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Agricultural Diversification towards High-Value Commodities and Role of Urbanisation in India

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1. INTRODUCTION

Urban and peri-urban population is rising rapidly in the developing countries. The available estimates reveal that by 2020 the developing countries of Africa, Asia and Latin America will be the home of some 75 per cent of all urban dwellers (CGIAR, 2003). India is no exception, where urban population has been increasing at an alarming rate of more than 3 per cent annually. The forecasts are that by 2030, the urban population will be 41 per cent of the total population in India (UN, 2002). Growing urbanisation and rising incomes are responsible for transforming agriculture, which is different from the traditional agriculture. Such a transformation is forcing a change in production portfolio, from cereal-based system to high-value commodities. Earlier studies have clearly demonstrated that diversification of agriculture in favor of commercial crops leads to greater market orientation of farm production, and progressive substitution out of non-traded inputs in favor of purchased inputs (Pingali and Rosegrant, 1995). Such a transformation through diversification is viewed as a strategy for poverty alleviation, employment generation, environment conservation and farm-income augmentation by optimising available resources (Satyasai and Vishwanathan, 1996).

Although agricultural diversification is an age-old practice, it has assumed greater importance in recent years due to market-led commercial agriculture. Its significance is associated with the era of globalisation of agriculture under the World Trade Organisation. As globalisation begins to exert its influence we see the adoption of

markedly different diets that no longer conform to the traditional local habits (Pingali and Khwaja, 2004). There are also apprehensions that the influx of cheap imports would adversely affect the agricultural sector in the South Asian countries. Diversification of agriculture in favor of more competitive and high-value enterprises is being regarded as an important strategy to overcome the emerging challenges of globalisation (Joshi *et al.* 2002).

This paper is focused on selected high-value commodities (HVCs) that are contributing to diversification of agriculture with reference to urbanisation as its main driver. More specifically, the objectives of the study are to: (i) map spatial distribution of agricultural diversification in favor of high-value commodities in India using GIS technique; (ii) examine the role of urbanisation in determining the nature, sources and speed of agricultural diversification; and (iii) determine the factors influencing diversification towards HVCs and quantify their contributions.

Fresh fruits, vegetables, milk, ruminant meat, fish, poultry meat and eggs are often characterised as high-value commodities. These are perishable in nature and yield high returns. In this paper, we have covered all these commodities except fish. We have hypothesised that urbanisation is a key driver of agricultural diversification towards HVCs in urban and peri-urban areas.

The paper is organised in to five sections. The 1st Section is devoted to the database and methodology used in the study. Spatial sub-division of districts into diversification zones (based on share of HVCs in the total value of agricultural production) is presented in Section 2. The role of urbanisation in agricultural diversification towards HVCs is discussed with the help of spatial analysis in Section 3. The 4th Section analyses the relative importance of factors influencing diversification towards HVCs. And finally, conclusions and policy recommendations derived from the study are summarised in the last section.

Database and Methodology

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) maintains the district level database for India from 1970 to 1994. This dataset was updated from 1994 to 1998 and expanded to include more variables in the context of diversification and

urbanisation. While data related to the crop sector, land-use, inputs, and infrastructure were readily available from the secondary sources; data on livestock outputs at the district level were not available. Therefore, state level data on the value of livestock products by species were collected from Central Statistical Organisation (CSO) and the state value of livestock products was apportioned to the districts in each state, based on the proportion of its livestock population by species. For data on human population, the census data for 1991 were extrapolated to 1998 using growth rates between 1981 and 1991. The final database, thus, included more than 200 variables, for 492 districts covering 16 states in India, on crops, livestock population and products, land-use, technology, inputs, infrastructure, agro-climatic, socio-economic and demographic indicators.

One problem encountered in using the time-series data for districts was their frequent reorganisation. Between 1970 and 1998, a total of 182 new districts were created from the existing ones. A satisfactory method for dealing with the problem of new districts (created after a certain year) had to be worked out to maintain continuity in the database over a long-term and for conducting spatial analysis or operationalising GIS for which digitised maps with district boundaries for selected years were available. For this, data for newly formed districts were apportioned back to their parent districts and boundaries of newly formed districts were adjusted to 1970 base. This provided continuity in the data, making it possible to study the changes over time. The final data set thus consisted of data for 309 districts that were comparable over time and space.

Agricultural diversification in this study was defined as the changing share of high-value commodities in the total value of agricultural output. And urban population was used as a proxy for urbanisation. Following steps were adopted to delineate the districts based on agricultural diversification, and more so in the context of urbanisation:

(i) Districts were classified into three diversification zones based on their share of HVCs in the total value of agricultural output. The districts with > 50 per cent share of HVCs were classified as high diversity districts; with 25 to 50 per cent share, as medium diversity districts and with < 25 per cent share, as low diversity districts.

(ii) To examine the role of urbanisation in the spread of HVCs, the districts were subdivided into urban, urban-surrounded, and other (hinterland) districts. Districts with > 1.5 million urban population were grouped as urban, those surrounding the urban districts as urban-surrounded, and the remaining as other (hinterland) districts.

(iii) Analyses were conducted on the nature, sources (crop and livestock activities) and speed of diversification (growth rates in crop and livestock activities between 1982 and 1998) in the zones and district groups.

(iv) GIS approach (using Arc View) was used for spatial analysis of districts based on the share of key and all HVCs in the total value of agricultural production and/or gross cropped area.

(v) Regression analysis was carried-out to identify and quantify the factors influencing diversification towards HVCs

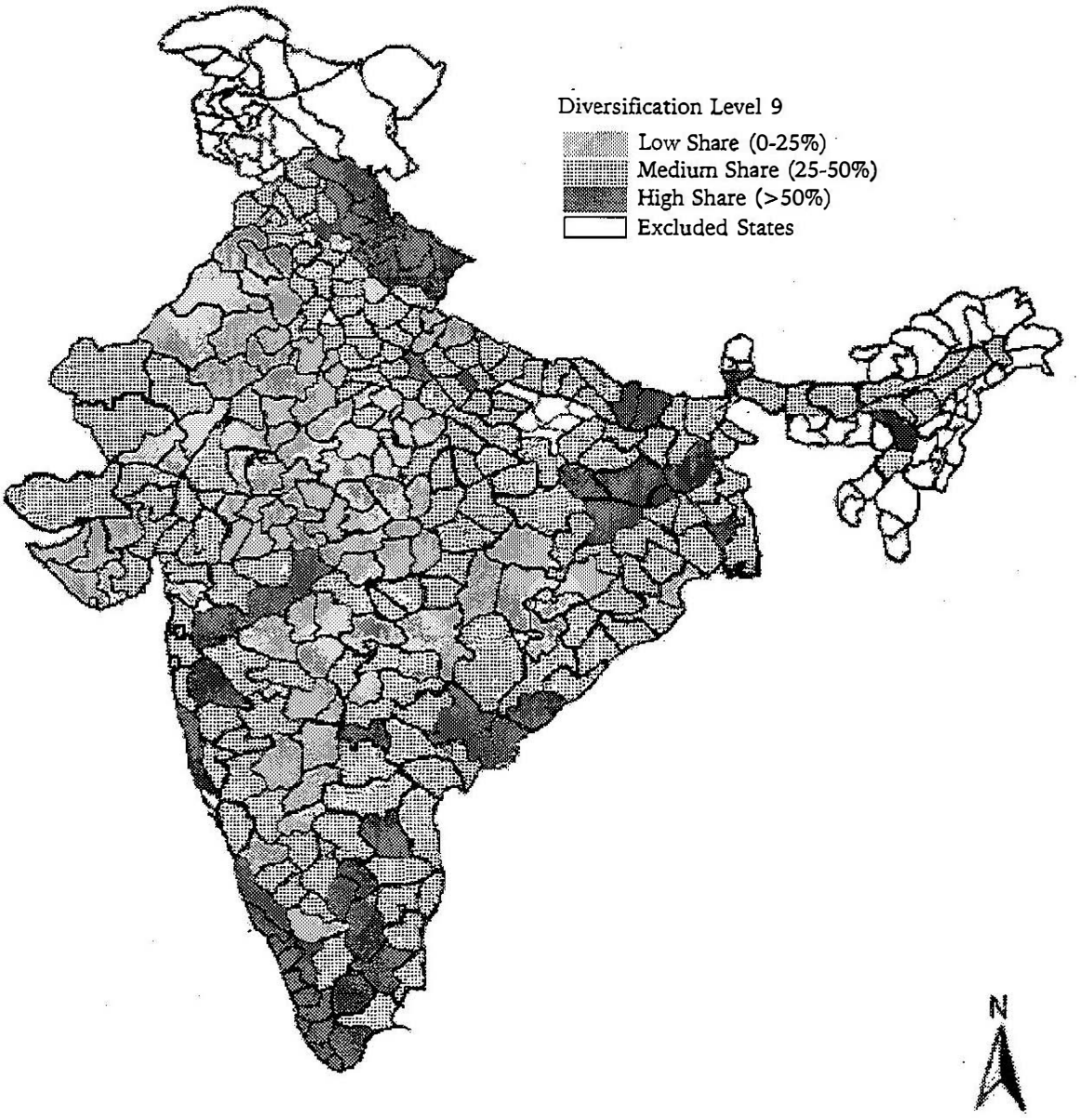
2. ROLE OF HVCs IN AGRICULTURAL DIVERSIFICATION

Diversification Zones based on Share of HVCs

At the all-India level, in 1998, HVCs accounted for 34 per cent of the total value of agricultural production—fruits and vegetables, 15 per cent; and livestock products, 19 per cent. There is, however, considerable spatial variation in the share of HVCs across the districts in India. Using the share of HVCs in the total value of agricultural production, districts were divided into three groups: high (> 50 per cent share), medium (25-50 per cent share) and low (< 25 per cent share) diversification zones. Spatially, considerable geographical contiguity was observed in the diversification zones (Figure 8.1). The districts in high diversification zone (Zone 1) were on the coastal and hill regions, with a number of exceptions. The districts in medium diversification zone (Zone 2) were found to cover a large part of the irrigated area (north India), eastern parts of India and area close to the coasts in southern and western India. The districts in low diversification zone (Zone 3) were mainly in the

Figure 8.1

Classification of Districts according to the Intensity of Agricultural Diversification in India, 1998



central and northwestern parts of the country, including large tracts of semi-arid tropics. This observation was contrary to the expectation, but it should be noted that although diversification, in general, could be high in the semi-arid and arid regions since they grow a large

number of crops (cereals, pulses, oilseeds etc.), in this paper the focus is on the share of HVCs in the total value of production.

Characterisation of Diversification Zones

The relative importance of selected variables in three diversification zones is shown in Table 8.1. Out of a total of 309 districts, 54 per cent were found to fall in Zone 2 (medium diversification), 28 per cent in Zone 3 (low diversification) and 18 per cent in Zone 1 (high diversification). The relative shares of the three groups in the total net cropped area (NCA), value of production (VOP), population, etc. were in tune with the number of districts.

Table 8.1

Relative Importance of District Groups by Diversification Level, 1998

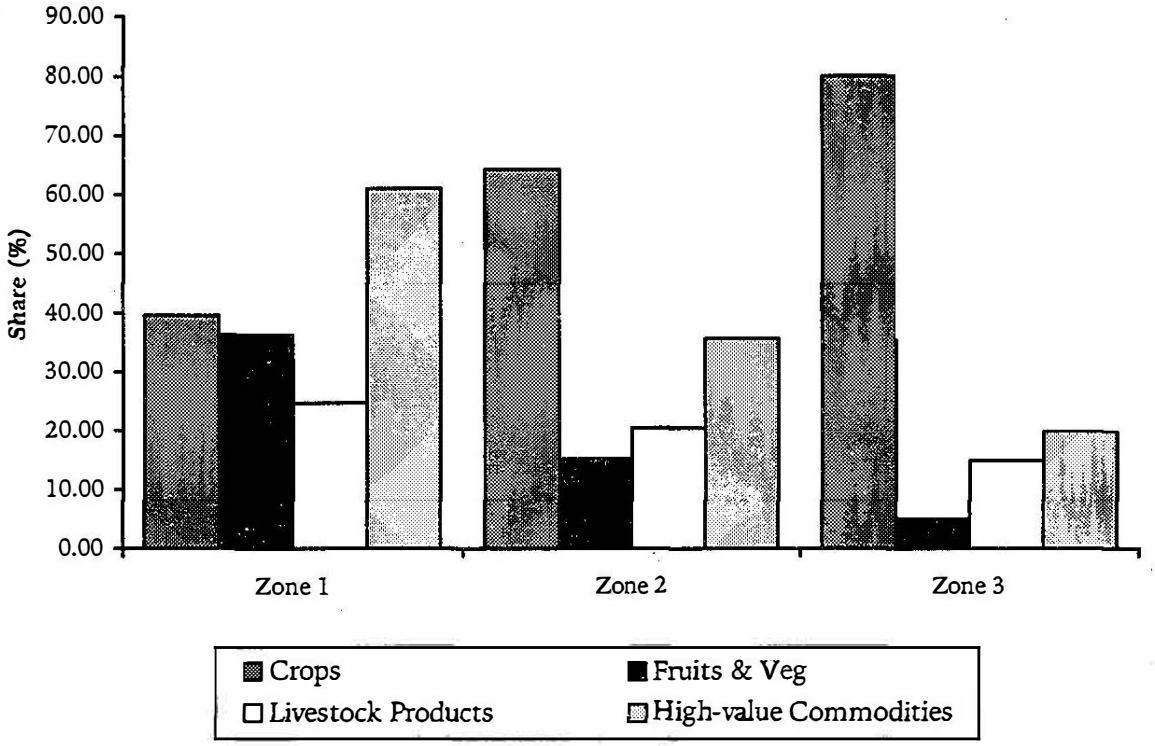
Indicators	*HVCs based Diversification Zones*		
	High (Zone 1)	*Medium (Zone 2)*	*Low (Zone 3)*
No. of Districts	56	167	86
No. of Districts (Per Cent)	18.1	54.0	27.8
Share in NCA (Per Cent)	11.3	53.0	35.6
Share of HVCs in VOP (Per Cent)	14.0	57.9	28.1
Share in Population (Per Cent)	19.7	60.3	20.0
Share in Urban Population (Per Cent)	25.0	54.0	21.0

Nature and Speed of Diversification

In 1998, on an average, HVCs accounted for 61 per cent of the total value of agricultural production in Zone 1, 35 per cent in Zone 2, and 20 per cent in Zone 3 (Figure 8.2). Amongst HVCs, the fruits and vegetables had the largest share in Zone 1 followed by milk and meat, while in Zone 2 these items had almost equal shares. In Zone 3, the share of crops like cereals (particularly wheat and coarse cereals), pulses, and commercial commodities (oilseeds, sugarcane and cotton) was dominant with almost 80 per cent share. Amongst the HVCs, livestock products dominated in this zone (15 per cent share).

Figure 8.2

Share of High-value Commodities by Diversification Zones, 1998



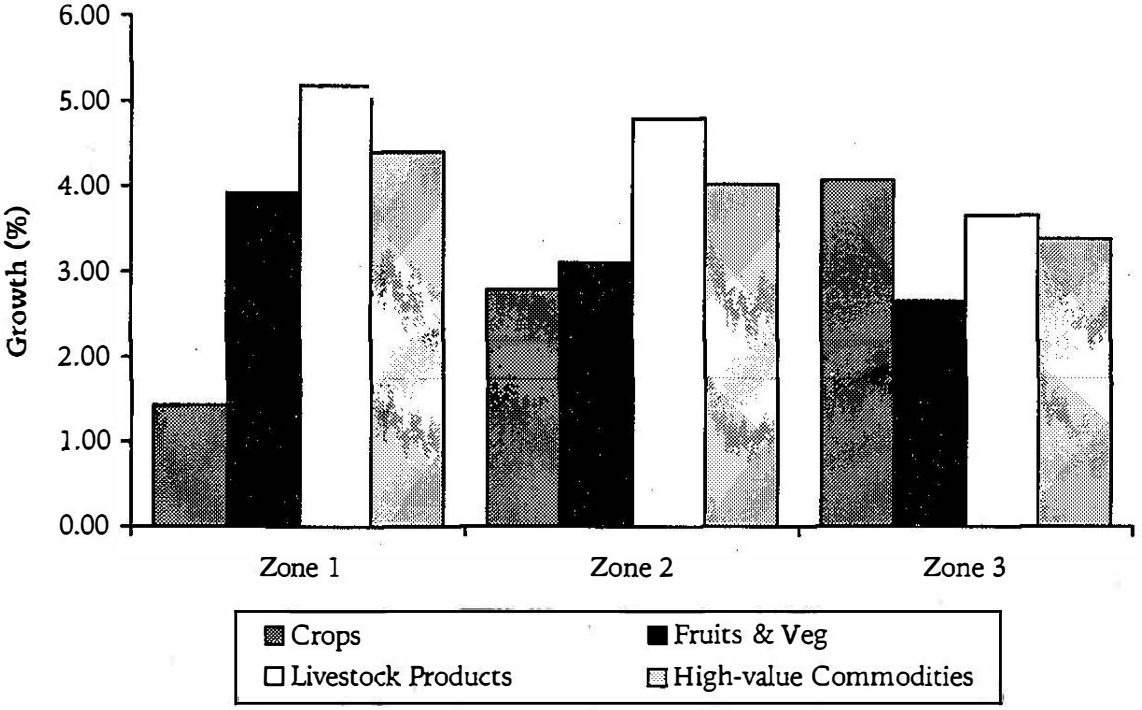
Speed of agricultural diversification (particularly of HVCs) between 1982 and 1998 was measured as the compound growth rates in value of crop and livestock products. In Zones 1 and 2, HVCs were growing at more than 4 per cent per annum and the growth rates were generally higher than for all other commodities (except oilseeds in Zone 2) (figure 8.3). Amongst the HVCs, the growth of livestock products (milk and meat) was faster than that of fruits and vegetables in both these zones. In Zone 3, although crops had the highest growth rates (mainly due to high growth in oilseeds followed by commercial crops), HVCs were growing faster (3.4 per cent) than cereals and pulses. Within HVCs, in Zone 3 also, the livestock products (milk, meat and eggs) were growing faster.

3. ROLE OF URBANISATION IN DRIVING HVCS

One of the objectives of this study was to test the hypothesis that 'urbanisation is an important driving force towards HVCs'; i.e. as we move closer to urban centers, agriculture should diversify towards

Figure 8.3

Growth in High-value Commodities by Diversification Zones, 1982-1998 (at 1982 Prices)



HVCs; on the contrary, as we move away from the urban centers, foodgrains should dominate. To better understand the role of urbanisation, districts were divided into (i) urban, (ii) urban-surrounded, and (iii) other districts. The concept behind generating a zone of urban-surrounded districts was that these districts being close to urban areas have access to the growing urban markets.

Characterisation of Different District Groups

Characterisation of district groups for selected indicators revealed that the urban districts group had a smaller holding size, higher population density, higher percentage of urban population, higher density of roads and markets and higher rural literacy compared to those in other two district groups (Table 8.2). Adoption of technology (HYVs, tractors, irrigation, fertiliser-use) was also marginally higher, in urban districts group than other two groups. The value of high-value commodities per district or per rural population was significantly higher in the urban group of districts, and was found to decline on moving towards urban-surrounded and other group of districts.

Table 8.2

Selected Indicators for Different District Groups, 1998

Indicators	*Districts Group*		
	Urban	*Urban-surrounded*	*Others*
Demographic			
Population density (No./sq km)	725.0	350.3	278.6
Urban population (per cent)	55.9	19.6	20.4
Female literate (per cent of rural population)	45.4	30.7	27.4
Organisational			
Average size of landholding (ha)	1.4	1.6	1.8
Percentage of small landholders (per cent)	80.9	75.8	75.0
Technological			
Irrigation (per cent to GCA)	46.2	40.0	36.2
Area under HYVs (per cent)	37.5	37.7	36.4
Fertiliser-use (kg/ha of GCA)	110.7	83.1	73.2
Tractor density (per '000 ha)	11.5	8.7	8.3
Agro-climatic			
Average normal rainfall (mm)	1253	1162	1229
Infrastructure			
Market density (markets/10,000 sq km of GA)	30.0	24.9	18.6
Road density (km/sq km of GA)	0.7	0.6	0.4
Socio-economic			
High-value commodities (million Rs./ district)	1813	1148	794
High-value commodities (Rs. per capita)	671	462	403

Note: GCA: Gross cropped area; HYVs: High-yielding varieties; GA: Geographical area.

Spatial Analysis of HVCs and Urbanisation

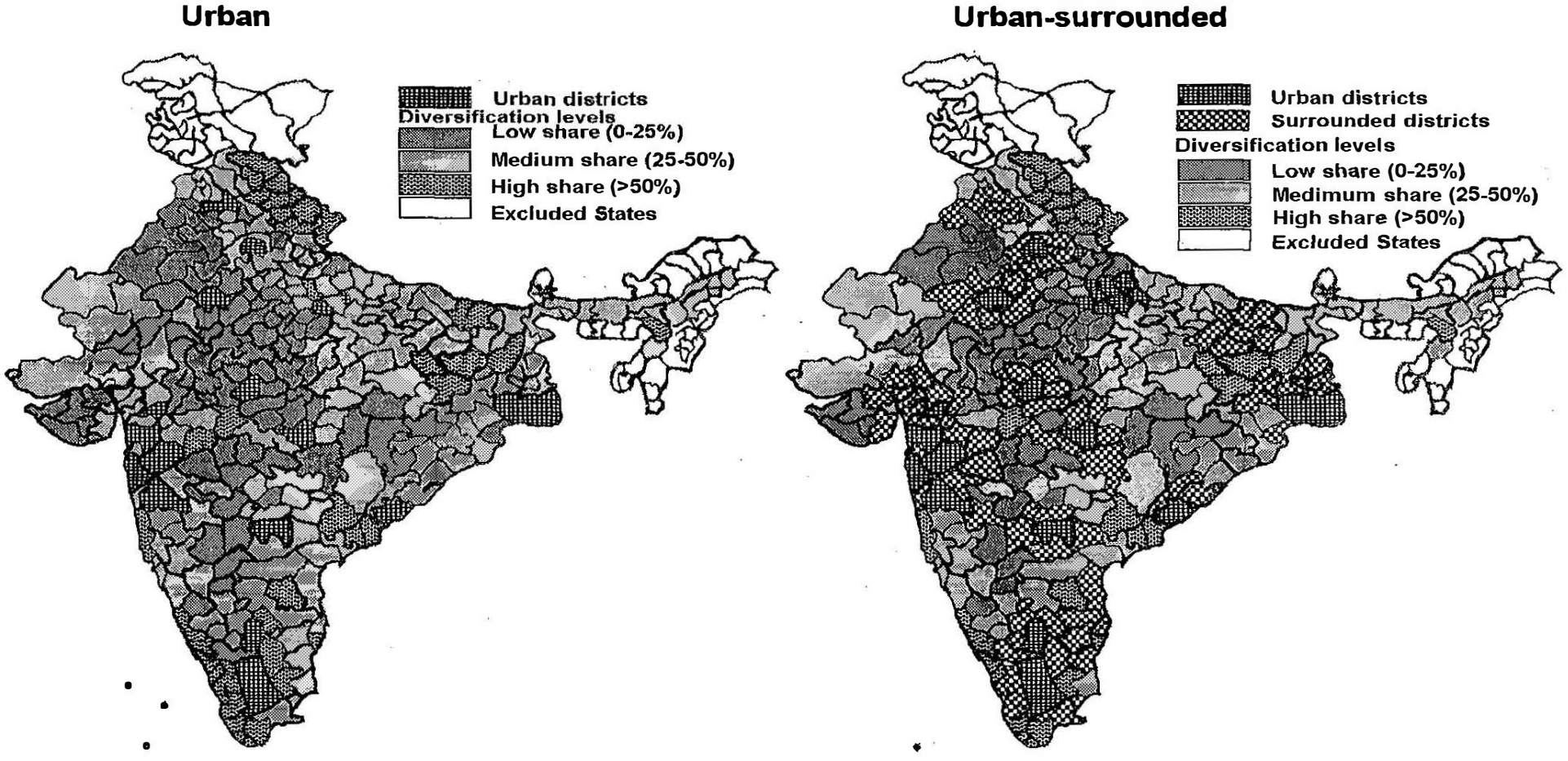
The first spatial analysis was carried out by superimposing urban districts and urban-surrounded districts on the diversification zones delineated in Section 2.1.

Diversification Zones and Urbanisation

Urban districts were superimposed over the agricultural diversification zones to test the hypothesis that HVCs are more concentrated around urban centers (Figure 8.4). It was found that a majority of the urban districts were in the high and medium diversification zones. Out of 31 urban districts, 11 (35%) were in the high diversification zone, 17 (55%) in the medium diversification and only 3 (10%) were in the low diversification zone. Out of a total

Figure 8.4

Share of High-value Commodities Superimposed by Urban and Urban-surrounded Districts in India, 1998



of 91 urban-surrounded districts, 16 (18%) fell in the high diversification zone, 50 (55%) in the medium diversification and 25 (27%) in the low diversification zone. For the other districts group, only 29 (15%) out of 187 districts were in the high diversification zone. Obviously, the cost advantage in transportation of HVCs and their quick disposal were the principal reasons that were making farmers close to urban centers more competitive than the far-off farmers.

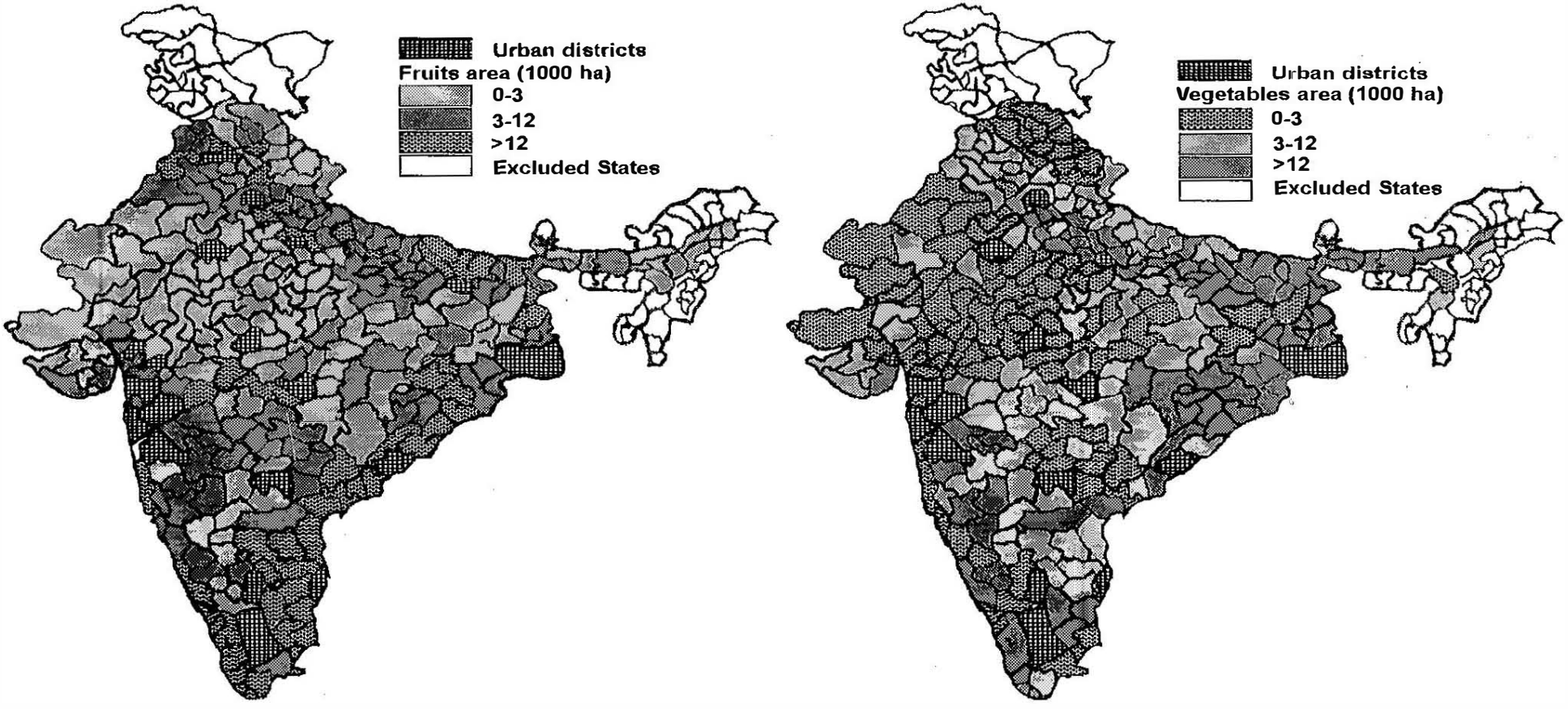
On the basis of this spatial analysis, we could infer that urbanisation was an important factor in the adoption of HVCs. Its impact, though limited, was gradually spreading to the surrounding districts also. With the development of roads and other infrastructural facilities, districts surrounding the urban centers had started supplying HVCs to the urban districts. As stated earlier, the demand for HVCs was found rising much faster in the urban districts than other areas due to rising per capita income and changes in tastes and preferences. To meet the demand for HVCs in the urban areas, the agriculture was found transforming itself from a food grain-based system to higher-value products. Kumar and Mathur (1996) have found that structural shifts (urbanisation) had a positive impact on demand for vegetables, fruits, meat, fish and eggs. Structural shifts were found to be as important as income changes in explaining shifts in the demand patterns towards high-value commodities. The income elasticity of demand for HVCs is high compared to those of staples, like cereals, pulses, etc. (Paroda and Kumar, 2000). It is expected that these urban districts will be the growth centers, where demand for HVCs will grow rapidly.

Fruits & Vegetables and Urbanisation

The absolute area under fruits in India is mainly concentrated in the eastern and western coastal districts, and northwestern and northeastern districts (Figure 8.5). It may be mentioned here that fruits have specific niches based on agro-climatic or soil characteristics. However, fruit cultivation is also spreading to some non-traditional areas with the availability of improved varieties and increasing demand due to urbanisation. By superimposing urban districts on the area under fruits, we found that area under fruits was high in a majority of the urban districts; 23 out of 31 urban districts (75%) had high-to-medium density of area under fruits. For the

Figure 8.5

Share of Fruits & Vegetables in Total Value of a Agricultural Output Superimposed by Urban and Urban-surrounded Districts in India, 1998



urban-surrounded districts, it was 60 per cent and for other districts, it was 50 per cent.

For vegetables, the spatial distribution was different from fruits. Northern, northeastern and eastern districts had the highest area under vegetables, and like fruits, the northwestern districts had the lowest area. Most of the districts in the northwestern region were specialising in rice-wheat based system due to policy distortions in favor of rice and wheat. However, in other areas it was clear that 'urbanisation is an important driving force to diversification', as a majority of the urban districts (28 out of 31: 90%) fell in the high or medium category of vegetable density. For urban-surrounded districts, the value was 70 per cent, and for other districts, 60 per cent.

Milk and Urbanisation

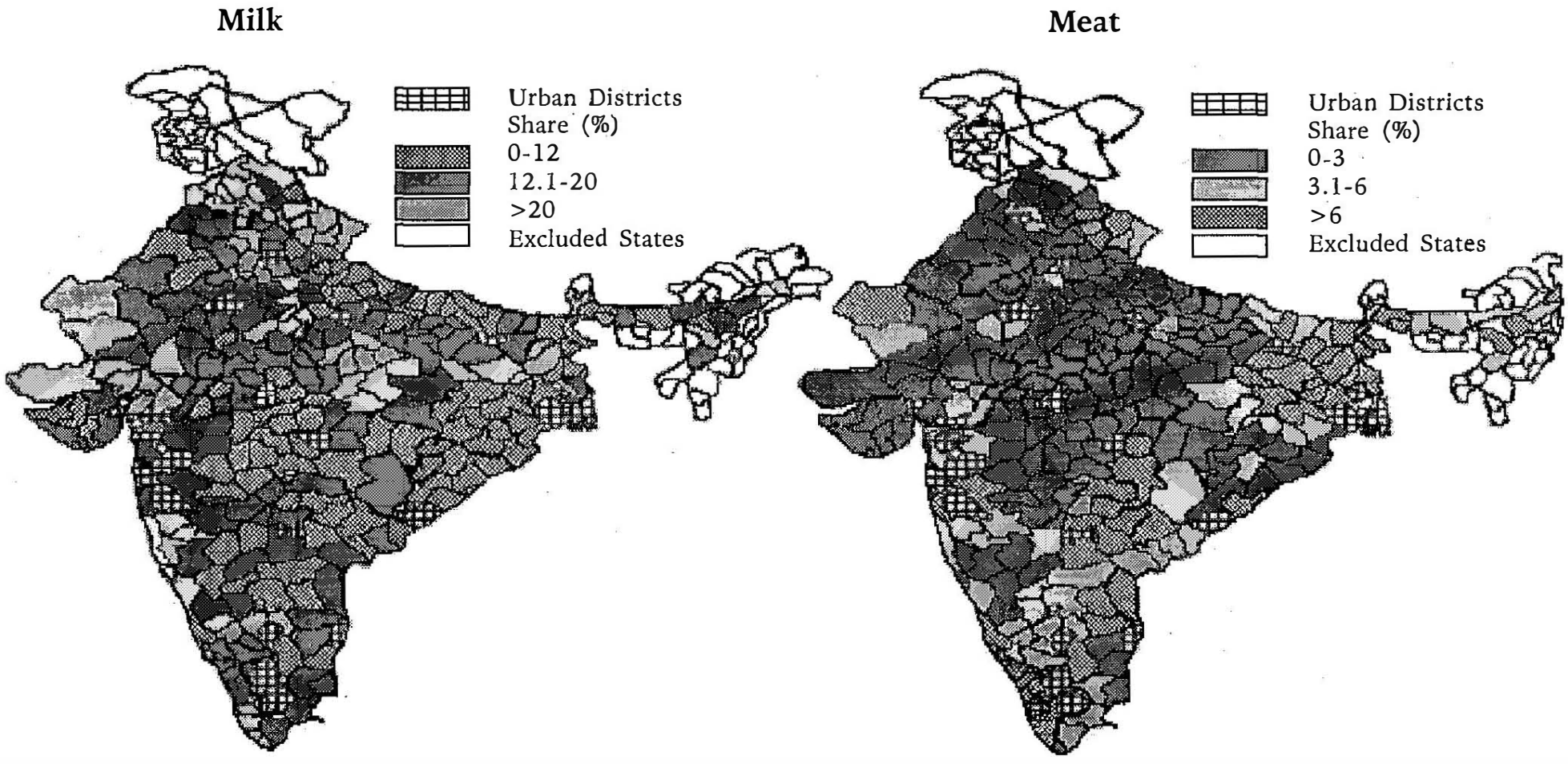
The spatial distribution of the shares of milk value (at 1982 prices) in the total agricultural production is presented in Figure 8.6. Milk production was found to be high mainly in the northern, western and a few pockets in southwestern region of India. Although urbanisation is an important factor in driving milk production, it was less significant than fruits and vegetables. Only 9 out of 31 urban districts (29%) were found to fall in the high milk production category. About 30 per cent of districts in the other districts group had a high share in milk production compared to 15 per cent for the urban-surrounded group. This implied that milk production was not concentrated in urban centers or urban-surrounded districts alone and a significant contribution of milk was from the interior (away from urban centers) districts. The reason for such a variation in production of milk compared to that of fruits and vegetables around urban centers was the expansion of effective cooperative network in the dairy sector. The promotion of 'Operation Flood' to boost milk production and augment income of rural smallholders promoted dairy sector uniformly irrespective of their proximity to the urban center.

Meat and Urbanisation

Meat production is relatively higher in the eastern and southern India, the Deccan Plateau, and a few districts in the western India,

Figure 8.6

Share of Milk and Meat in Total Value of Agricultural Output with Urban Districts Superimposed in India, 1998



close to Mumbai and Pune. Unlike milk, meat production was found to be high in a large number of urban districts (Figure 8.6). The urban-surrounded districts too contributed significantly to meat production. Demand for poultry meat and eggs in several urban districts and small ruminant meat in urban districts of eastern India was found driving the increased production of meat. Thus, unlike milk, a majority of districts (65%) in the other group category had low shares in meat production. There were, however, a few urban districts in the central, and northwestern India where the share of meat production was low, perhaps due to a large number of vegetarian population.

Nature, Sources and Speed of Diversification

High-value commodities accounted for 43 per cent of the total value of the production in the urban districts group, compared to 35 per cent in urban-surrounded and 32 per cent in the other districts group (Table 8.3). In the case of meat, particularly the poultry meat

Table 8.3

Nature of Diversification in Value of Production in Urban and Other District Groups: Value Shares at Constant Prices (Per Cent), 1998

Commodities	*District Groups*		
	Urban	*Urban-surrounded*	*Other*
Cereals	*39*	*39*	*42*
Rice	24	19	19
Wheat	11	13	16
Coarse Cereals	5	7	7
Pulses	*3*	*5*	*6*
Oilseeds	*6*	*10*	*11*
Commercial Crops	*9*	*11*	*9*
Sugarcane	8	8	6
Cotton	1	3	3
Fruits & Vegetables	*19*	*16*	*14*
Fruits	9	10	7
Vegetables	10	7	6
Total Livestock	*24*	*19*	*18*
Milk	17	14	15
Meat & Eggs	6	4	3
High-value Commodities	*43*	*35*	*32*

and eggs, the share of urban districts was almost double than in the other two groups. Fruits and vegetables, and milk had marginally higher shares in the urban districts compared to other two groups.

Sources of Diversification

The change in total value of production between 1982 and 1998 (at 1982 constant prices) was calculated and the total change in value was apportioned to different commodities contributing to the change (Table 8.4). A perusal of Table 8.4 revealed that the HVCs accounted for almost 50 per cent of the change in total value in the urban districts, 41 per cent in the urban-surrounding districts and 35 per cent in other districts. The higher contribution of livestock products, namely milk and meat products, to the change in urban districts mainly accounted for this difference. Thus, although milk production was more widespread across all district groups, it had grown marginally faster in the urban group of districts during the past 20 years.

Table 8.4

Sources of Diversification in Value of Production (Per Cent) in Urban and Other District Groups, 1982-1998 (1982 Constant Prices)

Commodities	*District Groups*		
	Urban	*Urban-surrounded*	*Other*
Cereals	*34.1*	*30.6*	*35.4*
Rice	24.5	16.4	14.9
Wheat	9.2	12.2	17.8
Coarse Cereals	0.4	2.0	2.7
Pulses	*1.3*	*3.7*	*3.0*
Oilseeds	*8.7*	*14.4*	*17.5*
Commercial Crops	*7.5*	*10.3*	*9.2*
Sugarcane	7.3	7.7	5.6
Cotton	0.2	2.7	3.5
Fruits & Vegetables	*16.2*	*17.6*	*13.4*
Fruits	11.0	11.6	9.0
Vegetables	5.2	6.0	4.4
Total Livestock	*32.3*	*23.4*	*21.5*
Milk	22.5	17.3	17.3
Meat & Eggs	9.8	6.1	4.2
High-value Commodities	*48.5*	*40.9*	*34.9*

To supplement the above findings, the annual compound growth rates of HVCs were computed to assess the speed of agricultural diversification at different levels of urbanisation. The results are presented in Table 8.5. Amongst the livestock commodity group, meat and eggs had the largest growth in urban districts (7.2% per annum), compared to 5.6 per cent in the urban-surrounded districts and 5.2 per cent in others group. The growth of milk too was marginally higher in the urban districts group. In contrast, fruits and vegetables had a higher growth rate in the groups of urban-

Table 8.5

Annual Compound Growth Rates in Value of Production in Different District Groups, 1982-1998 (at 1982 Constant Prices)

Commodities	*District Groups*		
	Urban	*Urban-surrounded*	*Other*
Cereals	*2.83*	*2.46*	*2.66*
Rice	3.56	2.78	2.43
Wheat	2.69	2.97	3.78
Coarse Cereals	0.21	0.84	1.12
Pulses	*1.48*	*2.23*	*1.54*
Oilseeds	*6.32*	*6.31*	*6.60*
Commercial Crops	2.57	3.08	3.28
Sugar	2.85	2.94	2.94
Cotton	0.57	3.60	4.02
Fruits & Vegetables	*2.72*	*3.67*	*3.31*
Fruits	4.20	4.44	4.57
Vegetables	1.56	2.76	2.12
Total Livestock	*5.45*	*4.59*	*4.30*
Milk	4.94	4.33	4.12
Meat & Eggs	7.20	5.57	5.20
Bovine Meat	5.74	4.65	4.50
Ovine Meat	6.98	4.75	6.13
Pig Meat	6.79	5.95	4.85
Poultry Meat & Eggs	7.47	6.21	4.75
High-value Commodities	*4.06*	*4.14*	*3.85*
All Commodities	**3.42**	**3.37**	**3.35**

surrounded (3.7%) and other districts (3.3%), compared to that in urban districts group (2.7%). Early adoption of fruits and vegetables around the urban centers and gradual move towards near urban centre was found as the main reason for relatively higher growth rates in urban-surrounded districts. Such a tendency was observed due to land constraints in the urban centres. However, the spread of meat and poultry production was still expanding rapidly in the urban centers as these products are not bound by land constraints.

Although a mixed picture emerged from the above analysis, it could be inferred that urbanisation, by and large, had been an important factor in driving the production of HVCs, as these had a higher share in the total value of production in the urban group of districts than in other two groups. In the urban districts, HVCs also accounted for a larger share in sources of change in agricultural value between 1982 and 1998. Interestingly, for urban-surrounded and other district groups the difference is marginal. The urban-surrounded districts as a group were clearly not driving HVCs production, but individually, a few districts among the group might be contributing a large share.

To find why only some urban-surrounded districts had more diversification towards HVCs in the group, we superimposed the network of national highways passing through urban centers to the surrounded districts (Figure 8.7). Urban-surrounded districts were then grouped into three categories, based on the number (0, 1, 2 or more) of highways passing through them. These district groups were then characterised for the share of HVCs in the total agricultural value (Table 8.6). It was found that no national highway was passing through 25 districts, only one was passing through 45 districts and 2 or more highways were passing through 23 districts. HVCs had a higher share in the total value of production (37%) in the district groups through which national highways were passing. Thus, urban-surrounded districts with greater passes of national highways and better road network were more diversified towards HVCs to meet the demand in urban centres. It reflected the importance of roads in promoting agricultural diversification. Therefore, a higher investment in roads would boost the production of HVCs to meet the demand of urban population.

Figure 8.7

National Highways and Share of High-value Commodities in Urban Districts in India, 1998

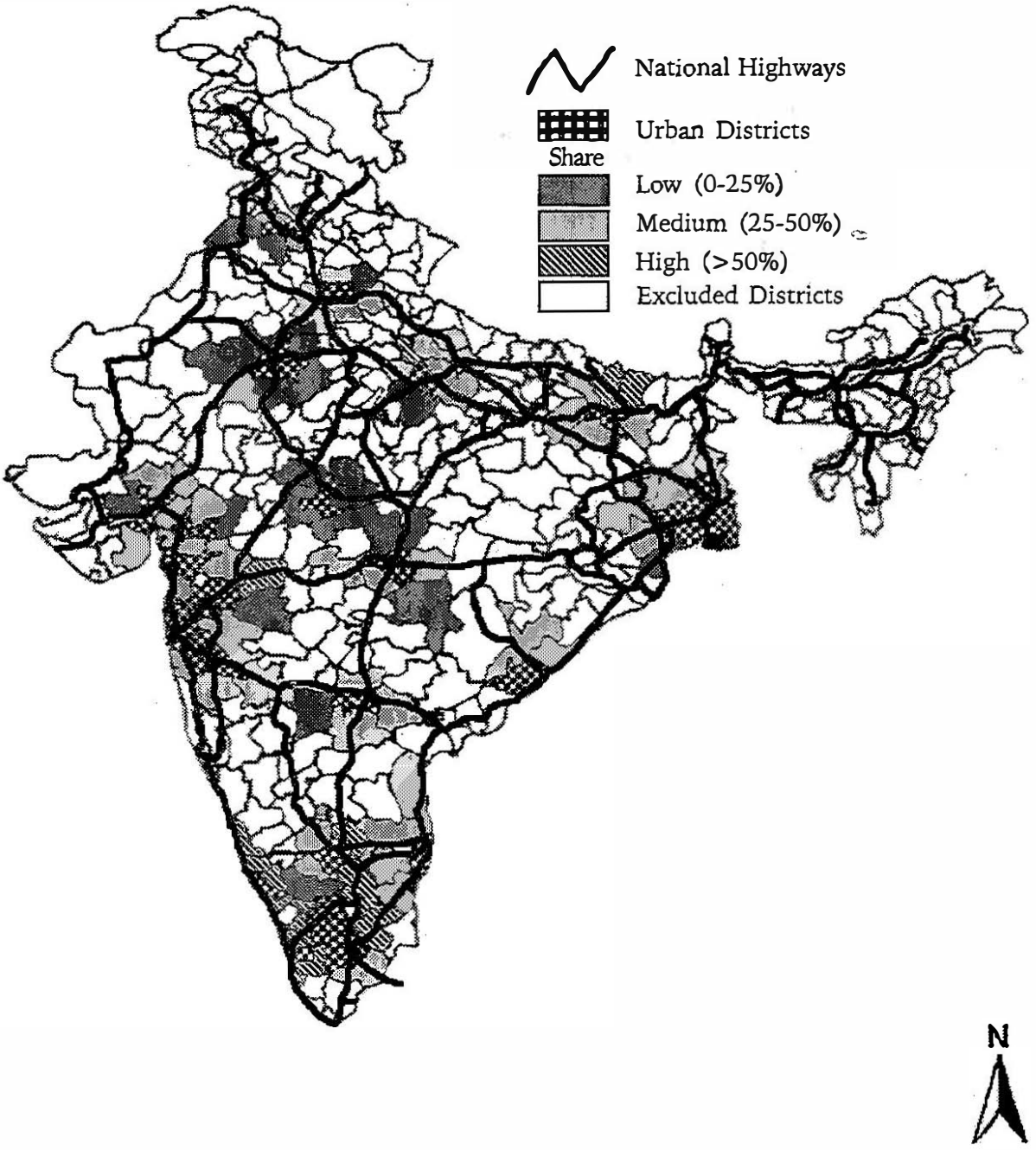


Table 8.6

Impact of National Highway Passes on Agricultural Diversification within Urban-surrounded District Groups based on the Share of High-value Commodities in Total Agricultural Value (Per Cent)

Commodity	*No. of National Highway Passes/No. of Districts*					
	Zero (0.39)[1]		*One (0.57)*		*≥Two (0.83)*	
	25[2]		*45*		*21*	
	Years		*Years*		*Years*	
	1982	*1998*	*1982*	*1998*	*1982*	*1998*
Fruits	4.4	4.9	10.3	11.2	7.6	10.9
Vegetables	6.9	6.1	8.7	7.4	5.9	6.7
Bovine Milk	13.4	14.8	11.9	14.1	12.7	15.5
Meat	0.9	1.2	1.3	2.0	1.8	1.7
Poultry, Pig Meat & Eggs	1.2	1.5	1.6	2.9	2.4	3.2
Total HVCs	**26.8**	**28.4**	**33.9**	**37.6**	**30.3**	**37.8**

Note: 1. Figures within the parentheses represent road density, km/sq km in 1998.
2. Number of districts.

4. FACTORS INFLUENCING DIVERSIFICATION TOWARDS HIGH-VALUE COMMODITIES

Model Selection

To study the factors that drive HVCs, several models were tried. These included Ordinary Least Square (OLS) estimates (linear function) and the ordered probit model (OPM). The OPM was tried since the dependent variables were shares of HVCs in the total value of agricultural production and these could be considered as count-type data arising from categorisation of continuous data. The shares were thus polychotomous-dependent variables that had a natural order. By coding these as 0, 1, 2, ..., one might regard these as ordinal ranking that could be modeled using 'ordered probit model'.

Description of Variables

The spatial analysis has provided sufficient clue that urbanisation has been an important factor in influencing adoption of HVCs. However, based on the above analysis it has not been possible to

pinpoint other factors influencing adoption of HVCs nor could we underline their significance levels Therefore, factors influencing agricultural diversification towards HVCs were analysed using OLS and ordered probit models (OPM)

The dependent variables were defined in three ways so as to capture the role of different factors in affecting agricultural diversification These were based on the shares in the total value of agricultural production of (i) high-value commodities (HVCs), (ii) fruits and vegetables, and (iii) poultry meat and eggs

For the ordered probit model, the data for the above dependent variables were ordered as 0, 1, and 2, from low to high shares in the total value of agricultural production by taking suitable cut-off points The criteria to delineate the districts for total HVCs was same as followed to classify districts for diversification intensity (i) the districts with > 50 per cent share of HVCs as high (2), (ii) with 25 to 50 per cent share as medium (1), and (iii) with < 25 per cent share as low (0) diversification For fruits and vegetables the cut-off points were (i) >25 per cent as high (2), 10-25 per cent as medium (1), and <10 per cent as low (0) For poultry, pig meat and eggs the cut-off points are (i) > 5 per cent as high (2), 1-5 per cent as medium (1), and <1 per cent as low (0)

The explanatory variables considered in these models included agro-climatic, technological, socio-economic and infrastructure variables, that determine share of HVCs from the supply and demand side These variables are listed in Appendix A-8 1 For the demand side, variables like urban population, per capita rural and urban income, we expected a positive relationship with the share of HVCs The demand for HVCs would increase with higher growth in income Studies have indicated that the income elasticity of demand for HVCs was high not only in urban areas but in rural areas also For this analysis since data on per capita income at the district level were not readily available, only urbanisation was included in the models

Among the supply side factors, all infrastructure-related variables, like roads, markets, veterinary institutions, Artificial Insemination (AI) Centers for livestock, etc would have a positive impact on HVCs Roads and markets provide a direct link to the producer with the consumer, cutting down on transport and transaction costs Veterinary institutions and AI centers would help in a faster adoption

of improved livestock technologies. Variables like irrigation, tractor density, area under HYVs, etc. would either have a negative influence on HVCs or remain insignificant. In regions with access to irrigation, farmers practice high input agriculture specialising in a few crops or enterprises. Here, agriculture is less risky and market access is good for the specialised products.

Adoption of crossbred technologies in the livestock sector would have a positive impact on HVCs, particularly milk and meat production. Districts with higher rainfall and longer 'length of growing period' (LGP) are likely to affect adoption of HVCs positively due to a longer cropping season and scope for multiple cropping.

Results of Modeling Studies

All HVCs

All variables in the model, explaining share of HVCs in the total value of production had the expected signs with varying significance levels (Table 8.7). For the demand side variables, urban population,

Table 8.7

Factors Determining Diversification: Results[1] of Modeling Studies on all HVCs, 1997-98

Explanatory Variables	*Estimated Coefficient*	
	Ordered Probit	*OLS*
Urban Population (URBPER)	0.0161**[2]	0.1967***
Smallholders (MSFPER)	0.0404***	0.2780***
Road Density (ROAD)	0.4671*	2.5595
Crossbred Cattle (CBCAT)	0.0147**	0.2693***
Veterinary Services (VETY)	4.4033***	15.8928***
Tractors (TRACT)	-0.0312***	-0.3555***
Rainfall (RAIN)	0.0002	0.0047***
Constant	-3.3411	1.7620
R^2	0.64	0.60
Adjusted-R^2	0.68	0.59

Note: 1. Estimates based on district level data, N=309.

2. ***, ** and * indicate significance at 1, 5 and 10 per cent probability levels, respectively.

as expected, had a positive impact on HVCs and was significant at 1 per cent probability level in both OLS and OPM models. The share of HVCs was positively related to the number of smallholders, indicating that they tended to diversify their production portfolio to mitigate risk, and have additional income. An interesting point here was that small farmers were willing to diversify after meeting their food-security needs, if suitable technology and market outlets at remunerative prices for HVCs were readily available.

On the supply side, several variables were tried and after some experimentation, a few had to be dropped due to the problem of multicoliniarity. For example, variables on irrigation and tractor density were correlated and hence only one was included in the models. Similarly, LGP was excluded since it was correlated with rainfall.

All the infrastructure-related variables had the expected impacts and were significant at 5 per cent (roads) and 1 per cent (veterinary facilities) probability levels. Roads were however, insignificant in the OLS model.

Adoption of crossbred cattle was found to be significant at 1 per cent probability level and had a direct bearing on livestock activities related to milk and meat. As expected diversification had taken a backseat in the districts having intensive agriculture (particularly of rice and wheat).

Fruits and Vegetables

Urban population, rainfall and small farmers had a significant and positive influence on the share of fruits and vegetables (Table 8.8). This indicated that rise in urban population on the demand side and increase in the number of smallholders on supply side contributed positively to expansion of area and production of fruits and vegetables. Tractor density had a significant and negative effect on diversification towards fruits and vegetables, as it is regarded a proxy for intensive agriculture towards rice and wheat. Thus, while the irrigated areas were specialising in rice and wheat, the rainfed areas were diversifying towards fruits and vegetables, due to their low water requirement. Roads density was positive and significant in both the OLS and OPM equations and was significant at the 10 per cent probability level.

Table 8.8

Factors Determining Diversification: Results[1] of Modeling Studies on Fruits and Vegetables, 1997-98

Explanatory Variables	*Estimated Coefficient*	
	Ordered Probit	*OLS*
Urban Population (URBPER)	0.0162***[2]	0.142***
Smallholders (MSFARM)	0.0493***	0.247***
Road Density (ROAD)	0.4108*	4.922***
Tractors (TRACT)	-0.0223**	-0.160***
Rainfall (RAIN)	0.0004***	0.004***
Constant	-4.2310	-12.368
R^2	0.57	0.38
Adjusted-R^2	0.60	0.37

Note: 1 Estimates based on district level data, N=309

2. ***, ** and * indicate significance at 1, 5 and 10 per cent probability levels, resepectively

Meat (Monogastrics Only) and Eggs

Urban population, roads, markets and normal rainfall influenced poultry production positively, and all the variables were significant. (Table 8.9). Like for fruits and vegetables, the coefficient of smallholders explained that poultry production was also more concentrated in districts where they are relatively more predominant. Adoption of improved poultry too had a positive effect on poultry production, although it was significant at 10 per cent probability level. Only irrigation was negatively related to poultry production, implying that in highly irrigated districts, poultry activity was less important.

In short, it could be concluded that technological, socio-economic, agro-climatic and infrastructure-related factors play a definite role in determining diversification towards high-value commodities. Urbanisation is an important factor, but not the only one, in driving diversification towards HVCs. Several factors on the supply side have been found to influence adoption of HVCs at the farm level.

Table 8.9

Factors Determining Diversification: Results[1] of Modeling Studies on Monogastrics Meat and Eggs, 1998

Explanatory Variables	*Estimated Coefficient*	
	Ordered Probit	*OLS*
Urban Population (URBPER)	0.016***[2]	0.0549***
Smallholders (MSFARM)	0.013***	0.0418***
Road Density (ROAD)	0.799***	1.0533**
Improved Breed (IMPPOU)	0.008***	0.0086
Irrigated Area (IRRI)	-0.010***	-0.0292***
Rainfall (RAIN)	0.001***	0.0009***
Constant	-2.333	-2.5826
R^2	0.66	0.27
Adjusted-R^2	0.69	0.26

Note: 1. Estimates based on district level data, N=309.

2. ***, ** and * indicate significance at 1, 5 and 10 per cent probability levels, respectively.

5. SUMMARY AND CONCLUSIONS

High-value commodities account for a large share of the total value of agricultural production in a number of districts in India. Based on the share of HVCs, districts have been delineated into low, medium and high diversification zones. HVCs on an average account for 60 per cent share in the high diversification zone compared to 20 per cent in the low diversification zone. However, the speed of diversification towards HVCs is high in all the zones compared to other crops like cereals, pulses, oilseeds, etc., with a few exceptions. Amongst the HVCs, livestock products like milk and particularly poultry meat and eggs, have been growing the fastest.

Urban districts group has been found to have a higher share of HVCs than urban-surrounded and other districts group, and within HVCs, vegetables and meat products have a higher share. The difference between urban-surrounded and other district groups in share and speed of diversification towards HVCs is marginal. However, urban-surrounded districts with better road network have been diversifying faster since they are able to meet the demand for

HVCs in the urban centers. Besides urbanisation, technological, agro-climatic, socio-economic factors and infrastructure-related variables have significantly influenced diversification towards HVCs. Density of small farms, and infrastructural facilities are positively associated with HVCs. Infrastructure-related variables like roads, markets and veterinary facilities significantly influence diversification towards HVCs. On the other hand, irrigation, area under HYVs, and high-input agriculture in the better-endowed regions have a negative influence on HVCs. Rainfall also plays an important role in diversification. Promoting rainfed areas through appropriate infrastructure development for agricultural diversification would have far-reaching implications on the developmental and poverty alleviation programs in these areas.

Since urban population is growing at the rate of more than 3 per cent per annum, demand for HVCs will drive their production. Small farmers would be the major beneficiaries of higher production of HVCs as it provides them an opportunity to diversify their income sources and thus mitigate risk. However, supply side constraints will have to be addressed rapidly to keep pace with demand.

This analysis has also brought out regional variations in HVCs across the country. It has implications on regional development as well as planning. Farmers close to cities will stand to gain more from HVCs than those farther away. Investment strategies particularly related to infrastructure (roads, markets, cold chains) will have to be matched with the demand drivers and the supply side factors. This would have implications on public and private sector investment strategies.

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Appendix A-8.1

Expected Impact of the Determinants of the High-value Commodities

Explanatory Variables	*Units*	*Description*	*Expected Sign*		
			All HVCs	*Fruits and Vegetables*	*Livestock Products*
Demand Side Factors					
URBPER	Percentage to total population	Urban population	+	+	+
POPDEN	No /sq km of geographical area	Human population density	+	+	+
VOPR	Rs/person	Value of agricultural production	+	+	+
Supply Side Factors					
CBCAT	Percentage	Cross-bred cattle to total cattle	+	NA	+
IMPPOU	Percentage	Improved poultry to total poultry	+	NA	+
VETY	No /'000 livestock units	Veterinary institutes	+	NA	+
AI	No /'000 livestock units	AI centers			+
CPRGA	Percentage	CPR to geographical area	+	NA	+
RAIN	mm	Normal rainfall	+	+	+
CVRAIN	Coefficient of variation	Seasonal rainfall distribution	-	-	-
LGP	Days	Length of growing period	+	+	+
FERT	kg/ha	Consumption of NPK	+	+	NA
MSFPER	per cent	Marginal & small landholdings	+	+	+
FSIZE	ha	Size of landholding	-	+/-	-
ROAD	km/sq km of geographical area	Road density	+	+	+
MARKET	No./10,000 sq km of geographical area	Agricultural commodity market density	+	+	+
TRACT	No./'000 ha of net cropped area	No. of tractors	-	-	-
HYVs	per cent	Area under high-yielding varieties	-	-	NA
IRRG	Per cent	Irrigated area to total cropped area	-	-	-

Note LU= Livestock units
CPR= Common property resources
NA= Not applicable