



ECONOMIC ANALYSIS OF RISK IN DRYLAND AGRICULTURE OF MAHARASHTRA

Satpute S. V.¹, V. A. Shinde², B. J. Deshmukh³ and S. S. Bhosale⁴

2 and 4 Associate Professors of Agricultural Economics,
1,3 Junior Research Assistant, Dept. of Agril. Economics, Mahatma Phule Krishi Vidyapeeth,
Rahuri
Dept. of Agril. Economics, Mahatma Phule Krishi Vidyapeeth, Rahuri. Dist. Ahmednagar,
Maharashtra

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Abstract: The paper has examined different types of risk in dryland agriculture. The present study was conducted to estimate risk efficient optimum farm plan for small medium and large farms by using linear programming MOTAD model during agricultural year 2010-13. The results revealed that in case of price risk, sunflower was most risky crop whereas bajra was less risky crop whereas in case of production risk, kharif groundnut and soyabean were most risky crops. Among the ten major dry land crops grown in Solapur district, the production risks are more than the price risks in case of bajra, maize, kharif groundnut, safflower and soybean. Hence, these two oilseeds and major pulse crop of Solapur districts i.e pigeon pea are more risky crops. Risk aversion behaviour of farmers in Solapur district indicated that all the respondent irrespective of the size groups are risk averters and least of the farmers from large size group exhibited risk taking behaviour. By using MOTAD technique a new profit maximizing optimum farm plans were evolved for small, medium and large size farms in Solapur district. It indicated that profit get maximized with increase in mean absolute deviation. It means that farmers have to take more risk for getting more profit. Cultivating under risk should be made part of farmers training and extension programme brought in to improve the efficiency of individual farms.

1. Introduction

Agriculture in Maharashtra is mainly characterized by uncertain and unstable rainfall pattern with low farm investment in agriculture inputs. Nearly 70 per cent of the farmers in dry lands operate on small holdings and about 90 percent of total pulses and oilseeds production come only from dry land. Hence planning for economic development, dry farming cannot be neglected. Indian Irrigation Commission has indentified 99 districts throughout the country as the most drought prone areas. The district of Maharashtra i.e. Solapur is included in the identified districts. Solapur is the most drought prone area in Maharashtra as it has been constantly and consistently affected by drought for the past 35 years out of 55 years after independence. The normal rainfall of the Solapur district is 650.4 mm which is lowest rainfall when compared to other parts of Maharashtra. Hence, there is an immense need to study the sensitivity of production, the efficiency with which drought prone farms are being operated and the nature of drought prone farming system to achieve desired level of

stability in farm income which will go in a long way in planning for drought preparedness. Very few studies have been undertaken in Maharashtra. Keeping these in view, the present investigation was carried out. one dry land district in Maharashtra viz; Solapur was typically chosen.

2. Objectives

1. To estimate the nature and magnitude of risk in major dry land crops.
2. To estimate the risk aversion behavior of the selected farmers
3. To evolve risk efficient farm plan with optimum crop mix on selected farm.

3. Methodology

For the present study, data were obtained from both primary and secondary sources. The sample for the study was selected using multistage random sampling technique. The primary data were collected by visiting each of the selected farmers personally and interviewing them with a set of well structured pre-tested schedules. The secondary data on area, production and productivity of principal dry land crops and their farm harvest prices of the

selected two districts and state as a whole for 50 years (1960-61 to 2009-10) were collected. This information was collected from various sources such as Directorate of Economics and Statistics, Government of Maharashtra and Office of the Chief Planning Officer of Solapur. The coefficient of variation is used to measure the magnitude of risk in yield, prices and gross return per hectare for all the crops. The information on production, marketing and financial risks reflecting the risk aversion behavior of farmers has been selected. The set of questions and the scores assigned were calculated. The risk aversion index was worked out. The MOTAD model (Hazell, 1971) were estimated by using linear programming logarithm with LINGO

15.0 version. The results were plotted on a graph would give expected income (E) - mean absolute deviation (A) frontier (E-A frontier). The E-A frontier generated by the above model was used to evolve the optimum enterprise combinations which would minimize the risk in farming at the same time maximize the income.

4. Results and Discussion

Magnitude of risk in major dry land crops

The present study attempts to measure the extent of risk in yield, prices from agriculture. For time - series data, the negative deviation from trend constitute the risk. The coefficient of variation was used to measure the magnitude of risk in yield, prices and gross returns per hectare of selected crops.

Table 1: Magnitude of risk in Solapur district during entire Period (1980-81 to 2009-10)

Sr. No.	Name of Crop	Coefficient of Variation (CV) %			Instability Index (CVt)%		
		Price Risk	Production Risk	Gross Return Risk	Price Risk	Production Risk	Gross Return Risk
1	Wheat	57.49	45.94	67.94	16.10	30.78	22.42
2	Rabi sorghum	54.09	39.49	67.52	24.88	39.10	36.46
3	Bajra	52.65	54.57	66.01	15.27	54.02	31.68
4	Maize	56.48	56.64	71.75	18.07	44.18	32.29
5	Pigeon pea	68	54.8	82.37	29.24	45.21	47.77
6	Gram	56.92	56.1	81.58	16.51	42.64	35.08
7	Kh.Groundnut	58.94	85.33	81.02	19.45	135.96	51.04
8	Safflower	62.37	70.36	74.83	22.45	50.66	45.65
9	Sunflower	72.49	53.69	83.58	36.25	53.15	46.80
10	Soybean	52.4	85.53	76.50	28.30	78.67	65.40

The instability index in price risk in Solapur district during entire period was highest in case of sunflower (36.24 %) whereas lowest in case of bajra (15.26%) while in production risk the instability index was highest in *kharif* groundnut (135.95 %) whereas lowest in case of wheat (30.78%). The instability index of gross return risk was highest in case of *kharif* groundnut (51.04%) and lowest in case of wheat (22.42%). The gross return risk during entire period in Solapur district was highest in case of

sunflower (83.58%). The magnitude of gross return risk was lowest in case of bajra (66.01%) followed by *rabi* sorghum (67.52%) and wheat (67.94%). Among the ten major dry land crops grown in Solapur district, the production risks are more than the price risks in case of bajra, maize, *kharif* groundnut, safflower and soybean. Hence, these two oilseeds and major pulse crop of Solapur districts i.e pigeon pea are more risky crops (Kandaswamy 1988).

Risk aversion behaviour of the dry land farmers

Table 2: Risk aversion of farmers in Solapur districts

Sr. No.	Category	Size group			Overall
		Small farms	Medium farms	Large farms	
1	Low risk aversion (0-0.33)	2 (10.00)	3 (15.00)	4 (20.00)	9 (15.00)

2	Medium Risk aversion (0.34-0.66)	7 (35.00)	10 (50.00)	13 (65.00)	30 (50.00)
3	High risk aversion (0.67-1.00)	11 (55.00)	7 (35.00)	3 (15.00)	21 (35.00)
	Total	20 (100.00)	20 (100.00)	20 (100.00)	60 (100.00)

(Figures in parentheses are percentages to the total)

Risk aversion behaviour of sample farmers in Solapur district revealed that all the respondents irrespective of the size groups are risk averters (Elamin 1992). Persons with high risk aversion were more in small farmers category (55%), followed by

medium farmers (35%) and large farmers (15%). Hence, it can be inferred that risk aversion behaviour of dry land farmers decreases with increase in size of holding (Dixit et.al 2000).

Risk efficient optimum farm plans

Risk efficient farm plan for small farmers

The risk efficient optimal farm plan for small farmers is presented in Table 3.

Table 3 Risk efficient farm plan for small farmers

Sr. No.	Particulars	Existing System	Optimum Plan	Alternate Plan-1	Alternate Plan-2	Alternate Plan-3
1	Expected income in ` (E)	45992	58465	51540	55465	57540
2	Mean Absolute deviation in income in ` (A)	4482	6147	7731	7326	7709
3	Total Variable Cost (C)	21173	21173	21173	21173	21173
4	Added returns (C)	-	13056	5689	3246	1806
5	Crop enterprise (ha)					
	a) Pigeon pea	0.24	0.19	0.25	0.45	0.42
	b) <i>Kharif</i> Onion	0.17	0.32	0.22	0.32	0.27
	c) <i>Kharif</i> Groundnut	-	-	-	-	-
	d) Black gram	0.08	-	-	-	-
	e) Soybean	0.01	0.54	-	-	-
	f) Maize	0.07	-			
	g) <i>Rabi</i> sorghum	0.50	0.61	0.52	0.55	0.45
	h) Gram	0.05	-	0.22	0.10	-
	i) Wheat	0.14	-	-	-	-
	j) Bajra	-	-	-	-	-
7	Gross cropped area	1.36	1.65	1.36	1.52	1.42

The existing plan gave them a gross total income of ` 45992 by using a capital of ` 21173. The existing plan consisted of 0.50 ha of *rabi* sorghum, 0.26 ha of pigeon pea, 0.17 ha of *kharif* onion, 0.05 ha gram, 0.08 ha black gram, 0.07 ha maize and it involved a risk level of ` 4482. By using the same resources and technology, an income maximizing plan was evolved (Rajgopalan et.al.1978). The

alternate plan-1 using MOTAD technique gave a total return of ` 51540. The risk associated with alternate plan-1 dropped to ` 7731. Alternate plan-2 gave a return to fixed factors of ` 55465 but it further reduced the risk level to ` 7326. The alternate plan-3 further increased the profit ` 57540 and increased the absolute deviations to ` 7709.

Risk efficient farm plan for medium farmers

Table 4 Risk efficient farm plan for Medium farmers

Sr. No.	Particulars	Existing System	Optimum Plan	Alternate Plan-1	Alternate Plan-2	Alternate Plan-3
1	Expected income in ` (E)	65399	76339	58465	68465	72739
2	Mean Absolute deviation in	5823	20148	3984	7683	11625

	income in ` (A)					
3	Total Variable Cost(°)	30575	30575	30575	30575	30575
4	Added returns (°)	-	10940	-6934	3066	7340
5	Crop enterprise (ha)					
	a) Pigeon pea	0.26	-	0.64	0.41	0.47
	b) <i>Kharif</i> Onion	0.32	0.25	-	0.22	0.09
	c) <i>Kharif</i> Groundnut	0.13	-	-	-	-
	d) Black gram	0.03	-	-	-	-
	e) Soybean	0.06	0.52	0.43	-	-
	f) Maize	0.16	0.37	-	-	-
	g) Bajra	0.09	-	0.15	0.21	0.15
	h) <i>Rabi</i> sorghum	1.27	1.12	1.41	1.26	1.45
	i) Gram	0.09	-	-	0.32	-
	j) Wheat	0.06	-	-	-	-
	k) Bajra	0.13	-	-	-	-
	l) Safflower	0.08				
6	Gross cropped area	2.63	2.26	2.63	2.42	2.16

The existing plan gave them a total returns to fixed factors of Rs.65399 by using a capital of ` 30575, 87.45 male labour and 104.94 female labour. The plan consisted of 1.27 ha *rabi* sorghum, pigeon pea 0.26 ha, *kharif* onion 0.32 ha, 0.13 ha bajra and 0.29 ha *kharif* groundnut and total absolute deviations associated with these enterprises were `

5823. Given these three alternative risk efficient plans and one profit maximizing plan, we can offer a cafeteria of four farm plans from which a medium sized farmer in the study area of Solapur district can choose a plan that matches with his risk aversion coefficient and risk-return trade-off (Puhazendhi. 1987).

Risk efficient farm plan for large farmers

Table 5: Risk efficient farm plan for large farmers in Solapur district

Sr. No.	Particulars	Existing System	Optimum Plan	Alternate Plan-1	Alternate Plan-2	Alternate Plan-3
1	Expected income in ` (E)	89694	112694	108694	102543	96321
2	Mean Absolute deviation in income in ` (A)	13008	22370	20700	18132	15334
3	Total Variable Cost (°)	54248	54248	54248	54248	54248
4	Added returns (°)	-	23000	19000	12849	6627
5	Crop enterprise (ha)					
	a) Pigeon pea	1.27	1.02	0.82	0.47	0.56
	b) <i>Kharif</i> Onion	0.28	0.42	0.32	1.61	1.60
	c) <i>Kharif</i> Groundnut	0.27	0.23	-	-	-
	d) Black gram	0.08	-	-	-	-
	e) Soybean	0.11	0.42	0.62	-	-
	f) Maize	0.35	0.10	0.20	-	0.22
	g) Bajra	-	-	-	-	-
	h) <i>Rabi</i> sorghum	1.46	1.12	1.52	0.52	0.15
	i) Gram	0.17	-	0.35	-	-
	j) Wheat	0.16	-	-	0.50	0.77
6	Gross cropped area	4.15	3.31	4.03	3.10	3.52

With the same available resources and technological options, a plan was developed aiming at maximization of the profit. It gave a return of ` 112694 which was 21 per cent higher than that in the existing plan. Three alternative risk efficient farm

plans were developed by minimizing the mean absolute deviations associated with it. Alternate plan-1 yielded an income of ` 108694 and the risk associated with it was `20700.

From the above analysis it is evident that the mean absolute deviation in income could be increased to larger extent with increasing the existing income by inclusion of cash crop based cropping. The E-A frontier derived for small medium and large farms is presented in Fig- 1. The frontier had positive slope with a weakening trade-off (Hazell 1971). It concurrently coincides with the theory that as the expected income increases, absolute deviation in income increases, indicating that additional credit required for the farmers.

5. Conclusion

The magnitude of gross returns were at higher side in case of *rabi* sorghum bajra and wheat during pre liberalization period and lowest gross return risks were noticed in these crops during post liberalization period in Solapur district. Thus it is clear that the price as well as yield of these three major cereals remained more stable during post liberalization period. Hence those three cereals are less risky crops in Solapur district. As regards the *kbharif* groundnut, safflower and pigeon pea, the gross return risks were at lower side during pre liberalization period and these shifted towards higher side in post liberalization period. Hence, these two oilseeds and major pulse crop of Solapur districts i.e pigeon pea are more risky crops. Risk aversion behaviour of farmers in Solapur district indicated that all the respondent irrespective of the size groups are risk averters and least of the farmers from large size group exhibited risk taking behaviour. By using MOTAD technique a new profit maximizing optimum farm plans were evolved for small, medium and large size farms in Solapur district. It indicated

7. Referencess

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that profit get maximized with increase in mean absolute deviation. It means that farmers have to take more risk for getting more profit. The E-A frontier derived and the frontier had positive slope with a weakening trade-off. It concurrently coincides with the theory that as the expected income increases, absolute deviation in income increases, indicating that additional credit required for the farmers. It is evident that the mean absolute deviation in income could be reduced to larger extent without sacrificing the existing income by inclusion of cash crop based cropping. The typical result is that a significant reduction in mean annual deviations in net farm income is observed at the cost of relatively little expected income. If the decision makers expected income functions are known, the points of maximum expected income can be found by putting both curves together on the same graph. The points of tangencies give the maximum expected income for each farm.

6. Policy Implication

In the light of the empirical evidence, farm plans are sensitive to the risk criteria and farmers willingness to accept risk. Due to the presence of price and production inefficiency in the study area, farmers gain less net farm income under present conditions compared to the optimum conditions. A government policy should aim at improving the working of the markets that will enable farmers to increase their efficiency, especially price efficiency. On the other hand, cultivating under risk should be made part of farmers training and extension programme brought in to improve the efficiency of individual farms