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Instability in Andhra Pradesh Agriculture — A Disaggregate Analysis

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Abstract

Instability in farm production is causing serious shocks to supply and farm income and there is a growing concern about increased volatility in farm production, prices and farm income. The study has estimated instability in three major crops before (1981-93) and after (1993-04) the initiation of economic reforms at the state and district levels in Andhra Pradesh. It has revealed that in a large state like Andhra Pradesh, and which is the case for most states of India, the instability status as perceived through the state level data may be vastly different from that experienced at the disaggregate level. The study has concluded that the state level analysis does not reflect complete picture of shocks in agriculture production, and, further, shocks in production underestimates shocks in farm income. It has suggested the need for addressing risks in farm income by devising area-specific crop insurance or other suitable mechanisms.

Introduction

Despite progress in irrigation and technology, the agriculture production and income are subject to large year-to-year fluctuations, playing havoc with farmers' livelihood and adversely affecting their decisions to invest in farming. These fluctuations also undermine the viability of agriculture sector and its potential to contribute to economic growth as well as food and nutritional security. Most of the studies on Indian agriculture have looked at the instability in agricultural production at aggregate level and have focused only on production (Hazell, 1982; Dev, 1987; Sharma *et al.,* 2006). These studies suffer from two major limitations. One, they conceal the instability at disaggregate level when different parts forming the aggregate follow different distributions. Two, analysis of instability is restricted only to production and none of the studies have extended it to farm income; it is not seen whether fluctuations in prices aggravate instability in production or reduce it, to mitigate impact on farm income. Strategies to develop more appropriate risk management mechanisms require a better understanding of the nature and magnitude of risk at disaggregate level, and by including prices. This paper proposes to fill this gap.

The study has estimated instability in major crops before and after the initiation of economic reforms at the state and district levels in Andhra Pradesh. It has explored how state-level aggregation for a large state like Andhra Pradesh, can conceal risk and instability at the disaggregate district level. Further, the paper has also estimated volatility in farm harvest prices and has probed whether price fluctuations reduce or increase instability in gross returns.

Data and Methodology

The paper has used time series data on area, production, yield and farm harvest prices (FHP) at the state and district levels for rice, groundnut and cotton. The data were culled from Indian Harvest

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compact disk 2006, Centre for Monitoring Indian Economy. Series on gross revenue (GR) from the selected crops was calculated by multiplying production with farm harvest prices of the corresponding years.

The analysis has covered the period 1979-80 to 2003-04, which was divided into two sub-periods, viz. 1979-80 to 1992-93 and 1993-94 to 2003-04. The main consideration behind dividing the total period of past 25 years into two sub-periods was to see whether instability in farm production and returns show any change? The second sub- period has coincided with the economic reforms and agricultural liberalization era.

Instability has been estimated for area, production, yield, farm harvest prices and gross returns for paddy, groundnut and cotton. These three crops ranked at the top in terms of area under cultivation in the state and accounted for 24 per cent, 12 per cent, and 7 per cent of total crop area of the state. The coverage of study could not be expanded to more crops due to limitation of data relating to farm harvest prices.

Instability associated with selected crops was estimated by using the following index:

$$\text{Instability index} = \text{Standard deviation of natural logarithm } (X_{t+1} / X_t) \quad \ldots(1)$$

where, X_t refers to area (A), production (P), yield (Y), farm harvest price (Fp) or gross revenue (Gr) in the year "t"; and X_{t+1} denotes these for the next year.

This index is unit free and robust and measures deviations from the underlying trend (log linear in this case). When there are no deviations from the trend, the ratio of X_{t+1} and X_t remains same and their standard deviation is zero. As deviation from the underlying trend increases, the standard deviation also increases. Slightly different variant of this index has been used in the literature before to examine instability and impact of drought on it (Ray,1983; Rao *et al*.,1988).

Results and Discussions

The paper has first estimated the instability at state level and then has compared it with district level estimates to find dispersion and compare the change in instability over time, based on the state level data representing aggregates and district level data representing disaggregates.

Instability at State Level

Variability in agricultural production consists of variability in area and yield and their interactions. Variation in area under a crop occurs mainly in response to distribution, timeliness and variations in rainfall and other climatic factors, expected prices and availability of crop-specific inputs. All these factors also affect the variations in yield. Further, yield is also affected by outbreak of diseases, pests, and other natural or man-made hazards like floods, droughts and fire and many other factors. Different events may affect area and yield in the same, opposite or different way.

Instability in area, production and yield of rice, cotton and groundnut experienced at the state level in Andhra Pradesh during 12 years before and after 1992-93 has been presented in Table 1. Instability index for area has shown an increase after 1992-93 for rice and cotton and decline in the case of groundnut. It increased from 11.5 to 13.4 in rice and from 17.5 to 18.8 in cotton. During both the periods, instability in area was lowest in groundnut. Rice, which is generally grown under irrigated conditions, showed somewhat higher instability in area as compared to groundnut. Area under cotton has shown more than double the fluctuations in area under groundnut.

Instability was found lower in yield than area in the case of rice, whereas yields of groundnut and cotton showed much higher fluctuations than in area. The instability index of yield did not increase much over time in the case of rice, whereas it almost doubled in groundnut, from 21 to 41, between 1981-1993 and 1993-2004. Despite lot of concern about susceptibility of cotton to various pests in recent years, its productivity has shown less fluctuations after 1993 than before 1993.

Instability in production of rice was almost double than that in yield during the period 1981-1993. In the next 11 years, it increased further. In the case of cotton, deviations from trend growth were

Table 1. Instability in area, production, yield, farm harvest prices and gross revenue from important crops in Andhra Pradesh : 1980-81 to 2003-04

Crop	Period	Area	Production	Yield	Farm harvest price	Gross return
Rice	1980-81 to 1992-93	11.5	16.4	8.6	7.4	21.0
	1992-93 to 2003-04	13.4	21.0	9.0	8.3	19.2
Groundnut	1980-81 to 1992-93	8.4	25.4	21.1	14.3	29.8
	1992-93 to 2003-04	7.9	47.5	41.0	10.8	50.2
Cotton	1980-81 to 1992-93	17.5	25.8	29.5	23.9	37.9
	1992-93 to 2003-04	18.8	27.7	24.8	22.5	37.9

lower in production than yield, but higher than area during 1981-1993. After 1993, production instability in cotton increased despite less unstable yield. Volatility in production of groundnut doubled after 1992-93 and it was as high as 47 per cent in terms of standard deviation from trend. Among the three crops, rice production showed lowest year- to- year fluctuations.

Beside fluctuations in production, prices received by the farmers for their produce are equally important in causing variations in farm income. Therefore, it is important to consider fluctuations in farm income to understand and address risk in this income. It is important to point out that farm harvest prices showed much lower fluctuations than those in yield and production. Second, instability in farm harvest prices showed a decline over time in the case of groundnut and cotton and small increase in the case of rice. Among the three crops, farm harvest prices of paddy showed the lowest instability, 8.3 per cent. The decline in price fluctuations in groundnut and cotton after 1993 seems to be the result of increased integration and improvements in agricultural markets in the country. The reason for small increase in price instability of rice seems to be the result of liberalization of rice trade after 1995, which was earlier very tightly regulated by the government.

Generally, prices and production are expected to have negative co-variance as increase in production puts downward pressure on price and a decrease in production should result in an increase in price. It is generally expected to have a smoothening effect on gross return from a crop. But, this expectation is met if negative covariance in fluctuations between farm harvest prices and production exceeds the variance of either price or production.

Although, price instability showed a decline in groundnut and cotton over time, it was very high in the case of cotton. The net effect of fluctuations in production and prices on farm income represented by gross returns showed that instability in area, production, yield and prices did not negate each other. Rather, their impact got accumulated to some degree because of which instability in farm income was found higher than that in area, production and prices in all the cases, and it had not changed over time.

Instability at District Level

To see if instability in agriculture at the disaggregate level presents a different picture than that at the aggregate level, instability in selected dimensions was estimated for each district in the state. Rather than presenting instability results for each district in Andhra Pradesh, these estimates have been presented in terms of range, frequency of decline and increase or no significant change between the two periods selected for the study (Table 2). These results were then compared with those revealed by the aggregate data.

A perusal of Table 2 revealed that there was not only a wide variation in instability across districts, in some cases the range of instability at district level narrowed down, in contrast to the increase at the state level. A similar pattern was observed in the case of production, yield, farm harvest price and gross returns. In some cases, instability shown by the state aggregate was found lower than the minimum value in the range of instability across districts. These

Table 2. Range of instability in area, production, yield, farm harvest prices and gross revenue at disaggregate level

Crop	Period	Area	Production	Yield	Farm harvest price	Gross return
Rice	1981-93	7 to 60	16 to 86	9 to 43	7 to 18	20 to 79
Rice	1993-04	11 to 44	16 to 67	11 to 46	6 to 18	19 to 70
Groundnut	1981-93	9 to 54	14 to 62	10 to 47	7 to 22	15 to 64
Groundnut	1993-04	8 to 50	18 to 83	15 to 75	9 to 19	17 to 82
Cotton	1981-93	6 to 89	32 to 139	37 to 137	20 to 86	45 to 154
Cotton	1993-04	7 to 67	32 to 90	18 to 63	16 to 43	34 to 99

results indicated that in a large state like Andhra Pradesh, the state level estimates of risk involved in agriculture production, prices and return highly underestimate instability at the disaggregate level. These state- level estimates provided indication of shock in supply or agriculture output at the aggregate level, but they completely concealed the volatility to which the sub-region was subjected.

The district level instability estimates have shown that the range of instability in production and gross returns narrowed down for rice and cotton, but widened for groundnut.

Another way to examine the appropriateness of state level estimates of instability to reflect the changes at district level is to compare the changes in instability over time at state level with those at district level. This has been accomplished in Table 3. It shows the distribution of districts in Andhra Pradesh which have seen increase or decrease in instability in area, production, yield, farm harvest prices and gross revenue, and those which did not see any 'significant' change in the level of instability. The significant change was defined as the change of more than one percentage point.

A perusal of Table 3 shows that for rice, decline in instability was witnessed by 32 per cent districts in area, 36 per cent districts in production and 45 per cent districts in yield, whereas, the state level estimates showed only increase in instability. Similarly, in groundnut, compared to the increase at the state level, only half of the districts showed increase in instability in gross return. The state level data indicated a decline in instability in cotton yield, but district level data indicated an increase in 17 per cent of the districts. The most striking variation in state and district level data was found in the case of

Table 3. Distribution of districts based on significant* changes in level of instability

(in per cent)

Category	Crops	Area	Production	Yield	Farm harvest prices	Gross return
A. Districts	Rice	59.1	59.1	40.9	27.3	27.3
experienced	Groundnut	54.6	68.2	59.1	13.6	50.0
increase in	Cotton	11.1	33.3	16.7	5.6	16.7
instability						
B. Districts	Rice	31.8	36.4	45.5	54.5	72.7
experienced	Groundnut	40.9	31.8	36.4	72.8	40.9
decrease in	Cotton	72.2	66.7	83.3	88.8	83.3
instability						
C. Districts	Rice	9.1	4.5	13.6	18.2	0
experienced	Groundnut	4.5	0	4.5	13.6	9.1
change less than	Cotton	16.7	0	0	5.6	0
one percentage point						

*A change of more than one percentage point was taken as a significant change.

instability in gross return from cotton which showed no change at the state level but a decline in 83 per cent districts.

As mentioned earlier, fluctuations in income caused due to fluctuations in production gets smoothened to some extent if variation in prices received by farmers is opposite to that in production. However, prices are not a local phenomenon as they are likely be affected by the level of production in the other regions. Prices at the district level can be strongly influenced by the production in the same district if markets are segmented, or, if market integration is not of high order. Second, prices and production in the same district can be negatively correlated if production in the given district is strongly correlated with the production in the other regions which influence the price. In order to test the influence of local production on local farm harvest prices, correlation coefficient were computed between year to year changes in prices with change in production expressed in per cent terms. The results have been presented in Table 4.

Table 4. Correlation coefficient between changes in production and farm harvest prices: 1992-93 to 2003-04

Districts	Paddy	Groundnut
Adilabad	-0.106	-0.199
Anantapur	-0.430	-0.175
Chittoor	-0.304	-0.257
Cuddapah	0.224	-0.435
East Godavari	-0.180	0.275
Guntur	-0.085	-0.249
Hyderabad	-0.220	
Karimnagar	-0.607	-0.396
Khammam	-0.493	-0.445
Krishna	-0.027	-0.627
Kurnool	-0.570	-0.401
Mahbubnagar	-0.744	-0.029
Medak	-0.483	0.516
Nalgonda	-0.323	-0.423
Nellore	-0.423	0.297
Nizamabad	-0.047	-0.410
Prakasam	-0.553	-0.170
Rangareddi	-0.626	-0.251
Srikakulam	-0.323	-0.388
Visakhapatnam	-0.451	-0.216
Vizianagaram	0.121	0.266
Warangal	-0.299	-0.123
West Godavari	0.055	-0.015
Frequency distribution of correlation		
Negative	20	18
Positive	3	4

It was observed that out of the 23 districts of Andhra Pradesh, change in prices showed a negative correlation with change in production in 20 districts for rice and in 18 districts for groundnut. These results indicate that local production influences local prices and movement in prices moderate to some extent the fluctuations in gross return caused by fluctuations in production. As the correlation in most of the cases was weak, local prices were also affected by other factors and production outside the district.

Factors Affecting Instability

Factors that affect instability over time vary from crop to crop. The main reason for increase in instability of cotton area and production after 1992-93 seems to be the extension of its cultivation to non-traditional areas where cotton has replaced jowar, pulses and other cereal crops (*see*, Table 5). Cotton cultivation has been extended to red *chalka* soils, though these are not considered quite suitable for cotton cultivation.

The major cause of increase in instability and its high level in groundnut yield was the occurrence of frequent and severe droughts during period II (1992-93 to 2003-04). In 8 out of 11 years, successive droughts were reported in Anantapur and its neighbouring districts which were the major groundnut-growing areas. In one year, excessive rains caused the failure of crop in two or three districts. Further, decline in area under irrigation had also contributed to the increase in yield instability. Groundnut producers suffered not only due to increase in year-to-year fluctuations, but also due to lower yields during the period II.

Increase in instability in area and production of rice was mainly due to erratic, irregular and insufficient power supply for irrigation purpose and more erratic rainfall distribution during period II. In

Table 5. Factors related to instability in Andhra Pradesh

Crop	Period	Area ('000 ha)	Yield (kg/ha)	Irrigated area (%)
Rice	1981-93	3757	2208	94.64
	1993-04	3657	2713	96.11
Groundnut	1981-93	1892	877	19.01
	1993-04	1972	869	17.31
Cotton	1981-93	562	255	11.48
	1993-04	957	284	35.67

the case of cotton, expansion in irrigation seems to have lowered the yield instability, but not area and production instabilities.

Conclusions

Despite progress in irrigation and other infrastructural developments in agriculture, the instability in agricultural production has shown an increase after early- 1990s in the major crops grown in Andhra Pradesh. In contrast, farm harvest prices of groundnut and cotton have shown a decline in instability during 1993-2004, than during 1981-1993. The study has indicated that in a large state like Andhra Pradesh, the instability status perceived through the state level data may be vastly different from that experienced at the disaggregate level. In some cases, the state level estimates may be completely misleading as has been seen in the case of instability in cotton production in Andhra Pradesh, which has shown an increase at the state level but a decrease in two-thirds districts of the state. The effect of technology in stabilizing the yield varies across districts. Yield variability in cotton has declined in more than 80 per cent of the districts after 1993, despite increase in rainfall deviations. Among the three crops selected for the study, groundnut has been observed to be the most risky crop in respect of production as well as gross returns.

The net effect of fluctuations in production and prices on farm income has depicted that instabilities in area, production, yield and prices do not negate each other. The instability has been found higher in farm income than area, production and prices in all the cases, and it has not changed over time. This underscores the need for addressing risks in farm income by devising area-specific crop insurance or other suitable mechanisms.

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