Title

Nature and magnitude of risk in the semi-arid tropics (SAT) of India - a case of Mahabubnagar District in Andhra Pradesh.

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Journal

Agricultural Situation in India 2010 Vol. 66 No. 10 pp. 575-580

The Nature and Magnitude of Risk in the Semi-Arid Tropics (SAT) – A case of Mahabubnagar district in Andhra Pradesh

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Introduction

Agriculture in the Semi-Arid Tropics (SAT) is almost universally characterized by low farmer investment in agricultural inputs such as fertilizers, pesticides and seeds. Even labor inputs and investments in land improvements and irrigation are usually low compared with other regions of the developing world. Many researchers have carried out research aimed at testing whether these low investment levels are partly or fully caused by the risky nature of agriculture in these areas or by the risky nature of farmers (Binswanger etal, 1979). Risk and risk aversion of farmers is not the only potential source of low investment or "underinvestment"; it could also result from generally low profitability (measured as expected returns) or from credit constraints. To establish that it is risk or risk aversion that lead to underinvestment, empirical knowledge on these questions is required.

Risks are inescapable in any agriculture production and marketing environment. It is widely know that production risks caused by both biotic and abiotic stresses and price risks occurring due to imbalances between supply and demand are the most important sources of risk faced by the farmers. Walker (1989) has well documented evidence that production risks are dominant in rain fed areas while price risks are more worrisome in irrigated agriculture as production risks are largely taken care of by irrigation. But with globalization of markets and crop shifts in favor of cash crops, price risks are also expected to have a greater impact on the variability of income from the rain fed areas. The riskiness in SAT agriculture is a well-known fact and needs no further research, except for more precise quantification. This paper made a humble attempt to unravel some of the many dimensions of risk and uncertainty plaguing rain fed agriculture in the district.

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Methodology

Mahabubnagar district of Andhra Pradesh was purposively selected for the present study since it is one of most drought prone districts of Telegana region of the state. Over three decades (1969-70 to 2004-05) of secondary data on crop areas, yields and farm harvest prices of all principal crops were collected for the district from the Directorate of Economics and Statistics, Andhra Pradesh and used for this purpose. The crop yields were multiplied with the corresponding farm harvest prices to obtain the gross returns at the district level for different crops and different years. The data on crop areas and yields were de-trended and the data on farm harvest prices and gross returns were deflated for proper specification of risk variables before working out their distributions. To measure the nature of risk, Pearsons' method (1962) of moments were used and to quantify the magnitude of risk, measures like coefficient of variation, instability index (Cuddy and Della, 1978) and average negative deviations from mean were used. To get an understanding of the changes in magnitude of risk over the years, the entire study period was divided in to three equal sub-periods. They are P1 (1969-70 to 1980-81), P2 (1981-82 to 1992-93) and P3 (1993-94 to 2004-05). In general, the negatively skewed and leptokurtic distributions are supposed to involve less risk while the positively skewed and platykurtic ones are associated with a greater risk.

Results and discussions

The distributions of areas, productivity, farm harvest prices and gross returns of different crops in the district are summarized and presented in tables 1 to 4. The distributions of area under crops did not depart from normal distribution in case of jowar, bajra, horse gram and sunflower; the distributions were negatively skewed in case of ragi and red gram while they were positively skewed in case of bengal gram and cotton (table 1). Leptokurtic distributions were followed by green gram and castor, while platykurtic distributions were followed by groundnut and paddy. The highest C.V was recorded by sunflower. It was also quite high (above 50 per cent) in case of bengal gram, green gram and cotton. The C.V's were lower (less than 30 per cent) in case of jowar, bajra, red gram, groundnut, horse gram and paddy. For all other crops, the C.V's in area ranged between 30 and 50 per cent. The instability indices also followed similar patterns as in C.V's. The average negative deviations were quite high (above 30,000) for jowar, groundnut and rice. They were quite low (less than 2500) for black gram and bengal gram. The average negative deviations ranged between 2500 and 30000 for all other crops. The C.V's in area under crops showed an increasing trend over different sub-periods in case of green gram, red gram, bengal gram and cotton. Jowar, ragi and horse gram showed a steady decrease in C.V's in area. In case of all other crops the trends were mixed.

The distributions in yield followed normal distributions in case of rice, jowar, ragi, bengal gram and sunflower (table 2). The distributions were positively skewed in case of red gram, horse gram and castor. Cotton and green gram followed leptokurtic distributions in yield while bajra and groundnut exhibited platykurtic distributions. The coefficients of variation in yields exceeded 50 per cent in case of cotton, bengal gram and green gram. They were lower than 30 per cent in case of paddy, jowar, ragi, horse gram, groundnut and bajra. The C.V's in yield ranged between 30 and 50 per cent in case of all other crops. The instability index exceeded 40 per cent in case of green gram, bengal gram and cotton. It was lower than 20 per cent in case of paddy, jowar and ragi. For the remaining crops the instability index in crop yields varied between 20 and 40 per cent. The C.V's increased over different sub-periods in case of bengal gram and green gram. It steadily decreased in case of bajra and horse gram. For the rest of the crops the trends in C.V were mixed over the three sub-periods.

The distributions of farm harvest prices (at constant prices) followed normal distributions in case of bengal gram, red gram, horse gram and cotton (table 3). Many crops like jowar, bajra, ragi, green gram and groundnut followed positively skewed distribution. Paddy followed leptokurtic distributions while sunflower displayed platykurtic distributions. Sunflower exhibited higher coefficients of variations than 50 per cent. The C.V's were 20 percent or lower in case of paddy, bengal gram, red gram, green gram, horse gram, ground nut and castor. For the other crops the C.V's ranged between 20 and 50 per cent. The instability index also followed similar trend as the C.V's for different crops. The average negative deviations from mean were less than 10 for paddy, jowar, bajra, ragi and horse gram. In case of other crops, it ranged between 10 and 50. Sunflower showed a rapid drop in coefficient of variation over different sub-periods, while green gram and showed an increasing trend. For the rest of the crops, the C.V's for different periods showed a mixed trend.

The distributions of gross returns were normal only for bengal gram and red gram (table 4). Positively skewed distributions were observed in case of many crops like paddy, bajra, green gram, cowpea, groundnut and sunflower. Jowar, ragi and castor displayed leptokurtic distributions. The coefficients of variations in gross returns exceeded 50 per cent in case of bengal gram, green gram, sunflower and cotton. The C.V's in gross returns were lower than 30 per cent in case of paddy and jowar. They ranged between 30 and 50 per cent in case of all other crops. The C.V's in different sub-periods steadily declined in case of jowar, ragi, sunflower and maize. On the other hand, the C.V's steadily increased in case of bengal gram and green gram. For all other crops the trends in C.V's were mixed in different sub-periods.

Summary and conclusions

The levels of income risk in the Indian SAT are high and come mostly from production rather than price risk. Very often the distributions deviated from normality, particularly for real farm harvest prices and real gross incomes. Newly introduced crops like maize and sunflower generally showed high coefficients of variations. The instability index gave similar results as the coefficient of variation. The average negative deviations were higher for commercial crops. Ultimately, the production risk and the risk aversion nature of the SAT farmer lead to underinvestment in SAT agriculture.

Policy implications

1. New economic and social policies should be designed to improve self-insurance and risk-diffusion devices to enable the SAT farmers to even out their consumption streams.

2. Government should do more long term investments to reduce the risk in SAT agriculture as the farmers in this region have poor resource base.
3. Institutional policies should be aimed at equalizing access to factor and product market or to land rather than technology policy.

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Table 1. Distribution and measurement of risk in crop areas

	Rice	Jowar	Bajra	Ragi	Bengal.g	Red.g	Green.g	Horse.g	G.nut	Castor	Sunflower	Cotton
N	36	36	36	36	36	36	36	36	36	36	36	36
Mean	116,740	261,798	33,521	30,034	4,067	38,220	16,536	39,341	137,686	98,560	14,008	26,878
Median	118,828	254,640	33,225	29,094	3,526	38,831	16,891	38,577	143,917	89,185	13,754	23,717
Estimated mode	116,889	261,850	33,560	31,094	5,087	38,700	#	39,594	137,729	#	14,225	#
Std. Deviation	34,138	29,380	6,285	10,300	2,486	7,134	8,894	9,815	36,238	29,259	9,328	15,567
Variance	1.6 E+09	8.6 E+08	3.9 E+07	1.0 E+08	6.1 E+07	5.0 E+07	7.9 E+07	9.6 E+07	1.3 E+09	8.5 E+09	8.7 E+07	2.4 E+08
Skewness	-0.258	0.120	0.248	-0.502	1.357	-0.567	1.096	-0.238	-0.118	1.310	0.469	1.507
Kurtosis	-1.064	-0.350	-0.551	1.098	1.838	0.510	2.275	0.993	-0.774	3.739	-0.395	2.833
Distribution type	Platy-kurtic	Normal	Normal	Negatively skewed	Positively skewed	Negatively skewed	Lepto-kurtic	Normal	Platy-kurtic	Lepto-kurtic	Normal	Positively skewed
Coefficient of variation	29	11	19	34	61	19	54	25	26	30	67	58
Instability index	30	4	6	22	57	11	35	9	26	24	38	36
Average negative deviations from mean	32980	81985	14672	13588	1220	8215	7710	21928	32683	21464	12245	18326
CV-P1	26	12	18	57	22	6	14	36	33	23	30	29
CV-P2	36	9	14	16	34	14	34	13	17	18	98	36
CV-P3	27	7	20	9	77	30	78	10	20	40	62	67

\# Mode cannot be calculated by Elderton method

Standard error of Kurtosis is 0.768

Standard error of Skewness is 0.393

Table 2. Distribution and measurement of risk in crop yields

	Rice	Jowar	Bajra	Ragi	Bengal.g	Red.g	Green.g	Horse.g	G.nut	Castor	Sunflower	Cotton
N	36	36	36	36	36	36	36	36	36	36	36	36
Mean	1,724	560	386	738	446	209	242	303	694	259	270	176
Median	1,679	581	398	728	458	186	217	294	693	241	264	159
Estimated mode	1,724	560	386	739	453	212	#	307	694	266	275	#
Std. Deviation	242	105	106	137	244	84	155	77	167	87	129	96
Variance	58,534	11,040	11,141	18,708	59,386	7,022	23,954	5,908	27,935	7,567	16,536	9,217
Skewness	0.100	-0.170	0.020	-0.299	0.329	0.601	1.178	0.480	-0.087	0.805	0.398	1.814
Kurtosis	-0.275	-0.726	-0.881	-0.002	0.558	-0.456	1.983	0.479	-1.122	0.128	0.526	5.182
Distribution type	Normal	Normal	Platy-kurtic	Normal	Normal	Positively skewed	Lepto-kurtic	Positively skewed	Platy-kurtic	Positively skewed	Normal	Lepto-kurtic
Coefficient of variation	14	19	27	19	55	40	64	25	24	34	48	54
Instability index	9	14	23	11	45	35	64	21	24	30	24	47
Average negative deviations from mean	362	112	100	117	152	60	119	81	139	62	265	77
CV-P1	10	20	31	14	12	36	39	30	20	43	29	44
CV-P2	18	20	27	21	39	42	44	28	29	15	69	41
CV-P3	14	17	21	20	71	35	76	15	21	34	33	78

Mode cannot be calculated by Elderton method

Standard error of Kurtosis is 0.768

Standard error of Skewness is 0.393

Table 3. Distribution and measurement of risk in farm harvest prices

	Paddy	Jowar	Bajra	Ragi	Bengal.g	Red.g	Green.g	Horse.g	G.nut	Castor	Sunflower	Cotton
N	36	36	36	36	36	36	36	36	36	36	36	36
Mean	49	51	43	41	112	116	111	55	124	112	26	165
Median	47	47	39	37	115	112	111	55	122	108	47	171
Estimated mode	#	55	49	48	113	116	114	55	128	120	26	168
Std. Deviation	7	14	11	11	22	21	21	8	19	22	25	38
Variance	52	183	130	125	483	451	444	72	346	490	638	1,458
Skewness	1.684	1.336	1.628	1.753	0.284	0.456	0.674	0.205	0.576	1.201	-0.094	0.541
Kurtosis	3.818	1.495	2.268	2.645	0.234	-0.407	0.960	-0.526	1.525	1.746	-2.078	0.429
Distribution type	Lepto-kurtotic	Positively skewed	Positively skewed	Positively skewed	Normal	Normal	Positively skewed	Normal	Positively skewed	Positively skewed	Platy-kurtotic	Normal
Coefficient of variation	15	27	27	27	20	18	19	15	15	20	96	23
Instability index	5	12	10	10	6	6	8	5	4	6	32	9
Average negative deviation from mean	5	8	6	6	18	16	16	7	13	13	26	32
CV-P1	19	25	26	26	20	15	11	12	20	23	93	24
CV-P2	6	14	12	8	12	20	15	20	10	17	88	22
CV-P3	10	21	13	13	16	15	15	12	11	13	2	21

Mode cannot be calculated by Elderton method
Standard error of Kurtosis is 0.768
Standard error of Skewness is 0.393

Table 4. Distribution and measurement of risk in gross returns

	Paddy	Jowar	Bajra	Ragi	Bengal.g	Red.g	Green.g	Horse. g	G.Nut	Castor	Sunflower	Cotton
N	36	36	36	36	36	36	36	36	36	36	36	36
Mean	84,176	27,971	16,394	29,997	48,391	23,663	26,038	16,711	86,308	29,116	8,510	28,829
Median	82,239	27,134	15,249	28,336	44,401	21,997	22,289	15,677	82,433	24,078	6,052	24,813
Estimated mode	85,620	#	18,865	#	50,434	23,847	#	17,571	#	#	8,953	#
Std. Deviation	14,730	7,036	6,200	9,476	27,831	9,284	16,769	5,151	26,955	13,068	9,535	16,338
Variance	2.1 E+08	4.9 E+07	3.8 E+07	8.9 E+07	7.7 E+08	8.6 E+07	2.8 E+08	2.6 E+07	7.2 E+08	1.7 E+08	9.0 E+07	2.6 E+08
Skewness	0.663	1.500	1.308	1.465	0.548	0.522	1.318	0.908	1.040	1.948	0.730	1.424
Kurtosis	0.678	3.365	1.795	3.641	0.661	-0.836	2.057	0.878	1.192	5.710	-0.468	2.125
Distribution type	Positively skewed	Lepto-kurtotic	Positively skewed	Lepto-kurtotic	Normal	Normal	Positively skewed	Positively skewed	Positively skewed	Lepto-kurtotic	Positively skewed	Positively skewed
Coefficient of variation	17	25	38	32	58	39	64	31	31	45	112	57

CV - P1	17	23	37	27	19	32	37	28	33	60	108	60
CV - P2	19	17	23	24	41	43	39	40	37	25	93	43
CV - P3	11	13	28	17	67	32	91	19	24	34	33	64

Mode cannot be calculated by Elderton method

Standard error of Kurtosis is 0.768

Standard error of Skewness is 0.393