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Supply Response and Investments in Agriculture in Andhra Pradesh

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Performance of Agriculture in Andhra Pradesh, 1980 to 2008

- The share of agriculture in the Net State Domestic Product has declined over the years

- Agriculture grew slower at 3.5% between 1980 and 2008 compared to the rest of the state economy which grew at 8.5%

- However, from 2000 to 2008 agriculture grew at 4.3%

- Recent agricultural growth is accounted for by the livestock, fisheries, and fruit & vegetable

- Productivity growth in most of the staple crops have been marginal or in some cases, even declined

- Among the crops, yields of maize and cotton have been the fastest growing

About this study

- This study examines how farm output, farm inputs and farm investment have responded to changes in prices of output, factor prices (wages), technical change, and public investments.

- The study is based on secondary data from Andhra Pradesh covering 20 districts, from 1970-71 to 2007-08

- The objective is to suggest evidence based policy changes for accelerating growth in agriculture.
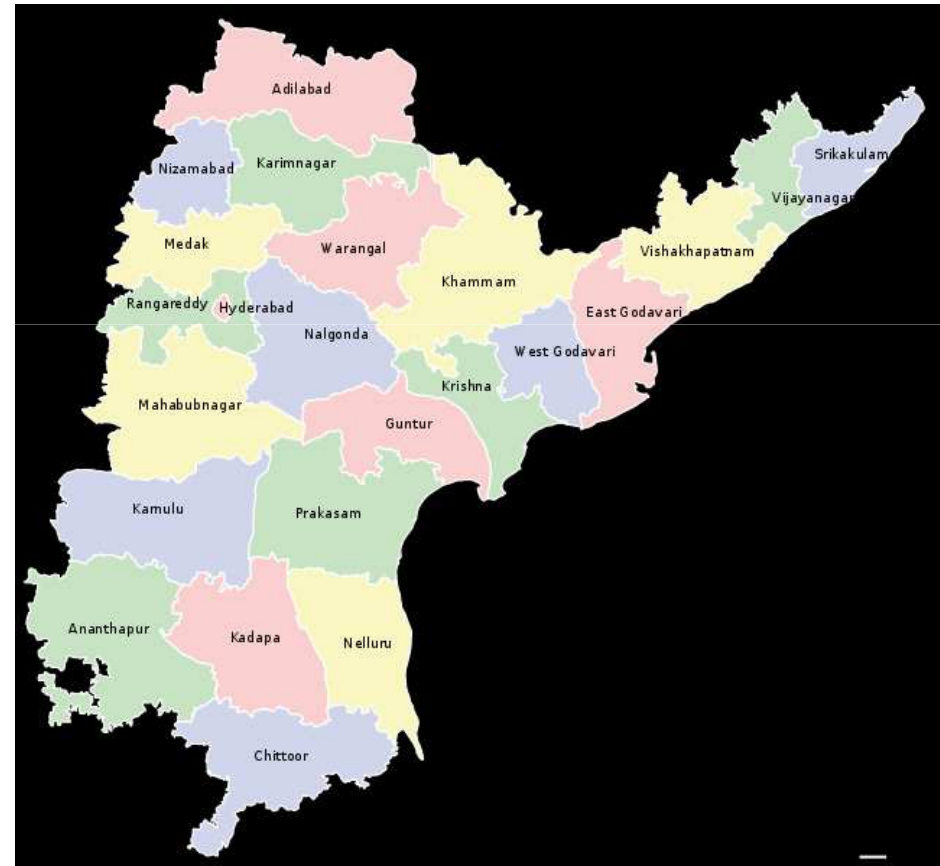
Construction of Price and Output Index

- The aggregate crop output and prices is the index of 15 major crops with district specific prices of 1970-71 as the base.

- Laspayres output and price indices for each district were computed.

- We define state base price P_{io} and the reference quantity Qio (i.e. simply the average production per district) as:

$$P_{io} = (\Sigma_j\ p_{ijo}q_{ijo})/(\Sigma_j q_{ijo}),\ \ Q_{io} = (\Sigma_j q_{ijo})\ /n$$

where i stands for commodity, j for district, and t for time; t= 0, i.e., base year 1970)

- After substituting state prices and the reference quantities, district-level indices were computed as:

$$q_{jt} = (\Sigma_j q_{ijt} P_{io})/(\Sigma_i Q_{io} P_{io}), \quad p_{io} = (\Sigma_i q_{ijt} p_{ijt})/(\Sigma_i Q_{io} P_{io})$$

q_{jt} and p_{io} are respectively, the multilateral Laspayres quantity and price indices for district j in time t.

- The aggregate output index reflects both variation over time in each district relative to its base year 1970-71 as well as variations in output and prices across districts relative to average of all districts during the base period.

Variables used in Model Estimation

- **International prices:** Food price indices provided by International Monetary Fund (IMF), converted to base 1970-71.

- **Fertilizer prices:** All India average prices of urea, super phosphate and murate of potash weighted with yearly total consumption of nitrogen (N), phosphorous (P) and potash (K).

- **Wage rates** for agricultural laborers (field labour).

- Aggregate output price indices, fertilizer prices, international price indices and wages **deflated** using all India wholesale price index (WPI) for primary commodities.

Variables used in Model Estimation

- **Private agricultural investments**: Tractor, pump-set, irrigated area, and labor force.

- **Agricultural intensification and technology**: Cropping intensity and area under high yielding varieties.

- **Public infrastructure**: Road length, canal irrigation, rural literacy, number of regulated markets, and number of scheduled commercial bank branches.

- **Climatic variables**: seasonal rainfall and deviations from normal.

Estimation Model

- Systems of equations using three stage least square methodology with regional dummies for Coastal Andhra, Rayalaseema and Telangana were estimated for
  - Aggregate output price, wages, aggregate output, fertilizer use
  - District data for 20 districts from 1970-71 to 2007-08 (740 observations)
  - Equality constraint was imposed on coefficients of fertilizer prices in aggregate output equation and predicted farm harvest prices in fertilizer use equation.

- The investment regression equations were estimated using fixed effects model for:
  - Tractor, pumpsets, net irrigated area, agricultural work force, cropping intensity, area under HYV's
  - Data are for 8 census years from 1972 to 2007 (160 observations)

Supply Response Equations: Expected Signs of Explanatory Variables

Estimation of Aggregate Supply Response Equations				
Abbreviation	Aggregate Output Price	Agricultural Wage	Aggregate Output	Fertilizer Use
Lagged year predicted real aggregate output price index		X+	X +	X +
Real price of fertilizer (rupees per ton)	X+	X	X -	X -
Predicted real agricultural wage (rupees per day)	**X+**		**X-**	**X**
Real international food price index	X+			
Lagged year total road length (Km per net sown area)	X-	X	X+	X+
Lagged year commercial banks branches per net sown area		X	X+	X+
Lagged year market density per net sown area	X+	X	X +	X +
Canal irrigation (percent of net sown area)		X	X+	X+
Rural literacy (percent of total rural population)		X	X +	X +
HYV area as percent of gross sown area		X	X+	X+
Irrigated area percent of net sown area		X+	X+	X+
Tractors per net sown area		X	X+	X+
Agricultural population per square kilometer geographical area		X-		
Percent urban population per district		X+		
Kharif rainfall (mm)	X-	X	X+	X+
Deviation of kharif rainfall from normal	X+	X -	X-	X-
Year (1970-71 to 2007-08)	X+	X	X+	X+

Investment Equations: Expected Signs of Explanatory Variables

Estimation of Real Investment Equations					
Abbreviation	Tractors	Pumpset	Agricultural workers	Cropping intensity	HYV
Lagged year real aggregate output price index	X+	X+	X+	X+	X+
Predicted real agricultural wage (rupees per day)	**X+**	**X-**	X+		X-
Total road length (Km per net sown area)	X+	X+	X	X+	X+
Commercial bank branches per net sown area	X+	X+	X+	X+	X+
Market density per net sown area	X +	X +	X+	X+	X+
Canal irrigation (percent net sown area)	X+	X+	X+	X+	X+
Rural Literacy (percent Rural Population)	X +	X +	X+	X+	X+
Year (1972 to 2007)	X+	X+	X+	X+	X+

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

Variables	Output Price	Agricultural Wages	Aggregate output	Fertilizer Use
Constant	-2.026*	-3.906*	1.412*	-0.645
Dummy for Rayalaseema	-0.0769***	0.028	-0.102*	0.031
Dummy for Telangana	-0.545*	0.166*	-0.417*	0.154**
Predicted Real Aggregate Output Price T-1		0.099*	0.200*	0.007
Real Price of Fertilizer	-0.067	-0.048	-0.007	0.023
Predicted Real Agricultural Wage	0.488*		0.289*	0.669*
Real International Food Price Index	0.054*			
Total Road Length T-1	-0.236*			
Total Road length T-2		0.086***	0.209*	0.729*
Commercial Bank Branches T-1		0.034****	0.010	0.286*
Market Density T-1	0.170*	-0.022	0.112*	-0.036
Canal Irrigation		0.045*	0.009*	-0.063*
Rural Literacy		0.084***	-0.065*	0.307*
HYV Area		0.001	0.033*	0.419*
Irrigated Net Sown Area		0.088*	0.049*	0.262*
Tractors per Net Sown Area		-0.037**	-0.005	0.196*
Agricultural Population per geographical area		-0.003		
Percent urban population per district		0.096*		
Kharif rainfall(mm)	-0.033*	0.003	-	0.106*
Deviation of kharif rainfall from its normal			-0.006**	
Year 1970-71 to 2007-08	0.014*	0.016*	0.011*	0.006****
R^2	0.603	0.749	0.726	0.915

Note: *, **, ***, **** are level of significance at 1,5,10,and 15 percent respectively

Factors Determining Investment in Agriculture

Regression Estimates of Real Investment Model- Single Equation Fixed Effects

Variables	Tractor	Pumpset	Net Irrigated Area	Agricultural Workers	Cropping Intensity	HYV Area
Real Aggregate Output Price			0.107**	-0.115*	0.037**	0.201*
Real Aggregate Output Price T-1	0.299*	0.041		0.067****		
Predicted Real Agricultural Wage	3.775*	0.521	2.574*	0.201		-5.109*
Road Length per Net Sown Area	-0.315	-0.221	-0.248**	0.198**	-0.015	0.661*
Commercial Banks per Net Sown Area	0.459*	0.613*	0.059	0.162*	0.013	1.344*
Market Density per Net Sown Area	0.561**	0.472*	0.199***	0.049***	0.013	0.045
Canal Irrigation Percent	0.049	0.069****	0.064**	-0.035***	0.003	0.100
Rural Literacy Percent	-0.292	0.493**	0.328**	0.076	0.022	1.162*
Year 1970 - 71 to 2007-08	-0.074	-0.044	-0.302*	0.011	0.009	0.174*
R^2	0.959	0.958	0.959	0.941	0.852	0.936

Note: *, **, ***, **** are level of significance at 1,5,10,and 15 percent respectively

Conclusion

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

- Responsiveness of output to its own price is more than input prices (e.g fertilizer). However, own price elasticity on aggregate output is low and confirms the earlier findings that agricultural supply is inelastic in the short run

- Fertilizer use increases with the development of roads, banks, rural literacy, technology variables and climate. Prices (crop and fertilizer) are not influencing fertilizer use

- Real agricultural wages are responsive to prices, infrastructure, and technology variables and proximity to urban centers

Conclusion

- Investment in tractors, pumpsets and use of HYVs are significantly influenced by output prices, credit and markets

- Results illustrate potential to increase aggregate crop output through improvement of investment priorities and proper government policy.

- Investment in irrigation and other infrastructure may help to mitigate adverse effects of climate on aggregate output.

Thank You