur	5.0	5.0	-	-	9.3	9.3	-	-	17.1	17.1	8.2	8.0
Karimnagar	-	-	-	-	-	-	-	-	-	-	-	-
Anantapur	-	-	5.0	4.9	4.7	4.7	-	-	-	-	-	-
Kurnool	31.5	31.5	32.7	30.7	-	-	-	-	4.3	4.3	19.7	15.8
Medak	-	-	11.0	12.3	-	-	-	-	-	-	4.8	5.0
West Godavari	-	-	-	-	5.7	5.7	-	-	-	-	-	-
Nellore	-	-	-	-	-	-	-	-	23.1	23.1	-	-
Khammam	-	-	-	-	-	-	-	-	-	-	-	-
Krishna	-	-	-	-	-	-	-	-	-	-	-	-
Nalgonda	-	-	-	-	-	-	-	-	-	-	-	-
East Godavari	-	-	-	-	10.5	10.5	94.9	94.9	-	-	11.4	16.5
Srikakulam	-	-	-	-	8.2	8.2	1.6	1.6	4.0	4.0	-	-
Cuddapah	-	-	9.6	8.5	-	-	-	-	-	-	-	-
Mahbub nagar	6.4	6.4	9.2	8.6	5.2	5.2	-	-	-	-	4.8	4.7
Chittoor	13.1	13.1	-	-	7.8	7.8	-	-	8.9	8.9	6.6	6.2
Visakha patnam	-	-	-	-	11.1	11.1	3.1	3.1	23.8	23.8	6.1	5.7
Hyderabad	15.4	15.4	8.6	8.6	9.9	9.9	-	-	4.8	4.8	10.6	9.8
Andhra Pradesh	**76.5**[a]	**764.7**[b]	**31.1**	**522.8**	**21.5**	**430.3**	**19.1**	**381.8**	**2.0**	**39.3**	**234.4**	**2,862.3**

Area ('000 ha) Production ('000 tons).

Source: Government of Andhra Pradesh.2004. Department of Horticulture.

Table A2.4 District-wise milk, meat and egg production, Andhra Pradesh, 2002.

	Milk	Meat					
District	Total ('000 metric tons)	Buffalo (%)	Total ('000 metric tons)	Large ruminant (%)	Small ruminant (%)	Pig & poultry (%)	Eggs (million)
Nizamabad	136	69.3	10	7.9	30.2	61.9	181.2
Warangal	158	76.0	14	4.8	21.5	73.7	532.9
Adilabad	168	56.3	5	16.9	50.6	32.5	172.9
Guntur	668	97.4	22	2.5	38.5	59.0	1,462.3
Karimnagar	328	69.8	18	6.4	40.2	53.4	360
Anantapur	192	59.9	12	5.5	31.9	62.6	235.3
Kurnool	403	75.7	14	20.6	33.0	46.4	222
Medak	206	66.6	49	51.4	41.3	7.2	422.3
West Godavari	446	84.2	12	7.9	21.8	70.3	1,426.8
Nellore	339	87.0	17	10.2	23.9	65.9	428.1
Khammam	308	71.9	7	12.1	32.5	55.4	193
Krishna	486	81.8	24	5.3	30.7	63.9	832.6
Nalgonda	262	68.9	19	4.4	16.2	79.4	584.6
East Godavari	483	73.6	13	4.2	20.0	75.8	1,089.4
Srikakulam	277	35.1	9	0.9	30.4	68.7	269.1
Cuddapah	136	87.0	9	7.2	28.2	64.6	266
Mahbubnagar	436	68.5	35	2.5	19.1	78.4	863.9
Chittoor	535	17.3	23	1.6	15.1	83.3	1,214.6
Visakhapatnam	403	62.9	18	0.4	16.9	82.7	686
Hyderabad	213	61.6	69	38.4	38.1	23.5	3,419.4
Andhra Pradesh	**6,582**	**69.3**	**398**	**17.0**	**30.0**	**53.0**	**14,862.2**

Source: Govt. of Andhra Pradesh. 2003. Directorate of Animal Husbandry.

Table A3.1 Correlations between HVCs and selected indicators: Andhra Pradesh[a].

Variable	HVCs[b]	Fruits	Vegetables	Milk	Ruminant meat	Pig, poultry, eggs	Livestock[c]	Commercial crops[d]
Urban (%)	0.50	-0.02	0.59	0.05	-0.21	0.73	0.56	-0.18
Population density (inhabitants/km^2 of geog. area)	0.49	0.06	0.45	0.02	-0.45	0.71	0.51	-0.54
Literacy (rural females %)	0.10	0.48	-0.21	-0.13	-0.72	-0.16	-0.26	-0.37
Marginal farms (%)	0.25	0.33	-0.16	-0.10	-0.64	0.24	0.07	-0.55
Farm size (ha)	-0.25	-0.33	0.19	0.09	0.63	-0.25	-0.08	0.56
Poverty (%)	-0.05	-0.19	0.10	0.22	0.53	-0.09	0.08	0.59
Human Development Index	0.25	0.13	0.15	-0.08	-0.63	0.37	0.18	-0.29
Income (Rs. per capita/year)	0.29	0.25	0.10	-0.02	-0.57	0.28	0.14	-0.22
Wages (Field labor male, Rs./day)	-0.21	0.09	-0.63	-0.26	-0.31	-0.11	-0.23	-0.13
Wages (Field labor female, Rs./day)	0.13	0.33	-0.33	-0.04	-0.45	0.03	-0.05	-0.01
Crop credit (Rs./net cropped area)	-0.18	0.21	-0.27	-0.20	-0.72	-0.28	-0.39	-0.31
Allied activities (agrl.) credit (Rs./ha)	0.26	0.33	0.08	0.19	-0.68	0.05	0.03	-0.49
Crop and allied activities credit (Rs./ha)	-0.08	0.21	-0.17	-0.15	-0.74	-0.16	-0.27	-0.38
Road density (km/km^2 of geog. area)	0.25	0.21	-0.17	0.05	-0.46	0.29	0.19	-0.54
Market density (markets/km^2 of geog. area)	0.18	0.27	-0.09	-0.21	-0.39	0.20	0.02	-0.48
Irrigation (%)	-0.27	0.12	-0.46	-0.36	-0.59	-0.20	-0.37	-0.28
Tractors density (tractors/1,000 ha)	-0.05	0.16	-0.30	-0.02	-0.57	-0.10	-0.15	-0.32
Fertilizer consumption (kg/ha)	-0.19	-0.09	-0.16	-0.25	-0.61	0.06	-0.13	-0.43
Area under HYV (%)	-0.29	-0.01	-0.38	-0.31	-0.68	-0.11	-0.29	-0.53
Un-irrigated land covered by watershed programs (%)	0.54	0.05	0.41	0.42	0.45	0.49	0.60	0.05
Normal rainfall (mm)	0.00	0.38	-0.46	-0.13	-0.54	-0.17	-0.25	-0.52
Crossbred animals (%)	0.41	0.41	0.08	0.24	-0.29	0.13	0.16	-0.06
Common land (%)	-0.15	-0.60	0.03	-0.05	0.41	0.40	0.35	0.08
Feed availability (metric tons/LSU[e])	-0.21	0.08	-0.19	-0.11	-0.70	-0.25	-0.32	-0.32
Fruit/vegetable processing units (number)	0.39	0.29	0.14	0.35	-0.22	0.14	0.22	0.05
Fruit/vegetable processing units & cold storage units (number)	0.54	0.42	0.18	0.25	-0.45	0.34	0.31	-0.06
Livestock, fruit/vegetable processing units & cold storage units (number)	0.67	0.42	0.43	0.36	-0.46	0.43	0.42	-0.24
Paddy and flour mills (number)	-0.26	-0.16	-0.38	-0.20	-0.11	-0.02	-0.11	-0.34

[a]N = 23. District-level data for Andhra Pradesh

[b]All dependent variables are shown as percent of total value of agricultural production.

[c]All livestock products.

[d]Commercial crops include oilseeds, sugarcane, cotton, chilies, turmeric and tobacco.

[e]LSU = Livestock Units.

Source: District level database.

Table A3.2 Description and summary statistics of variables entered in the models.

Variable abbreviation	Description	Mean	SD	CV
Explanatory variables				
PCI	District per capita income at factor cost (Rs/year at 1993–94 constant prices)	10,065	1,680.1	16.7
WAGEF	Wages (Field labor female, Rs/day)	35.7	5.8	16.3
WAGEM	Wages (Field labor male, Rs/day)	49.0	5.5	11.3
FVCOLPR	Fruit/vegetable processing industries and cold storage units (number)	5.6	6.7	119.9
FVLSPR	Fruit/vegetable, and livestock processing industries, and cold storage units (number)	10.6	9.3	87.7
IRRI	Irrigated area (percent of gross cropped area)	44.6	19.5	43.7
NRAIN	Normal rainfall (cm)	88.1	1.8	20.7
CREDIT	Credit to agriculture allied activities (Rs/ha)	8,303	4,475	53.9
TERMLN	Agriculture term loans (plant and horticulture sector)/ha	799	628	78.6
ROADD	Road density (km/km^2 of geographical area)	66.2	11.7	17.7
SMFARM	Marginal and small farms (%)	80.8	9.5	11.8
WSCOV	Un-irrigated land covered by watershed programs (%)	16.9	15.9	94.1
URBAN	Urban population (%)	24.0	13.9	57.9
POVERTY	Number of poor (%)	22.6	10.9	48.0
Dependent variables				
HVCs	Share of high-value commodities in total value (%)	37.0	11.5	31.0
Fruits	Share of fruits in total value (%)	10.2	7.8	76.3
Vegetables	Share of vegetables in total value (%)	2.1	2.0	93.1
CMILK	Share of cattle milk in total value (%)	3.4	2.9	86.9
BMILK	Share of buffalo milk in total value (%)	10.9	3.3	29.8
RMEAT	Share of ruminant meat in total value (%)	2.1	1.0	47.9
Pig, poultry meat and eggs	Share of pig, poultry meat and eggs in total value (%)	8.2	6.5	79.5
Livestock	Share of total livestock products in total value (%)	24.7	8.4	34.0

Source: District level data.

Table A4.1 Contract farming projects in India.

Serial no.	Name of the firm/agency	Partners	Crops	State	Mode of contract	Remarks	Impacts
1	Nijjer Agro Foods Ltd.	None	Tomato and chilies	Punjab	The firm provides seedlings, technical assistance, and offers pre-determined price.	The model has been running successfully for 15 years. Farmers have some dissatisfaction because they depend on others for inputs and credit.	Farmers are happy as they are obtaining tomato yields of 37–49 tons/ha with improved varieties, against 12–25 tons/ha with traditional varieties.
2	United Breweries Ltd.	Punjab Agro Food Corporation (PAFC) Ltd., and the *arhatiyas* (commission agents)	Barley	Punjab	The firm provides seedlings, technical assistance, and offers pre-determined price (PDP). Price structure is flexible in this model.	Farmers are not satisfied with the price offered by the firm, which is less than the MSP of wheat and paddy. The firm's argument is that the benefit/cost ratio of the barley crop is remunerative when compared to wheat and paddy.	Yields have increased from 8.7 tons/ha to 10.5–11.1 tons/ha.
3	Mahindra ShubhLabh Services Ltd.	Punjab National Bank, Satnam Overseas Ltd., Sukhjit Starch, and the *arhatiyas* (commission agents)	Basmati paddy and maize	Punjab	The firm provides inputs, credit, and technical assistance through its partners. Farm machinery is provided on lease. Farmers are charged for services at a flat rate of Rs 370 per ha per season for registration.	In this model, the initiative came from the farm input manufacturers. The produce was not procured directly by the end user in this model.	This model is in its initial stages.
4	Escorts Ltd.	GrainTech India Ltd., Basmati Rice Traders/ Exporters (Satnam Overseas Ltd., DD International & Amira Foods), and Punjab Agro Food Corporation (PAFC)	Basmati paddy	Punjab	The firm provides seedlings, technical assistance, and offers a pre- determined price. GrainTech provides extension services, and charges a one-time registration of Rs 100. The price structure is flexible in this model.	Farmers depend on the *arhatiyas* (commission agents) for credit, which may prompt the borrower to sell the produce to the *arhatiyas*. Farmers depend on the *arhatiyas* for credit, which may prompt them to sell the produce to the Group.	

Contd.

Serial no.	Name of the firm/agency	Partners	Crops	State	Mode of contract	Remarks	Impacts
5	Pepsi Co India Ltd.	Punjab Agro Industries Corporation (PAIC)	Basmati paddy, groundnut, chili and potato	Punjab, Uttar Pradesh	The firm provides seed at subsidized rates, technical assistance and farm machinery free of cost, and offers a pre-determined price.	The firm is procuring only manually harvested basmati rice, which increases the cost of cultivation. The firm is taking 20–25 days to pay the money after delivery of the produce.	
6	Cargill India Ltd.	ICICI Bank, Life Insurance Corporation of India, MAHYCO, IFFCO, Rallis India Ltd., BASF India Ltd. and Cargill Fertilizer	Wheat, maize and soybean	Uttar Pradesh (except soybean), Madhya Pradesh	The firm provides inputs, crop loans, life insurance through its partners. It offers prices prevailing at the market on the day of harvest.	The *arhatiyas* (commission agents) are a threat to the firm as they are operating on a large scale.	
7	Ion Exchange Enviro Farms Ltd. (IEEFL)	Farmers' Associations/ NGOs/SHGs (self-help groups)	Several fruits, vegetables, cereals, spices and pulses	Maharashtra, Haryana, Madhya Pradesh	The firm provides technical assistance.	The firm is offering a 25–30% higher price for quality organic produce than the prevailing market price at the time of harvest.	
8	Tinna Oils and Chemicals	None	Soybean	Maharashtra	The firm provides seed at subsidized rates and technical assistance.	The firm is offering a slightly higher price than the market price at the time of harvest, and payment is made on the spot. Farmers want supply of inputs on credit, prefixed prices, and transportation and packaging costs from the firm.	
9	Several firms	20 private firms	Gherkins	Karnataka, Tamil Nadu, Andhra Pradesh	The firm provides inputs on credit and technical assistance. It offers a pre-determined price.	Most of the contracted farmers are marginal and small farmers. The crop has no domestic market.	

Contd.

Serial no.	Name of the firm/agency	Partners	Crops	State	Mode of contract	Remarks	Impacts
10	AVT Natural Products Ltd.	None	Marigold Capricachili	Karnataka	The firm provides inputs such as seed and pesticides on credit, and technical assistance. It offers a pre-determined price.	Farmers are happy with services provided by the firm.	Marigold contracted farmers yields vary from 8–10 tons/ha against the much lower yields of non-contracted farmers.
11	Himalaya Health Care Ltd.	None	*Ashwa gandha*	Karnataka	The firm provides an assured market and a pre-determined price.	The firm is offering a very low price (Rs. 40/kg) compared to the market price (Rs. 80–150). Payment is delayed up to two months.	
12	Mysore SNC Oil Company	None	*Dhavana*	Karnataka	The firm provides inputs on credit and technical assistance. It offers a pre-determined price.		
13	Natural Remedies Private Ltd.	None	Coleus	Karnataka	The firm provides inputs such as seed and pesticides on credit, and technical assistance. It offers a pre-determined price.	The firm is providing credit at 12% interest rate.	
14	Appachi Cotton Company	Unit Trust of India, SHGs (self-help groups)	Cotton	Tamil Nadu	The firm provides inputs on credit (interest rate of 12% per year), crop insurance, and technical assistance through its partners. The price is not fixed in advance.		
15	Super Spinning Mills	Unit Trust of India	Cotton	Tamil Nadu	The firm provides inputs on credit (interest rate of 12% per year), crop loans, insurance for farmers, and technical assistance through its partners. The market price is offered.		
16	Bhuvi Care Private Ltd.	Rice dealers, rice millers and Godrej Agro Vet (P) Ltd. for maize	Maize, paddy	Tamil Nadu	The firm provides inputs on credit, technical assistance, and farm equipment on lease. The market price is offered.		

Contd.

Serial no.	Name of the firm/agency	Partners	Crops	State	Mode of contract	Remarks	Impacts
17	Lakshmi Seeds Private Ltd.	None	Cluster bean seeds	Tamil Nadu	The firm provides seed. It offers a pre-determined price.		
18	Ion Exchange Enviro Farms Limited	MS Swaminathan Research Foundation	Pineapple	Tamil Nadu	The firm provides technical assistance. It offers a pre-determined price. Price is 24–30% above the prevailing market price.		
19	Ugar Sugar Works Limited	None	Barley	Karnataka	The firm supplies inputs on credit and technical assistance. It offers a pre-determined price.		

Source: Foretell Business Solutions Ltd., Bangalore, Karnataka.

Table A4.2 Grape export market costs (Rs per kg) under contract farming.

Particulars	United Kingdom		Europe	
	Amount (Rs)	Percent of supermarket price	Amount (Rs)	Percent of supermarket price
Grape grower				
Received price	40.00	32.8	33.53	37.5
Exporter				
Box	5.00	4.1	4.89	5.5
Grape guard	1.67	1.4	1.67	1.9
Bubble sheet	0.22	0.2	0.22	0.2
Liner	0.22	0.2	0.24	0.3
Pouches/punnets	3.30	2.7	0.64	0.7
Packaging material cost				
Precooling and cold storage	4.50	3.7	4.51	5.0
Pallet and strapping	1.00	0.8	1.00	1.1
Labor	1.00	0.8	1.00	1.1
Local transport	0.76	0.6	0.76	0.8
Container transport	4.00	3.3	4.00	4.5
Costs incurred by exporter				
Exporter commission charges at Rs 9–10 per kg	9.00	7.4	10.0	11.2
Category Manager				
Sea freight charges	10.21	8.4	9.29	10.4
Container agency fee	—	—	0.13	0.1
Discharging	—	—	0.60	0.7
Import duties	—	—	6.91	7.7
Forwarding charges	—	—	0.09	0.1
Handling and distribution charges	8.00	6.6	0.73	0.8
Photo-inspection	—	—	0.13	0.1
Cold storage	2.84	2.3	0.47	0.5
Trucking	—	—	1.00	1.1
Chemical control	—	—	0.09	0.1
Quality control	—	—	0.11	0.1
Bank and license	—	—	0.22	0.2
Category manager commission charges 8%	9.24	7.6	7.16	8.0
Customs duty and clearance	6.63	5.4	—	—
Packaging recovery	7.57	6.2	—	—
Supermarket customer rebate 6%	6.93	5.7	—	—
Supermarket paid price	122.13	100.0	89.38	100.0

Source: Grape Growers Survey from Sam Agri Tech.

Table A6.1 Number of cold storage units and capacity in Andhra Pradesh.

District	Number of cold storage units	Capacity (metric tons)
Anantapur	8	22,382
Chittoor	11	16,430
Cuddapah	1	136
East Godavari	15	17,875
Guntur	60	209,697
Hyderabad	30	57,828
Khammam	8	26,347
Krishna	13	17,264
Kurnool	4	8,297
Mahbubnagar	1	2,494
Medak	1	27
Nalgonda	1	2,500
Nellore	10	22,136
Nizamabad	3	8,100
Prakasam	2	1,136
Ranga Reddy	12	37,700
Srikakulam	1	4,000
Visakhapatnam	32	35,793
Vizianagaram	6	30,515
Warangal	5	18,751
West Godavari	11	29,899
Total	**235**	**569,307**

Source: http://agmarket.nic.in/apnew.htm.

Table A6.2 Distribution of crop and allied activities credit from formal sources[a], Andhra Pradesh, 2003–04.

	Credit per hectare			Credit per cultivator	
District	Crop	Allied activities	Total primary sector[b]	Crop	Allied activities
Nizamabad	13,087	379	20,996	10,617	307
Warangal	6,578	374	13,399	7,166	407
Adilabad	3,118	226	5,310	4,825	349
Guntur	12,494	1,416	24,372	19,609	2,223
Karimnagar	8,290	478	18,050	7,343	423
Anantapur	4,156	179	6,242	7,953	342
Kurnool	5,555	653	10,244	11,634	1,367
Medak	6,017	398	11,072	6,911	457
West Godavari	17,690	1,114	28,578	36,325	2,288
Nellore	9,489	1,246	18,990	13,695	1,798
Khammam	5,725	271	10,027	8,710	412
Krishna	17,558	2,479	32,499	38,274	5,403
Nalgonda	5,401	290	10,228	6,950	373
East Godavari	14,121	1,940	32,786	27,538	3,782
Srikakulam	4,406	436	7,966	7,799	772
Cuddapah	9,305	517	17,063	12,685	705
Mahbubnagar	3,527	268	6,235	5,361	408
Chittoor	8,469	1,215	17,474	6,736	967
Visakhapatnam	6,484	1,041	16,754	4,138	664
Hyderabad	4,582	1,064	19,864	4,674	1,085
Andhra Pradesh	**7,818**	**763**	**15,200**	**10,596**	**1,034**

[a]Nationalized banks, private banks, regional rural banks and cooperatives.

[b]Total primary sector includes credit for agriculture, allied activities, non farm sector and other priority sectors.

Source: SLBC 2004.

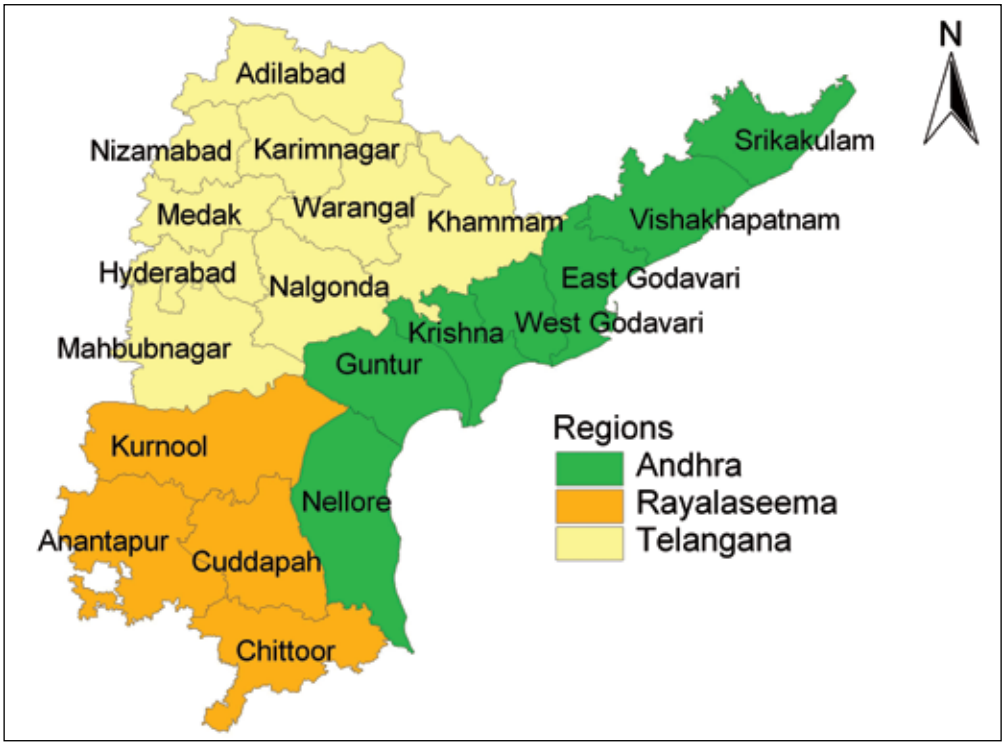
Appendix

A. Data and Methodology

For the purpose of this study, agricultural diversification is viewed as a shift in production portfolio towards high-value commodities (HVCs), such as fruits, vegetables, milk, meat, eggs and fish. All these commodities are perishable; their post-harvest management, marketing and processing would be different from that of foodgrains. The share of fruits, vegetables, milk, meat and fish in the total value of agricultural output is used as a proxy for approximating the extent of agricultural diversification. A region is assumed to be more diversified if the share of HVCs (fruits, vegetables, milk, meat, poultry and fisheries) in the total value of agricultural output is higher than in other regions/locations.

Data and approach

There are 23 districts in Andhra Pradesh, spread across three geographical regions: *Coastal Andhra* (9 districts), *Telangana* (10 districts) and *Rayalaseema* (4 districts) (Appendix Map 1). The three regions have significant differences in terms of agroclimatic endowments[34]. The average annual rainfall is lowest (650 mm) in Rayalaseema, and highest in Coastal Andhra (1,050 mm). Coastal Andhra is the most fertile of the three regions in terms of soils and irrigation potential, and it has favorable conditions for growing irrigated crops. Rayalaseema (in the rain shadow area), and several districts of Telangana, are more drought-prone.



Map A1: Climatic regions of Andhra Pradesh.

34 The three regions are further subdivided into seven subregions based on agroecological factors (length of growing period, soils, rainfall, topography, etc): (1) High Altitude and Tribal areas, (2) Krishna Godavari zone, (3) North Coastal zone, (4) Northern Telangana zone, (5) Scarce Rainfall zone, (6) Southern Telangana zone, and (7) Southern zone.

The study used the *District-level database for India* (1980–1998),[35] updated till 2002 for all the districts in Andhra Pradesh, and expanded to include more variables relevant to this study[36]. The database includes more than 200 variables on crops, livestock population and products, land use, technology, inputs used in agriculture, infrastructure, agroclimate, socioeconomy and demography for the 23 districts in Andhra Pradesh. But the analysis is confined to 20 districts, since the data for three recently carved districts—Prakasam, Vizianagaram and Ranga Reddy—were amalgamated with their parent districts to maintain continuity in the database over time.

Nature and speed of agricultural diversification

The nature and pattern of agricultural diversification in Andhra Pradesh was understood by computing the changes in shares of different commodities in the total value of agricultural output. It was corroborated by analyzing the changes in production and area (in case of crops), and the changes in numbers and composition (in case of livestock). The speed of agricultural diversification was examined by computing the annual compound growth rates of the value of different commodities over time, at constant prices. Annual compound growth rates of area (and number for livestock), production and productivity were also computed to assess the performance of different commodities. This was further corroborated by estimating the sources of change in gross value of agricultural output over time. The analysis was carried out for all the districts and district groups/regions in Andhra Pradesh. The spatial pattern of the nature and extent of agricultural diversification was mapped using digitized maps with ArcView®. The period of analysis covers two decades, from 1980–81 to 2000–01.

Drivers of agricultural diversification

Simple correlation and multivariate regression analysis was carried out to quantify the drivers of agricultural diversification. Separate models were estimated for fruits, vegetables, milk and meat. One combined model for all HVCs was also estimated. Ordinary Least Squares (OLS), Tobit and Seemingly Unrelated Regression Estimates (SURE) techniques were used to determine the drivers of agricultural diversification towards HVCs. The problems related to multicollinearity and heteroscedasticity were corrected. District-level cross-section data for 2000–01 were used for this analysis.

Implications of agricultural diversification

The costs and returns of different commodities in Andhra Pradesh were estimated and compared to identify high-profit and low-cost commodities. The costs and returns of important commodities were also compared to those in other Indian states. The comparison of costs and returns is based on the commercial cost of production (C2)[37], which includes paid-out costs and imputed costs. The paid-out costs include (1) hired labor (human, bullock and machinery charges); (2) maintenance expenses on owned animals and machinery; (3) expenses on inputs such as seed, fertilizer, manure, pesticide and irrigation; (4) depreciation on implements and farm buildings; (5) land revenue; and (6) rent paid for leased-in land. Imputed costs include value of family labor, rent of owned land, and interest on owned fixed capital. Net returns were computed by subtracting gross returns (quantity of produce multiplied by prices received) from the commercial cost of production.

35 Database is available with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), headquartered at Patancheru, Andhra Pradesh, India.

36 While data related to the crop sector, land use, inputs and infrastructure were readily available from secondary sources, data on livestock outputs at the district level were not available. State-level data on value of livestock products by species were collected from the Central Statistical Organization (CSO), and the state value was apportioned to the districts based on the proportion of livestock population/production of milk, meat, etc, in each district.

37 Cost C2: Includes all paid-out costs, imputed values of family labor, rent on owned land, and interest on owned fixed capital.

Data for this section came from both published sources and farm surveys. For major foodgrains and oilseed crops, data published by the Government of India, based on the estimates made under the Comprehensive Scheme for Cost of Cultivation of Principal Crops (CSCCPC), were used. The Scheme does not collect information related to horticultural and other high-value commodities (potato and onion are exceptions). Therefore, to compare the costs and returns of horticultural crops, the analysis relied on data collected under the baseline surveys of sample households in eight selected benchmark watershed villages located in four districts of Andhra Pradesh for the cropping year 2002–03[38]. The households in the baseline surveys were randomly selected using stratified random sampling techniques (for more information on sample size etc see Table A2.1 below). For the household surveys, net returns were calculated taking into consideration all input costs (own + bought) and imputed value of family labor and bullocks. The inputs included: fertilizers, seed, pesticides, FYM, sheep penning, bullocks, tractors, machines used etc. Costs and returns related to the dairy, poultry and fisheries sector were collected through surveys and interviews of key players.

Supply chain and vertical coordination

Supply chain analysis of important fruits and vegetables was carried out to evaluate the marketing costs and margins under different institutional arrangements. Data for this analysis was compiled from major fruits and vegetables markets in Hyderabad. These were compared to the costs and returns under the innovative *Rythu Bazaar*[39] and direct marketing models. A few case studies of innovative production and marketing arrangements were carried out for gherkins (a species of cucumber) and grapes for export market and broiler for domestic market.

Villages covered under baseline survey in Andhra Pradesh; location and sample size.

Village	Mandal	District	Households in the sample	Normal[a] (mm)	Irrigation Ratio[b] (%)
Kothapally	Shankarpally	Rangareddy	60	760	30.0
Kothapally – surrounding villages	"	"	60	760	-
Nandavaram	Banaganapalli	Kurnool	63	624	3.9
Devanakonda	Devanakonda	"	70	612	14.7
Tirumalapuram	Chintapally	Nalgonda	72	571	21.9
Kacharam	Yadagirigutta	"	90	815	22.1
Malleboinapally	Jadcherla	Mahbubnagar	60	630	23.7
Mentapally	Wanaparthy	"	65	685	22.3

a. Based on Mandal level rainfall data.

b. Irrigation ratio computed from sample data.

Source: Shiferaw et al. (2003).

38 Household level baseline surveys were carried out in selected villages in 4 districts of Andhra Pradesh by ICRISAT Socioeconomics staff prior to implementation of the watershed program. Only in Kothapalli village in Ranga Reddy district the watershed program was underway for 3 years when the data were collected. The comprehensive surveys covered demographic characteristics of the households, land, livestock and other assets, income sources, cropping patterns, marketed surplus, etc. An important component of the survey was cost of cultivation of major crops. For our purpose, average net returns (for the district) for a few selected high-value commodities and traditional crops are reported here for comparison.

39 *Rythu Bazaar* literally means "farmers' market." It is a designated piece of land with the necessary market infrastructure, set up by the Government of Andhra Pradesh in urban centers, to facilitate the direct marketing of fruits and vegetables by farmers from nearby villages. A unique feature of this market is the elimination of middlemen between the farmer and the consumer, thus reducing transaction costs and ensuring higher returns to the farmer.

Data for the case studies on supply chain and vertical coordination were collected from the households participating in the supply chain and innovative institutional arrangements for production and marketing. The data were also supplemented by interviewing the key stakeholders in the supply chain (including traders, processors/exporters), and with central/state government policy documents related to agricultural marketing, contract farming, processing, credit and extension.

B. Marketing of horticultural crops in Andhra Pradesh

Fruits are generally marketed through pre-harvest contracts, while vegetables are mostly disposed off through commission agents. In the case of fruits, the pre-harvest contractors carry away exorbitant profits at the cost of the producers, sometimes as high as 60% on their investment (Kaul 1997). The Government of India has established regulated markets to eliminate the fraudulent practices adopted by middlemen in the buying and selling of fruits and vegetables. In India, about 4,000 regulated markets for fruits and vegetables are functioning under the aegis of the Agricultural Produce Marketing Act (APMC) of individual states. Most of these markets are located in urban and semi-urban areas, but do not function optimally[40]. The markets in the major cities in some states are not covered by market legislation and continue to function under local civic bodies. Inefficient marketing channels and inadequate marketing infrastructure (transportation and storage facilities) contribute to the high and fluctuating consumer prices and lower producer share in the consumer rupee (Kaul 1997).

Vegetable markets in Andhra Pradesh

Gudimalkapur market: Spread over 2.91 hectares of land located at a distance of 5–7 km from the Hyderabad railway station and bus depot, the Gudimalkapur vegetable market has around 127 market stalls with 97 licensed commission agents. The annual market fee collection is Rs. 1.8 million, and is collected fortnightly from the commission agents. Licenses are renewed every 5 years, and the renewal fee varies from Rs1,000 to 3,000 depending on the business turnover of the agents. The government provides rest houses for farmers, and canteen, telephone, drinking water and sanitation facilities.

Vegetables arrive from Adoni, Kurnool, Anantapur, Chevella, Moinabad, Shankarpally, and Vijayawada. About 80% of the vegetables are sold for local consumption within the city and outskirts. The open auction system is the main method of sale, and the market fee is 1% of the value of produce. Commission charges are 4% of the value of produce, but the commission agents generally charge 8–10%.

Bowenpally market: Covering an area of about 9 hectares, the market is located 5 km from the Secunderabad railway station and deals both in vegetables and grain. Vegetables mainly arrive from Mahbubnagar, Chittoor, Anantapur, Medak, Nizamabad, and Ranga Reddy districts and from Vijayawada. About 70% of the vegetables are for consumption within the city, and the remaining 30% are exported to distant markets. The sale is through open auction. No godown or cold storage facility is available within the market.

40 Bhole (2005) found that in selected areas of Maharashtra, the regulated markets for fruits (orange) do not function efficiently. Farmers have to deal with problems such as high commission charges, high transportation and loading/unloading charges, lack of remunerative prices, and delayed payments by commission agents.

In both the markets, the following two market channels are predominant:

Market channel 1: Producer → Commission agent → Retailer.
Market channel 2: Producer → Commission agent → Wholesaler → Retailer.

The retailer's margin, price spread, market margin, and market costs are calculated for selected vegetables—tomato and eggplant in the Gudimalkapur market, and okra and potato in the Bowenpally market—on the basis of prices prevailing on the same day at successive levels of marketing. The price spread is greater in Channel 2 than in Channel 1 due to the involvement of wholesalers.

Fruit markets in Andhra Pradesh

Gaddiannaram market: There is only one wholesale fruit market functioning under APMC in Hyderabad. The market is spread over an area of about 9 hectares, in Gaddiannaram, Ranga Reddy district on the Hyderabad–Vijayawada national highway. At present, 133 sheds of different sizes have been constructed and allotted to commission agents and traders on rent.

Two bidding platforms, a farmers' rest house, and office building have been constructed, and the market has all other facilities such as internal roads, water, electricity and sanitation. An electronic weighbridge has been installed at the entry point by a private agency, which charges a nominal amount from the sellers (pre-harvest contractors, middlemen, growers) who bring the produce.

The major fruits arriving in the market include mango, sweet orange/musambi, orange/mandarin/santra, banana, apple, grapes, muskmelon and watermelon. These arrive largely from districts within Andhra Pradesh such as Nalgonda and Adilabad and from other states within India such as Himachal Pradesh and Karnataka.

Fruits are traded and transported to distant places from Gaddiannaram. For example, mango and sweet orange are sent to such places as Delhi, Mumbai and Vadodara. Generally, orange, banana, muskmelon, grapes, apple and watermelon are for local consumption and consumption in the neighboring districts.

The bulk arrivals (about 80%) into the fruit market at Gaddiannaram are from the preharvest/crop contractors. About 20% of the arrivals are from the growers. The orchards or fruit gardens are given on contract at different stages of the crop, right from the flowering stage to full maturity.

Procedure of sale: Mango, sweet orange, orange and pineapple are transported to the market in trucks. The type of packing and lots vary. After completing the necessary formalities at the entry gate, the vehicles carrying the fruit are sent to the premises of the commission agent concerned. The fruits are unloaded there and displayed in suitable lots for sale in the sheds of the commission agent.

Since the fruits are brought for sale from the gardens without grading, the wholesale purchasers and exporters grade the fruit according to size and color, and pack them in suitable quantities before dispatching them to different locations within and outside the state[41] .

41 The bidding is conducted at each shop, and the fruits are offered to the highest bidder. The buyers are usually wholesale purchasers, exporters and retailers. After the sale of the fruit, the commission agent issues a sales slip (takpatties) indicating the quantity, price, commission charges, handling charges, and pays the sale proceeds to the seller on the same day. Commission charges are 4% of the value of produce (from seller). A market fee of 1% of the value of produce is charged from the purchaser.

For fruits, the market channels are as follows:

Market channel 1: Producer → Pre-harvest contractor → Commission agent → Wholesaler → Retailer → Consumer.
Market channel 2: Producer → Commission agent → Wholesaler → Retailer → Consumer.
Market channel 3: Producer → Commission agent → Retailer → Consumer.

The producer's share in the consumer rupee varies from 28% to 42%, depending on the channel and fruit crop. The producer share is higher in Channel 2 than in Channel 1, since the pre-harvest contractors are involved in Channel 1. The marketing efficiency index is higher in Channel 2 than in Channel 1.

C. Contract farming policy for development of horticulture crops

The state government has developed a contract farming policy for the development of horticultural crops. The main components of the policy are given below:

- Promotion and **speedy implementation of Agri-Export Zones** (AEZ) for selected crops where contract farming is the key to promoting the interests of the farmer, processor and exporter.
- **Prioritized support to contract farmers in AEZs through the various prevailing schemes** of central and state government organizations such as the Agricultural and Processed Food Export Development Authority (APEDA), National Horticulture Board (NHB), Ministry of Food Processing (MFPI), etc.
- Provision for the following **basic support services** for contract growers and firms: good quality plant material and drip irrigation facility at 50% subsidy; disease forecasting system; agri-information system; testing laboratory facilities for soil, water, leaf and fruit at 50% subsidy; access to benefits related to procuring mobile precooling units, cold storage, refrigerated transportation, collection counters and pack houses; and freight subsidy. Subsidy of 50% on certification expenses for organic farming contracts in declared Crop Zones to promote organic farming under contract farming.
- **Training and skill building of horticulture growers** through training in key areas such as modern agronomic practices, integrated pest management, and post-harvest management; nation-wide exposure visits and guidance of expert consultants and subject matter specialists free of cost to contract farmers.
- Establishment of a **Project Management Unit** to exclusively handle all issues pertaining to contract farming projects in the Department of Horticulture, Government of Andhra Pradesh.
- **Exemption from Pollution Clearance Charges** for setting up of food processing units, payment of the Agricultural Market Cess for the produce under contract farming.
- Government **participation in the price negotiations,** but upon mutual consent/request of the contract farmer and contracting company only.
- **Priority facilitation in land acquisition** for food processing units to be accorded to companies adopting contract farming.
- **Encouragement of banks to provide loans** to contracting farmers through a tripartite agreement between the farmer, the company and the bank.
- Provision of a **single-window redressal system** for clearing the projects with speed and efficiency.

D. State Agricultural Produce Marketing Act, 2003

In 2000, the Ministry of Agriculture appointed an Expert Committee and an Inter Ministerial Task Force to review the present system of agricultural marketing and recommend measures to make the system more efficient and competitive. The committee and task force submitted their reports in 2001 and 2002, respectively, which suggested various programs, reforms and policies for strengthening the agricultural marketing system. The recommendations made by these reports were discussed at the National Conference of state ministries organized by the Ministry of Agriculture in 2002. A Standing Committee of State Ministers was constituted to review the recommendations made by these reports in January 2003. A common feature in both these committees was that state governments expressed the view that to promote an alternative marketing system, the development of a competitive marketing infrastructure was essential. For this it is necessary to formulate a model legislation on agricultural marketing system.

The Ministry of Agriculture appointed a committee under the chairmanship of KM Sahni to formulate a model law. The committee finalized the draft model legislation titled the State Agricultural Produce Marketing (Development and Regulation) Act, 2003.

The salient features of the Model Act (GoI 2003) are:

- Model act drafted for development of efficient marketing system, promotion of agri-processing and agricultural exports, and to lay down procedures and systems for putting in place an effective infrastructure for the marketing of agricultural produce.
- Legal persons, growers and local authorities are permitted to apply for the establishment of new markets for agricultural produce in any area.
- Provision made for the establishment of consumers'/ farmers' markets to facilitate the direct sale of agricultural produce to consumers.
- Separate provision is made for notification of 'Special Markets' or 'Special Commodities Markets' in any market area for specified agricultural commodities to be operated in addition to the existing markets.
- No compulsion on growers to sell their produce through the existing markets administered by the Agricultural Produce Market Committee (APMC).
- The APMC has been made specifically responsible for:
    - Ensuring complete transparency in the pricing system and transactions taking place in the market area;
    - Providing market-led extension services to farmers;
    - Ensuring same-day payment for agricultural produce sold by farmers;
    - Promoting agricultural processing including activities for value addition in agricultural produce; and
    - Publicizing data on the arrivals and rates of agricultural produce brought into the market area for sale.
- Set up and promote public–private partnerships in the management of agricultural markets
- Compulsory registration of all contract farming sponsors, recording of contract farming agreements, resolution of disputes, if any, arising out of such agreements, exemption from levy of market fee on produce covered by contract farming agreements, and provision of indemnity to producers' title/ possession over his land from any claim arising out of the agreement

- Provision for imposition of single-point levy of market fee on the sale of notified agricultural commodities in any market area, and discretion provided to the state government to fix a graded levy of market fee on different types of sales
- Market committees permitted to use their funds among others to create facilities such as grading, standardization and quality certification; creation of infrastructure on their own or through public–private partnerships for post-harvest handling of agricultural produce and development of a modern marketing system
- State Agricultural Marketing Boards to promote standardization of grading, quality certification, market-led extension and training of farmers and functionaries in marketing related areas.

A fruit and vegetable market in Karnataka, under the Model Act

Safal Fruit and Vegetable Auction Market (SAM): The National Dairy Development Board (NDDB) set up this hi-tech auction market in Bangalore in 2003, through its subsidiary, Mother Dairy Foods Processing Ltd. (MDFPL). This market provides transparent, efficient and computerized marketing of horticultural produce. MDFPL has established backward linkages in terms of farmers' associations and collection centers for channeling the produce into the market, and is planning forward linkages with retail stores.

Mode of functioning: SAM plans to form 225 farmers' associations in the country's major production belts. They would be connected through 45 collection centers, which will clean, sort, grade, weigh and pack produce.

Membership of such a producer association is mandatory for the grower to bring his produce to the auction market, and the farmer has to grow a minimum of one ton on his farm. This market can handle nearly 1,600 tons of fruit and vegetables daily.

The Government of Karnataka has abolished market cess for produce traded through SAM auction terminals. SAM charges a market fee at a flat rate of 4%.

The Dutch auction method for fruits and vegetables, and the American auction method for mangoes, potatoes and onions are being introduced. To ensure transparency and competition, this market provides an opportunity for everyone to participate through Internet and tele bidding. The market provides cold storage and ripening chamber facilities for growers.

E. Fisheries sector draft policy paper and ongoing schemes in Andhra Pradesh

The following Acts are in force in the state for regulation & development of fisheries in the state

The Indian Fisheries (AP) Andhra Area Amendment Act, 1927 (Act II of 1929).

The Indian Fisheries (AP Extension and Amendment) Act, 1961 (Andhra Pradesh Act V of 1961).

The AP Marine Fishing Regulation Act, 1995.

Draft policy

The Government of Andhra Pradesh is planning to bring in a comprehensive policy for the development of the fisheries sector, aimed at improving both production and quality through better regulation, improved infrastructure, and modern technology.

Salient features of the draft: The draft policy envisages various strategies and interventions to achieve the overall development of the fisheries industry in the state (Reddy 2005).

The government would be a **proactive facilitator** to serve the needs of the people and to promote the participation of both private and cooperative sectors in creating the required infrastructure.

The government stresses balanced exploitation of under-utilized resources, besides advocating community development. The government will also encourage, if required, joint ventures with foreign companies, especially in shrimp and fish exports.

The government envisages the exploitation of the untapped marine resource potential. At present, the state ranks fifth in marine fish production in the country.

Emphasis would be given to the development of tuna fishery, where fishing trawlers are proposed to be converted into long liners or gill netters among others, to focus on the exploitation of mid-sea fishery wealth.

Fishermen would be encouraged to use modern fishing inputs, navigational equipment, VHF sets, life floats, geo-positioning systems, fish finders, and other modern technologies.

The expansion of farming areas in an eco-friendly manner are encouraged to avoid the viral outbreaks and diseases that are spread by massive over farming.

The development of fish landing facilities and fishing harbors, strengthening of infrastructure to support traditional fish processing, development of road networks, and exploitation of untapped marine resources potential are some of the important steps proposed in the new policy.

New technological interventions for increased fish production, such as pen culture to rear seed into fingerlings, introduction of cage culture in reservoirs, promotion of alternate species such as sea bass, crabs, and other new species for culture.

AP state fishermen cooperative societies federation limited

The AP State Fishermen Cooperative Societies Federation Limited (AFCOF) has been established as an Apex Cooperative Society under the APCS Act in the year 1987. The objectives of the Federation are to:

- undertake procurement and distribution of fishery requisites
- establish cold storage plants and net making plants
- undertake procurement of fish

- set up fish stalls
- establish branches at suitable places to facilitate the business.

A few of the important schemes that have been implemented are Velugu, Harbor improvement works, Aqua laboratories, shrimp health management, and the construction of a fishing harbor at Machilipathnam. Funding for these projects came from diverse sources such as the FAO, the Rural Development Department, ASIDE funds and MPEDA.

Additionally, there is a special focus on fishermen welfare schemes such as setting up a shore-to-vessel communication system, extension of leases of fishery rights, insurance coverage, improved supply of fishing inputs, relief-cum-savings; assistance to fisherwomen has also been provided.

F. Agri-Export Zones (AEZs)

What does an AEZ ensure?

1. Identification of farmers
2. Availability of quality inputs such as seed, fertilizer, pesticides, water, power, etc
3. Extension of good crop production technologies
4. Extension of appropriate harvesting practices
5. Utilization of scientific post-harvest technologies such as grading, sorting, packaging, etc, to meet the quality norms
6. Infrastructural requirements
7. Transportation arrangements
8. Documentation needed for export marketing.

The state government is catalyzing growth and enabling all stakeholders in the value chain. It is providing comprehensive support and developing effective export promotion schemes. The interventions include financial, fiscal, monetary, administrative, legislative and diplomatic interventions.

Financial interventions

1. 'Convergence' of various schemes of central and state government agencies.
2. Central government agencies: APEDA, NHB, MFPI, DOA, NCDC and SFAC.

Fiscal interventions

1. Import and excise duty-free availability of all inputs (under the Advance License Scheme); zero duty on import of capital goods.
2. Agency: Directorate General of Foreign Trade.
3. All duties/cess/taxes are also exempt on inputs for exports
4. Monetary interventions

5. Short-term availability of credit at 8.5% in the AEZ zones.
6. Agency: Bank under NABARD refinance scheme.

Administrative interventions

These interventions are made primarily by the state governments for the following:

1. Deputation of scientists for research
2. Identification of farmers
3. Preparation of extension literature
4. Identification of extension teams
5. Extension work.

(These tasks can also be undertaken by the private sector).

Legislative interventions

1. Bring about changes in the existing legislation/rules/regulations to facilitate exports.

Agencies: Central and state governments.

Diplomatic interventions

Negotiate with the international trading partners for providing market access:

1. Reduction in tariffs and subsidies
2. Removal of non-tariff barriers.

About ICRISAT

ICRISAT
Science with a human face

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

Company Information

ICRISAT-Patancheru (Headquarters)
Patancheru 502 324
Andhra Pradesh, India
Tel +91 40 30713071
Fax +91 40 30713074
icrisat@cgiar.org

ICRISAT-Liaison Office
CG Centers Block
NASC Complex
Dev Prakash Shastri Marg
New Delhi 110 012, India
Tel +91 11 32472306 to 08
Fax +91 11 25841294

ICRISAT-Nairobi (Regional hub ESA)
PO Box 39063, Nairobi, Kenya
Tel +254 20 7224550
Fax +254 20 7224001
icrisat-nairobi@cgiar.org

ICRISAT-Niamey (Regional hub WCA)
BP 12404, Niamey, Niger (Via Paris)
Tel +227 20722529, 20722725
Fax +227 20734329
icrisatsc@cgiar.org

ICRISAT-Bamako
BP 320
Bamako, Mali
Tel +223 20 22 33 75
Fax +223 20 22 86 83
icrisat-w-mali@cgiar.org

ICRISAT-Bulawayo
Matopos Research Station
PO Box 776,
Bulawayo, Zimbabwe
Tel +263 83 8311 to 15
Fax +263 83 8253/8307
icrisatzw@cgiar.org

ICRISAT-Lilongwe
Chitedze Agricultural Research Station
PO Box 1096
Lilongwe, Malawi
Tel +265 1 707297/071/067/057
Fax +265 1 707298
icrisat-malawi@cgiar.org

ICRISAT-Maputo
c/o IIAM, Av. das FPLM No 2698
Caixa Postal 1906
Maputo, Mozambique
Tel +258 21 461657
Fax +258 21 461581
icrisatmoz@panintra.com

www.icrisat.org

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