Meso-Level Database Coverage and Insights

Village Dynamics in South Asia

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Database Coverage

Background: The meso-level dataset for India and Bangladesh contains data pertaining to the performance, structure and dynamics of agricultural economy at country level and its disaggregation at state/region, district, and sub-district level.

The dataset maintained by ICRISAT and updated under the Village Dynamics in South Asia (VDSA) Project provides a comprehensive one-stop shop for data related to key agricultural and socioeconomic variables that are relevant for hypotheses testing, identification of regions/districts for priority setting, and targeted poverty alleviation development initiatives. The meso-data thus acts as a link between the country/state/district level macro/meso-data and household-level micro data (see Figure 1).

All-India and State level data: The all-India database is available from 1950 while the state level data is from 1966 to the latest available year. The state data covers 19 major states of India (see Figure 2). Both the data sets include data on key agricultural variables besides related variables (population, climate, infrastructure, etc).

District level database: District level data for the 19 states indicated in the map is available from 1966 onwards for core and additional variables such as area and production (crop-wise), irrigation, land use, wages and prices, input use, census data (human population and livestock population), infrastructure (roads, markets, banks and veterinary institutions) and climatic variables.

Figure 2. Geographic coverage of meso-data in India – 19 states.

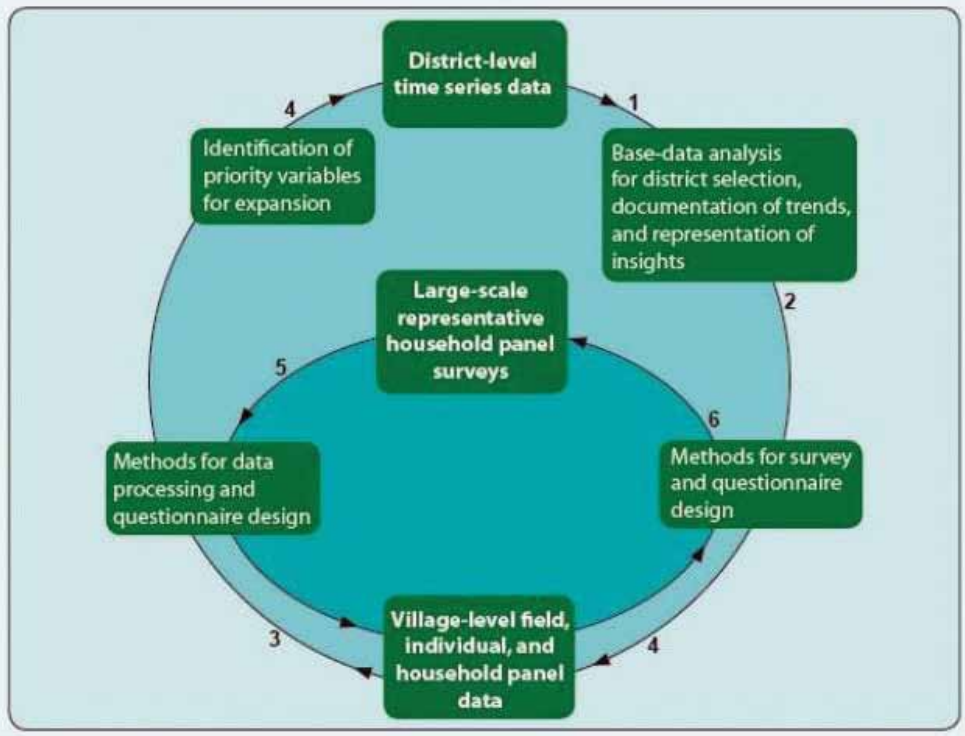


Figure 1. Linkages between meso- and micro-level database.

1. Meso-level data useful for identifying priority target areas to track poverty in the Village Dynamics Studies (VDS)
2. Trend analysis of available district level data highlights — key emerging issues in the semi-arid tropics and humid agro-ecologies
3. Insights from the Village Dynamics Studies are complemented with *taluka or mandal or upazilla* level data in the districts where the VDS villages are sited.
4. Conversely, the analysis of time-series micro data has implications for the priorities in the choice of variables to add to the meso-level data analysis to support informed decision making.
5. Large-scale panel databases (eg, LSMS) can contribute to improved methods of data entry and the use of standardized techniques to estimate consumption expenditure for the benefit of the Village Dynamics Studies.
6. A VLS-type panel can inform the LSMS panel on the gain in precision with adaptation of VLS methodologies — high frequency interviews, resident investigators with established rapport, coverage of split-off households, mobility and networks for transactions.

Since new districts are formed every year in various states, the dataset is divided into two components: Apportioned and Un-apportioned.

Apportioned data refers to the dataset that includes only 1966 base district boundaries, ie, for all the districts formed after 1966 the data for all variables is given back to their parent district and removed from the database. Thus, in the apportioned dataset, the continuity of data over time is ensured for comparison of key trends at two points in time enabling time series analysis. For the un-apportioned database, data for all districts are available from 1990-91 to the latest available year. As of 2008, there are a total of 534 districts in the un-apportioned and 305 in the apportioned datasets (see Figure 3).

Sub-district level data: Sub-district level (taluka or mandal) data is available for districts where the VDSA villages are located. Presently, in India, the VDSA villages are located in 8 states spread across 15 districts, 26 sub-districts and 30 villages.

Bangladesh Data: The meso level database for Bangladesh includes district level data commencing 1951 onwards on agriculture and socioeconomic variables at the regional level (old district), at the district level (64 new districts) and the upazila (sub-district) level. The variables include area, production and yield of crops, irrigation data by source and by means, socio-economic, demographics and human capital indicators.

The Concept map

The concept map was developed to provide the structure of various levels of meso-data being updated and organized under VDSA project. It will be useful for data warehouse development and web hosting. The detailed concept map of the meso dataset including levels of data and subject areas and variables is given below (see Figure 4).

Data warehouse

Data warehouse development is an important activity being pursued under VDSA. The purpose is to provide easy access to comprehensive macro, meso and micro datasets and ready to use reports on key parameters to clients and stakeholders. The meso level datasets have been harmonized across country, states, districts and sub-district level in terms of common file structure, variable codes, variable names and file names.

The aim is to foster better utilization of available information and datasets in policy and decision making, development and transfer of relevant agricultural technology, and planning for agriculture and rural development and transformation.

Insights from Meso-Level Database

Agro-ecological Regions and Production Systems

The National Agricultural Technology Project (NATP) divided the entire country into 5 broad Agro-Ecological

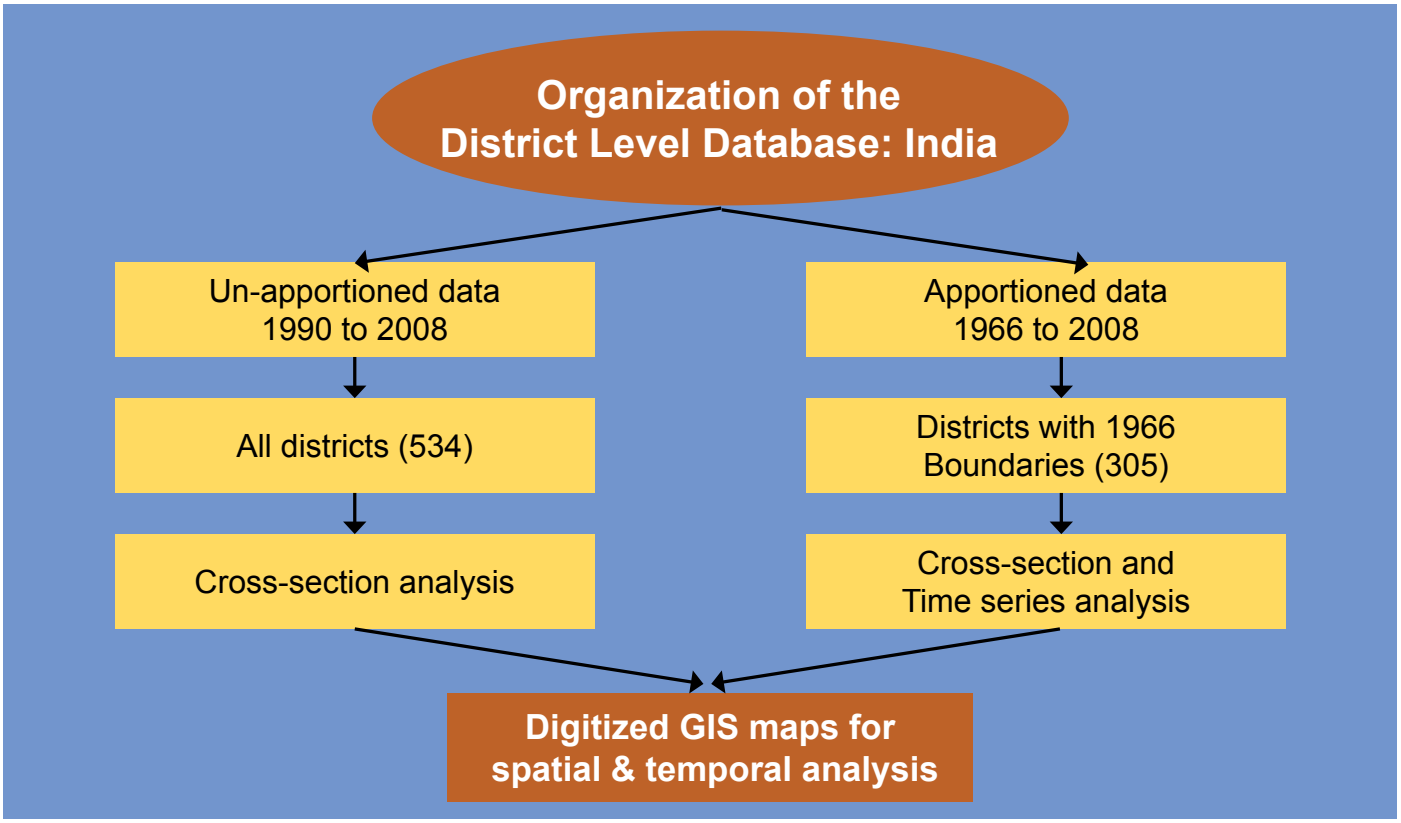


Figure 3. Flowchart depicting the organization of district level database, India.

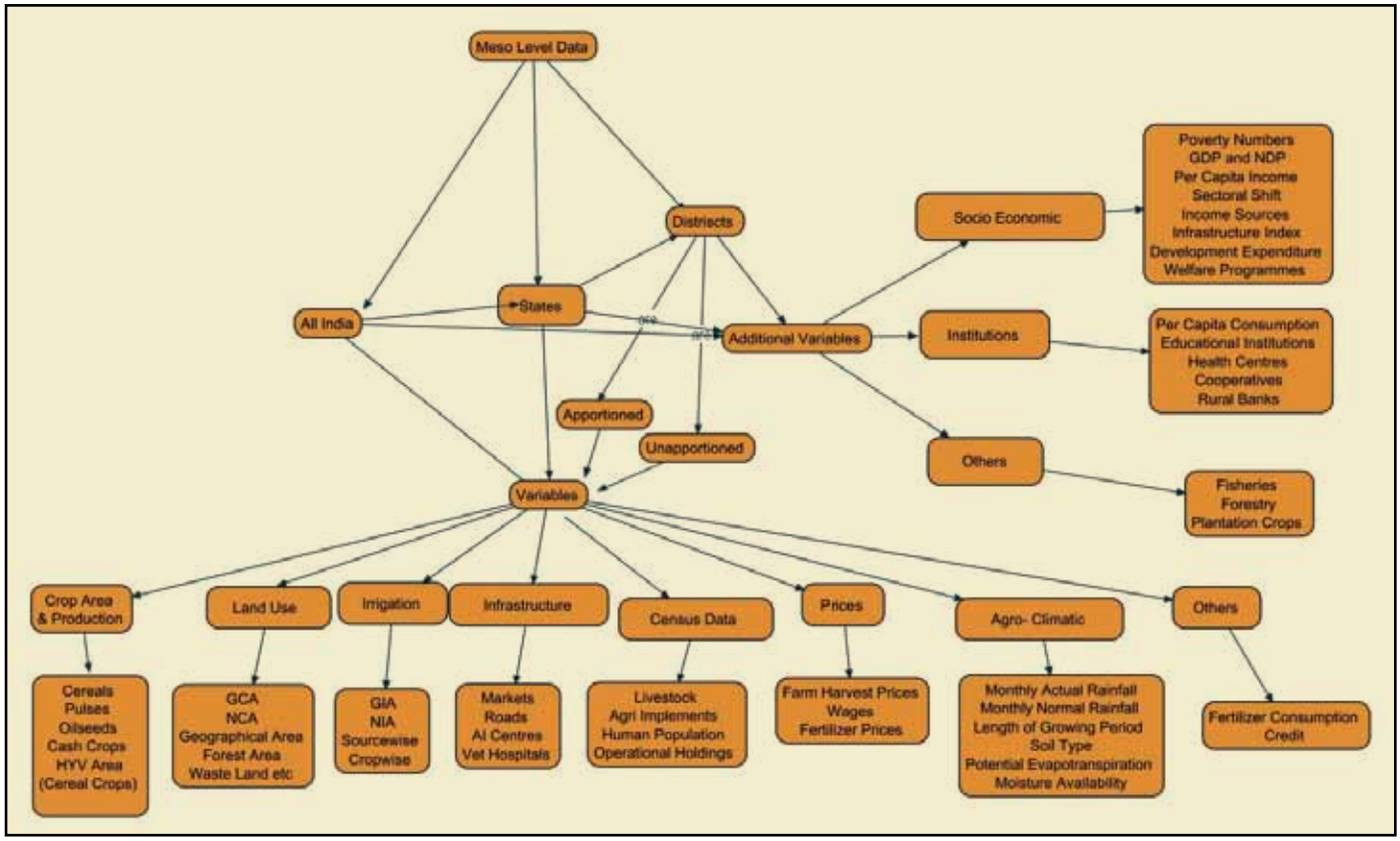


Figure 4. Concept map of meso-level data.

Regions (AER), namely Arid, Coastal, Hill & Mountain, Irrigated and Rainfed. These are further divided into 14 Production Systems (PS) (see Figure 5, Table 1). The districts in the dataset for India have been coded by AER and PS to include dimensions of agro-ecological regions and production systems for comparative analysis of systems.

The rainfed region is the largest occupying 53% of the total area, followed by irrigated (30%) (see Figure 6). Coarse cereals (40%) and pulses (19%) are the most important crops grown in the Arid Agro-ecosystem while rice (39%) is the dominant crop in Coastal regions. Similarly, rice (30%) and oilseeds (20%) are major crops in Hill and Mountain Agro-ecosystem whereas wheat (32%) and rice (24%)

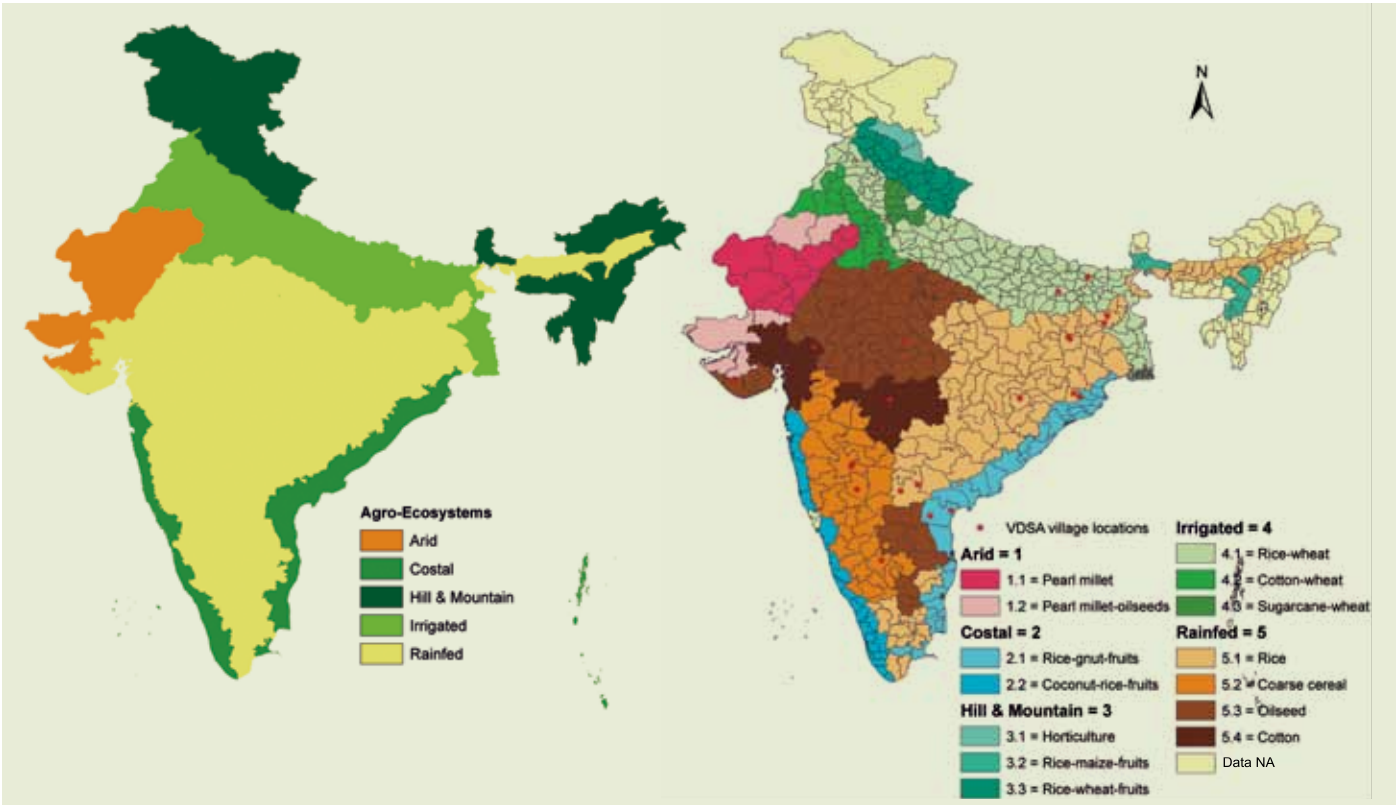


Figure 5. Agro-ecological regions and production systems.
(Source: PME Note 6, ICAR)

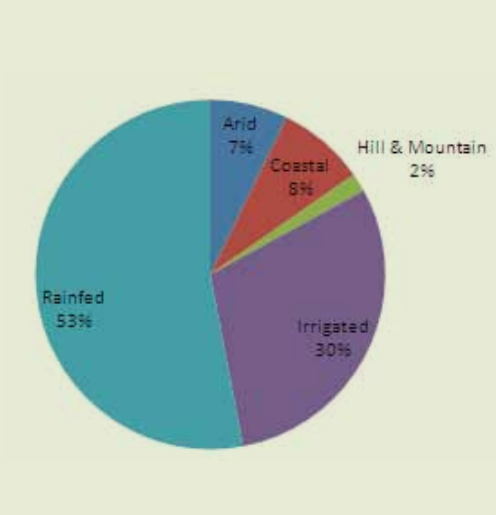
Table 1. Agro-ecological Regions (AER), Production Systems and location of VDSA villages in India.

AER	Production system	State and no. of districts	District, Taluka with VDSA Villages
Arid	Pearl millet	Rajasthan (9)	
	Pearl millet - oilseeds	Gujarat (4), Rajasthan (2)	
Coastal	Rice-groundnut-fruits	**Andhra Pradesh**[1] (9)[2], Orissa (11), Tamil Nadu (10), Andaman & Nicobar (2), Dadra & Nagar Haveli (1), Daman & Diu (2), Lakshadweep (1), Pondicherry (4)	**Prakasam**[3] (***Korisapadu***[4]: JC Agraharam[5], ***Bestavaripeta***: Pamidipadu)
	Coconut-rice-fruits	Goa (2), Karnataka (3), Kerala (14), Maharashtra (5), Tamil Nadu (1)	
Hill & Mountain	Horticulture	Himachal Pradesh (2), Jammu & Kashmir (3)	
	Rice-maize-fruits	Assam (5), West Bengal (2), Arunachal Pradesh (13), Manipur (11), Meghalaya (7), Mizoram (8), Nagaland (8), Sikkim (4), Tripura (4)	
	Rice-wheat-fruits	Himachal Pradesh (10), Jammu & Kashmir (14), Uttarakhand (12)	
Irrigated	Rice-wheat	**Bihar** (37), Haryana (9), Punjab (15), Uttar Pradesh (54), West Bengal (10)	**Darbhanga**(***Baheri***: Susari, Inai); **Patna** (***Bikram***: Arap, Bhagakole)
	Cotton-wheat	Haryana (10), Punjab (5), Rajasthan (7)	
	Sugarcane-wheat	Haryana (1), Uttar Pradesh (9), Uttarakhand (1)	
Rainfed	Rice	**Andhra Pradesh** (10), **Jharkhand** (22), **Orissa** (19), Assam (18), Bihar (1), Chhattisgarh (16), Madhya Pradesh (15), Maharashtra (3), Tamil Nadu (15), West Bengal (7)	**Mahbubnagar**(***Madgul***: Aurepalle, ***Devarakadra***: Dokur); **Dumka** (***Jarmundi***: Dumariya, ***Shikaripara:*** Durgapur); **Ranchi**(***Kanke***: Dubaliya, ***Namkum***: Hesapiri); **Bolangir**(***Patnagarh:*** Anlatunga, ***Punital*** **(** Villaikani) **Dhenkanal (*Kamakhyangar*:** Sogar, ***Gandia:*** Chandrasekharpur)
	Coarse cereal	**Karnataka** (26), **Maharashtra** (14)	**Bijapur** (***Indi:*** Kappanimbargi, ***Basavana Bagewadi:*** Markabbinahalli); **Tumkur** (***Madhugiri:*** Belladamadugu**,** ***Koratagere:*** Tharati +Ajjihalli) **Solapur** (***North Solapur:*** Kalman, ***Mohal:*** Shirapur)
	Oilseed	**Gujarat** (5), **Madhya Pradesh** (33), Andhra Pradesh (4), Rajasthan (14), Tamil Nadu (4), Uttar Pradesh (7)	**Junagadh** (***Mangrol:*** Karamdi Chingariya, ***Junagarh:*** Makhiyala); **Raisen** (***Gairatganj:*** Papda, Rampura Kalan)
	Cotton	**Gujarat** (16), **Maharashtra** (12)	**Panch Mahals** (***Shehera:*** Babrol, ***Goghamba:*** Chata) **Akola** (***Murtizapur:*** Kanzara, Kinkheda)

Note: 1. States where VDSA villages are located. 2. Figures in brackets are number of districts.
3.Districts within which VDSA village is located 4. Taluka where VDSA village is located
5. VDSA village.

are major crops in Irrigated areas. The Rain-fed Agro-ecosystem has a more diversified cropping pattern with the share of GCA under oilseeds (20%), rice and cereals 17% each, and pulses 16% (see Figure 5).

Further distribution of crop area by production systems within Agro-ecosystems is given in Figure 7. Altogether there are 14 production systems distributed across the agro ecosystems. These include pearl millet and pearl



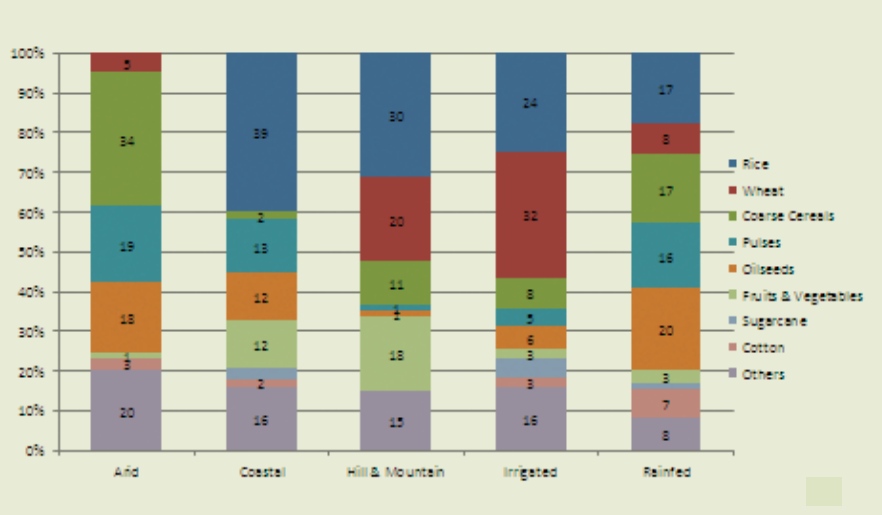


Figure 6. Distribution of area by AER. *Figure 7. Distribution of crop area by AER (% of GCA).*

millet based production system in Arid regions, rice and coconut based production system in Coastal areas, rice and fruits and vegetables based production system in Hill and Mountain regions, rice, cotton and sugarcane based production system in Irrigated regions and rice, coarse cereals, oilseeds and cotton based production in Rain-fed areas.

Spatial and Temporal Mapping of Meso-Data Using GIS

The tools like GIS are being used to provide visual mapping of key variables for spatial and temporal analysis. As an example, the rainy season (*kharif*) sorghum yields vary across districts and its change between 1982 and 2007 is shown in the district boundary map of India. In the last 25 years, yields have increased in several districts as also the number of districts with yields > 1000 kg / ha (see Figure 8).

Incidence of rural poverty varies considerably across districts in India. The incidence is higher in districts in eastern and central India. Higher incidence of urban poverty (>50%) is more widespread across the country (see Figure 9). On an average, in 2004-05 at the all-India level, the rural poverty is 33.8% while urban poverty is 20.9%. (Source: Chaudhuri and Gupta, EPW Feb 2009).

Diversification of Agriculture in India

Agricultural production in India is diversifying from production of cereals towards fruits and vegetables and livestock products like milk and meat. It is found that between Triennium Ending (TE) 1980-81 and TE 2009-10, the share of value of output of cereals in agriculture is declining while the shares of high value commodities like fruits and vegetables, milk, and meat are increasing (see Figure 10).

Trends in share of crop and livestock sectors in value of agricultural production in India show that share of livestock has increased from 15% during TE 72-73 to 26% by TE08-09 (see Figure 11).

In absolute terms, during TE 2009-10, the total value of output of fine cereals (rice and wheat) was the highest followed by milk, and fruits and vegetables.

Agricultural Diversification in Andhra Pradesh

In Andhra Pradesh while the share of agriculture in the economy declined from 40% to 27% by 2008-09, within the agriculture sector, the share of allied sectors like livestock, fisheries, and fruits and vegetables has increased due to higher growth rate in these sectors than crop sector.

Fixed effects estimation procedure was used to provide estimates of parameters of determinants of land diversification in the state. It was found that irrigation was leading to specialization while infrastructure like roads, markets and banks were supporting diversification. Urbanization and agricultural wage have positive effects on diversified allocation of land within the crop sector.

Rationalization of pricing policy, market reforms, and public investment in infrastructure will encourage commercialization of agriculture, production of high value crops and more diversified and efficient use of land and water resources.

The studies of agricultural diversification reveals that skewed price policy towards cereals discourage land diversification while higher agricultural wages induce shift in favor of high value crops. Similarly, public investment in infrastructure (roads, markets, banks) will encourage resource diversification in agriculture.

Aggregate Supply Response in Andhra Pradesh

The district level dataset has been used to study price and non-price determinants of aggregate supply response in Andhra Pradesh. The long run output supply elasticity with respect to its own price is strong but has a lower elasticity compared to non-prices factors like rural infrastructure, rural literacy, technology and climatic factors (see Table 2).

Thus, long run productivity and production growth of agriculture is possible through investments in rural infrastructure and technology along with provisions for input supply and market development.

Aggregate output is influenced by output price, level of infrastructure development, banks and technology variables:

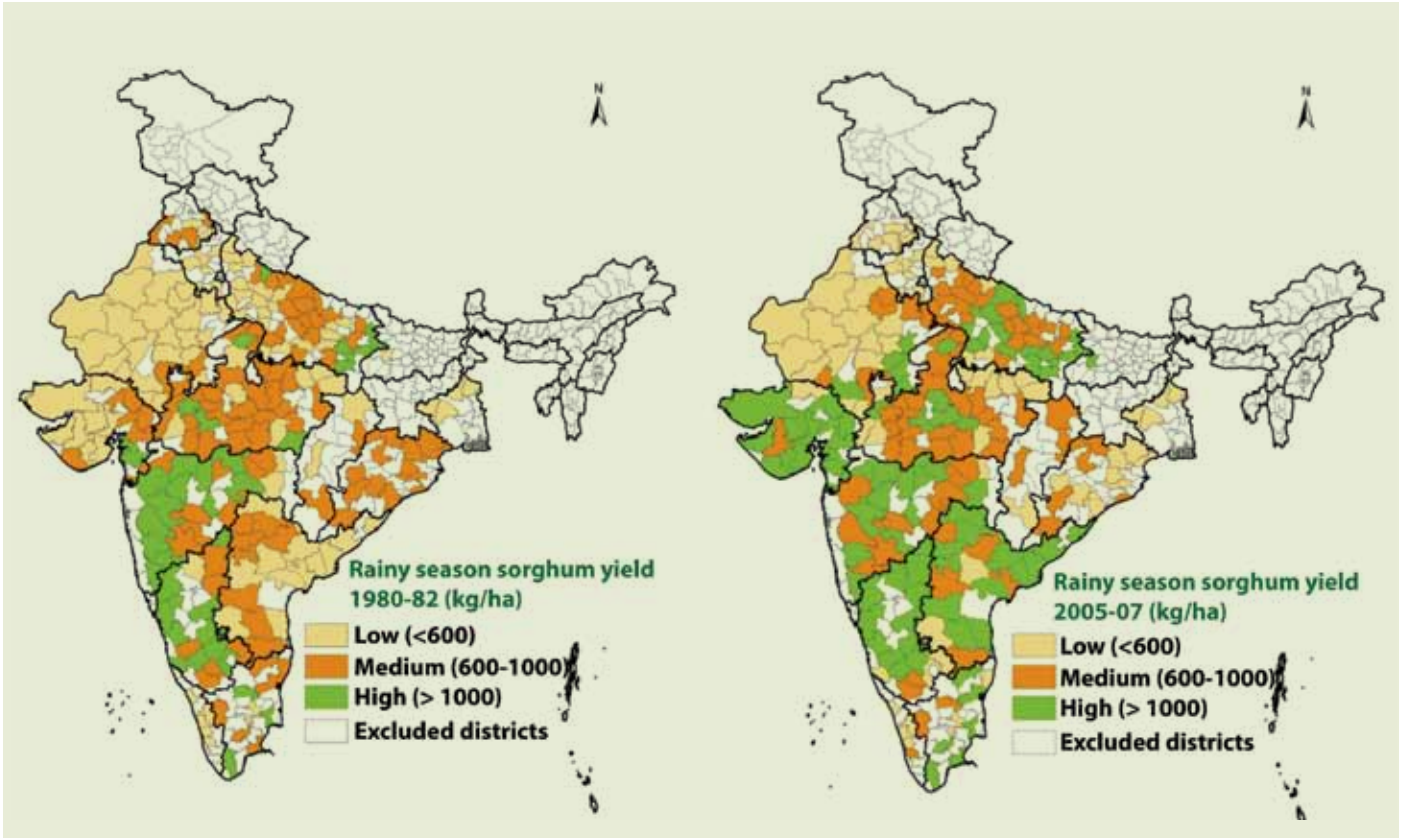


Figure 8. Rainy season sorghum yield: spatial overview.

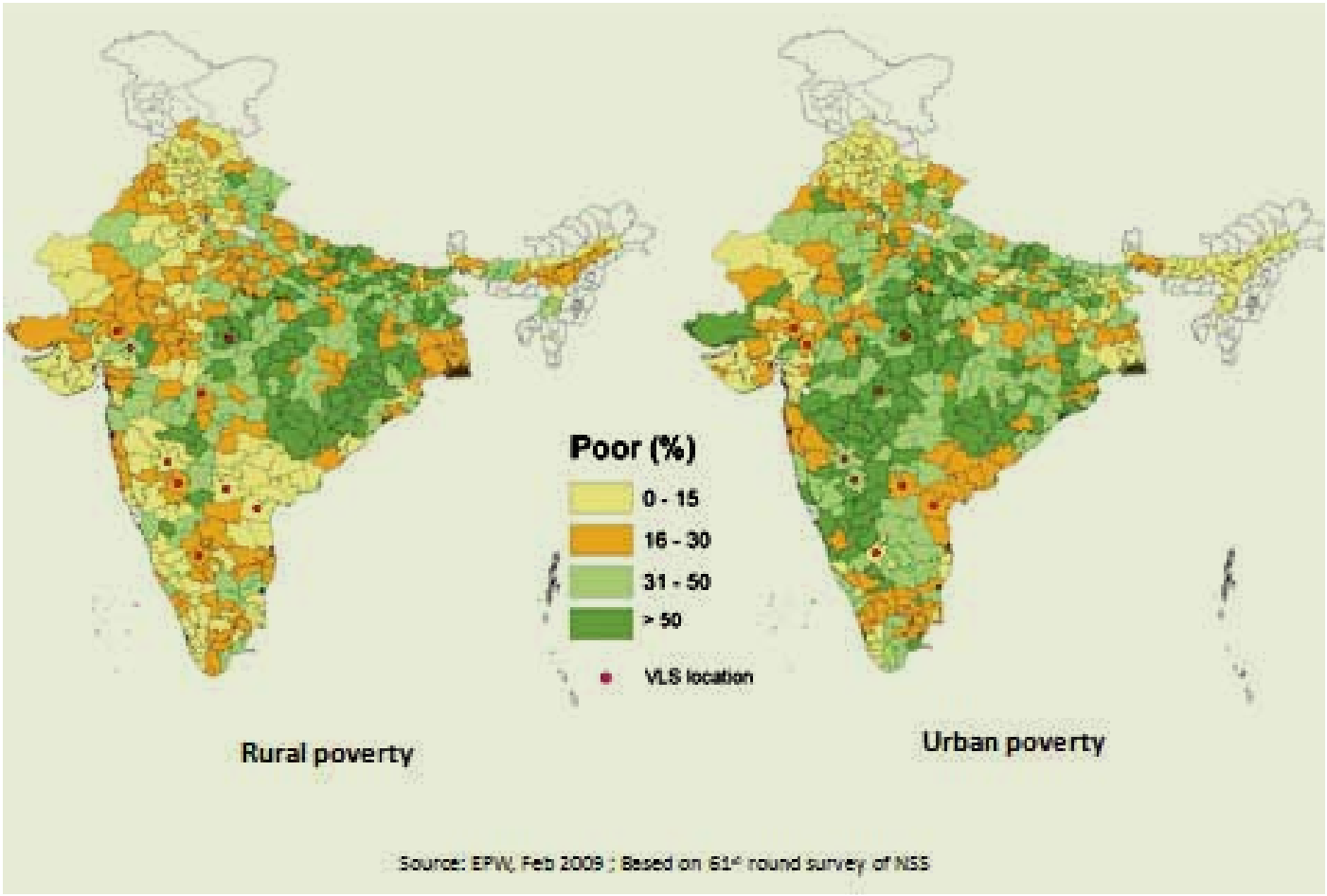


Figure 9. District wise poverty in India, 2004-05 (% poor).

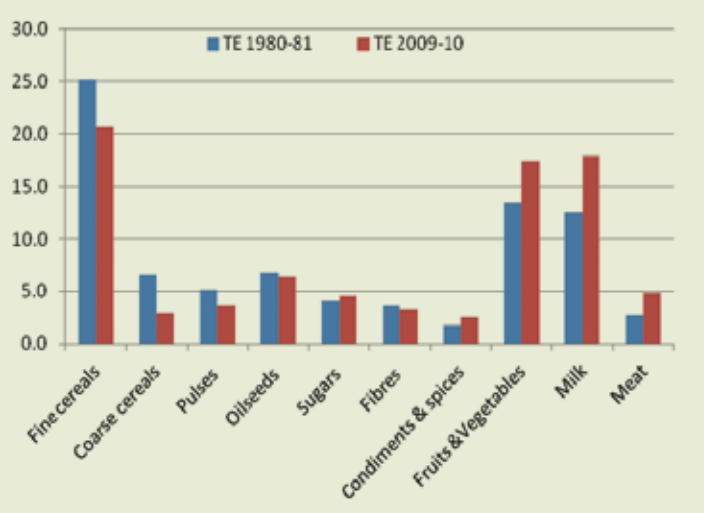


Figure 10. Share of major commodity groups in total agriculture value.

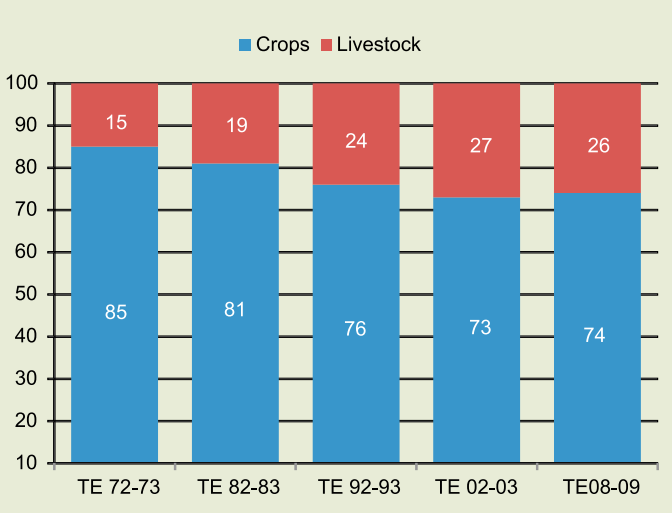


Figure 11. Share of crop and livestock sectors in total agriculture value.

- Responsiveness of output to its own price is more than input prices (eg, fertilizer).
- Investment in tractors, pump sets and use of HYVs are significantly influenced by output prices, credit and markets (from investment model not shown in Table 2).

Table 2. Regression Estimates of Aggregate Supply Response Model - Three Stage Least Square.

Explanatory variables	Dependent variable	
	Aggregate output	Fertilizer Use
Predicted Real Aggregate Output Price Index for Lagged Year	0.200[1]*	
Predicted Real Agricultural Wage (Rs. per day)	0.289*	0.669*
Total Road Length (km/NSA in 2 Lagged Year	0.209*	0.729*
Commercial Bank Branches (number/NSA) in Lagged Year		0.286*
Market Density (number/ NSA) in Lagged Year	0.112*	
Canal Irrigation (% of NSA)	0.009*	-0.063*
Rural Literacy (% rural population)	-0.065*	0.307*
Area under High Yield Varieties (% of Gross Sown Area)	0.033*	0.419*
Irrigated Area (% of Net Sown Area)	0.049*	0.262*
Tractors (number/Net Sown Area)		0.196*
Kharif Rainfall (June-Sept) (millimeter)		0.106*
Kharif Rainfall Deviation from Normal	-0.006**	

1. Coefficients and elasticities
* and ** indicates significance at 1% and 5% probability levels, respectively.

- Results illustrate potential to increase aggregate crop output through improvement of investment priorities and proper government policy.
- Findings from Aggregate output supply response in Andhra Pradesh reveal that public investment in infrastructure and financial institutions respond to agriculture potential and agro-climatic endowments, which needs rethinking of Government priorities to accommodate investments in less favored regions.
- The other important finding is that supply elasticity with respect to wage is higher than own price elasticity, indicating the possibility of reallocation of household labor to diverse uses, including release of more household labor in production of high value commodities.

Income Dynamics and the Role of Agriculture in Bangladesh

The study of structural changes in agriculture and poverty in Bangladesh corroborated meso-data analysis with micro evidences on agricultural diversification, rural income, consumption expenditure and rural poverty.

The study found that while share of agriculture in economy both in terms of output and employment is declining, the per capita income is increasing. Farm size in Bangladesh has declined over the years while tenancy cultivation has increased. Wages of agricultural labor have increased significantly along with non-farm employment and income. The analysis shows that the incidence of poverty in Bangladesh has declined significantly over the period from 1990 to 2010 (Figure 13).

The analysis linked meso data with micro evidences and found that increased income induced consumption expenditure on non-food items, reduced poverty and increased life expectancy in Bangladesh.

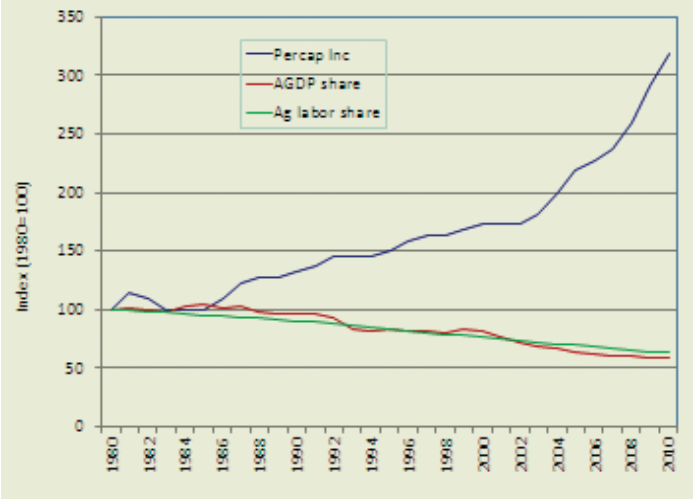


Figure 12. Structural changes in agriculture.

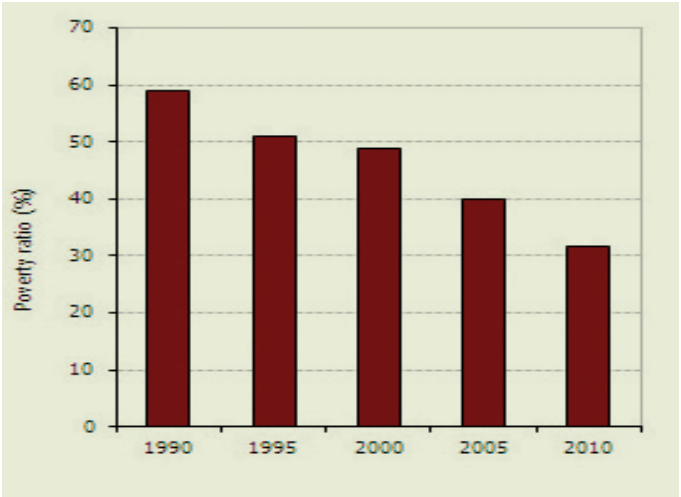


Figure 13. Poverty trends in Bangladesh, 1990-2010.

Data Uses and Future Plans

The meso dataset have been extensively used in the Institute's strategic planning exercises and for the development of CGIAR CRPs and bilateral project proposals. It is also in high demand by researchers from across the world for a diverse range of projects ranging from quantifying the effects of climate change to diversification of agriculture and priority setting.

With the availability of extended dataset, studies are planned for analysis of supply response and investment in major agro-ecosystems of India and Bangladesh, construction of typologies of agriculture, resource diversification in agriculture, and linkages in mixed crop-livestock production systems. Specifically, these studies include:

- Aggregate output supply and investment responses of agriculture in major agro-ecosystems in India and Bangladesh.
- Supply response of selected crops in major agro-ecosystems of India and Bangladesh
- Agricultural typology studies: agro-ecosystems and production systems, mixed farming systems in India and Bangladesh
- Agricultural diversification towards high value commodities in India and Bangladesh.
- Total factor productivity (TFP) changes and factors driving change in selected production systems.
- Farm productivity and rural poverty linkages
- Identification of collection of poverty indicators for tracking rural poverty

Focus will be on agricultural transformation and farm productivity and meso-micro linkages in agro-ecosystems and production systems in India and Bangladesh.

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