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CROP INSURANCE TO PROTECT FARMERS UNDER DRY FARMING CONDITIONS IN MAHARASHTRA

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The problem of dry farming is a twin problem—problem of very low annual precipitation and uncertainty of rainfall. The severity of the problem is aggravated when the rainfall is ill-distributed. This very low and uncertain rainfall causes uncertainty in crop yields which are already low. Uncertainty of yields is the basic risk which every farmer has to face. The income of farmers in dry farming region is not only small but it also fluctuates widely from year to year. The farmers owing to their insufficient means and resources are seldom able to stand risk especially when it involves disastrous losses. The result is that there is often a serious decline in farm incomes and consequent failure on the part of farmers to pay their land revenue and other taxes, diminishing purchasing power leading to decline in their demand and their inability to repay the loans which results in mounting of debts. So ultimately the entire community is affected by the risk of which the farmers are the direct and primary victims.[1]

The most extensive device for transferring of risks, particularly risk arising from natural factors is insurance. Insurance as a measure of financial security against life and property is well established in industries and businesses. But insurance in the field of agriculture, especially crop insurance, is of recent interest. Crop insurance is a device to meet the problem of risks in farming. Crop insurance spreads the losses over many persons exposed to these risks. It spreads losses over many areas and over many years. It enables the farmers to substitute a regular annual premium cost for irregular losses.[2] Crop insurance is a device to protect the investment of the farmer in his crop. It is a technique of protecting farmers against the element of chance in crop production and stabilizing farm income. It strengthens and protects the credit of the farmer and adds a measure of security to farming

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1. Report of the Working Party on Crop and Livestock Insurance, Food and Agriculture Organization of the United Nations, Rome, 1957.
2. W. H. Rowe : Federal Crop Insurance —A Description, FCIC, USDA, Washington, D.C., U.S.A., 1959.

as an occupation.   Thus crop insurance is a device to take some of the gamble out of farming.[3]

Farm risks which are natural and cannot be wilfully brought about, which are uniform in their behaviour, regular in their occurrence for intelligent estimation and which are independent of each other can only be insured. Some of the farm risks of this type which can be insured are : drought, flood, too much of rainfall, frost, cold, hail-storm, cyclonic-storm, insect pests and various diseases.

Of all the natural risks to farming in India and particularly Maharashtra the major risk is inadequacy of rainfall which leads to oft-occurring scarcity and famine conditions in the State.

Economic Geography of Maharashtra

Farming in Maharashtra is predominantly dependent on monsoon. Only 7-8 per cent of the cropped area in the State is under irrigation and all the remaining area is under unirrigated crops.   Monsoon in the State is very irregular, ill-distributed and uncertain.   The inevitable result is that local scarcities and famines usually occur practically every year in one part of the State or the other.   The absence of adequate means of irrigation facilities has led to large scale dependence on monsoon which has made the poor cultivator a helpless tool in the hands of his so called 'fate.'

The soil-climate complex in Maharashtra is very heterogeneous and there are wide disparities in respect of topography, rainfall, soil types, cropping pattern and agricultural practices.   On the basis of similar agro-climatic conditions the State is divided into six important regions: (1) Konkan, (2) Ghat, (3) Maval, (4) Central Region, (5) Less Rainfall Region and (6) Assured Rainfall Region with sub-regions A, B and C.

Although both the Central and Less Rainfall Region can be considered under the dry farming conditions, the latter reveals more typical and exact dry farming conditions in the State where the rainfall ranges from 35 to 75 cms. only.   The Less Rainfall Region comprises of eastern part of Kolhapur, Sangli, Satara, Poona, Ahmednagar, Nasik and Dhulia districts, Sholapur district (except Barsi taluka) and western parts of Jalgaon, Bhir and Aurangabad districts.[4] About 32,470 sq. miles geographical area of the State, spread in eleven districts, comes under this region.   This means that little less than one-third of the geographical area (30 per cent) in the State is under strains and stresses of natural water required for the existence of plant and animal life.

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    3. W. H. Rowe : Some Suggestions for an Experiment in Crop Insurance, FCIC, USDA, Washington, D.C., U.S.A., 1960 (mimeo).
    4. Guide to Agricultural Officers (Marathi), Information Bulletin No. 172, Department of Agriculture, Maharashtra State, Poona.

Measuring Production Risk

The empirical or quantitative measurement of farm production risk is the basic requirement in crop insurance. Risk in crop production can be measured by ascertaining year to year variations in crop yields over a period of years. Customarily high risk agriculture and low risk agriculture are differentiated on the basis of variability of yield from year to year. Empirical evaluation of production risk is rather severely limited by availability of suitable data.[5] The chief problem is lack of necessary long period and reliable data. Given such data, it may be easier to calculate farming risks, in so far as such risks are caused by purely natural elements and therefore, are independent of human action or volition. Modern statistical and actuarial methods make it possible to reduce the apparently inconsistent behaviour of different natural elements often to measurable limits.[6]

Several natural hazards are responsible for variability in yield in different localities. It is very difficult to establish the frequency and intensity of each natural hazard and estimate the extent of damage caused by individual hazard in all risk crop insurance. The losses from all causes are reflected in the yield of the crop. The actuary is not particularly interested in how much of the loss was due to each cause if all causes are insured against. Therefore, the yield data are used to develop loss data resulting from all causes of loss combined.[7]

Insurance Coverage or Guarantee

The method of all risk crop insurance involves guaranteeing a certain amount of physical production per acre. The amount of yield to be guaranteed is an extremely important and significant figure and the determination of this amount is one of the functions of the actuaries. The actuaries must determine a safe figure of the amount to be guaranteed and determine the premium rate to be charged for such level of guarantee or coverage.

The level of guarantee or coverage is generally expressed as a certain percentage of the long-time average yield. The level of guarantee is expressed in physical quantities—pounds or kilograms per acre—to avoid uncertainty arising due to fluctuations in prices. In countries like U.S.A. and Japan where crop insurance has been in vogue for many years, the maximum level of guarantee has been limited to 75 per cent of the average yield. However the actual level of guarantee varies according to the degree of risk involved in crop production. In localities where the yield variability is very low indicating small risk of losses the level of guarantee is higher (upto 75 per cent) as compared to the high risk area where the level of guarantee is much low.

5. E. Lloyd Barber and Donald C. Horton, "Measuring and Interpreting Farm Production Risks," *Agricultural Finance Review*, Vol. II, November, 1948 (Bureau of Agricultural Economics, USDA).

6. P. K. Ray : Principles and Practices of Agricultural Insurance, Bookland Private Ltd., Calcutta, 1958.

7. W. H. Rowe : Considerations of Establishing Crop Insurance in Latin America, FCIC, USDA, Washington, D.C., U.S.A., 1966.

Premium Rate

The net premium rate is the annual average loss per acre and is expressed in physical quantities and converted into money value at some previously agreed price. To make the premia comparable among various areas or districts they are also expressed in terms of percentage of average yields. The income of farmers are generally associated with average per acre yields. Higher yields mean larger incomes which ultimately mean greater paying capacity of a farmer. Therefore, the premia as expressed in terms of percentage of the average yield are useful to decide whether the premia are within the paying capacity of the farmers.

Here an attempt is made to measure production risk of selected crops in the Central and Less Rainfall Region, on the basis of yield variability studies over a period of 12 years.

Materials and Method

The major crops of dry farming region are *kharif* jowar, *rabi* jowar, bajri, groundnut, wheat and pulses. Of these crops, jowar and bajri are the staple food crops of Maharashtra and occupy about 60 per cent of the total area under foodgrains. Therefore, only jowar (both *kharif* and *rabi*) and bajri are selected for this study.

The long-time average per acre yield data, particularly at the individual farm level is not available in this country. The data used for this study are the annual average yields per acre in each district published in the Season and Crop Report of State Agriculture Department for a period of 12 years from 1950-51 to 1961-62.

The statistical measures such as the mean, standard deviation and co-efficient of variation are used to study the yield variability over a period of 12 years.

Results and Discussion

We shall discuss the yield variability of *kharif* jowar, *rabi* jowar and bajri in different districts of dry farming region (Table I).

There are wide fluctuations in the yields of all the selected crops from district to district. In the case of *kharif* jowar the range of coefficient of variation is from 4.08 in Satara district to 24.34 in Dhulia district. Yields are more stable in Kolhapur, Sangli, Satara and Poona districts and they fluctuate more in Dhulia and Sholapur districts. In Kolhapur district which has the highest yield (511 lbs.), the yield variability is much low (9.94). But in Sholapur district although the average yield is the lowest (203 lbs.) the yield variability is very high (18.21) which means greater chances of losses.

In the case of *rabi* jowar minimum variation is in Satara district (13.05) and maximum in Ahmednagar district (31.71). Yields are more stable in

TABLE I—DISTRICTWISE MEAN YIELD, STANDARD DEVIATION AND COEFFICIENT OF VARIATION OF SELECTED CROPS

Districts arranged in descending order of mean yield					Mean yield (lbs. /acre)	Standard deviation	Coefficient of variation
Kharif jowar							
Kolhapur	..	..	..	..	..	511	50·81	9·94
Sangli	..	..	..	..	..	444	28·30	6·37
Satara	..	..	..	..	..	431	17·61	4·08
Dhulia	..	..	..	..	..	421	102·43	24·34
Nasik	..	..	..	..	..	317	43·49	13·70
Ahmednagar	..	..	..	..	..	217	21·19	9·95
Poona	..	..	..	..	..	206	14·38	6·96
Sholapur	..	..	..	..	..	203	37·04	18·21
					345	39·40	11·67
Rabi jowar							
Kolhapur	..	..	..	..	..	518	72·44	14·00
Dhulia	..	..	..	..	..	335	86·01	25·69
Sangli	..	..	..	..	..	321	48·51	15·22
Nasik	..	..	..	..	..	303	65·51	22·61
Satara	..	..	..	..	..	292	38·09	13·05
Poona	..	..	..	..	..	180	44·20	24·60
Sholapur	..	..	..	..	..	149	41·18	27·62
Ahmednagar	..	..	..	..	..	136	43·01	31·71
					279	54·87	21·81
Bajri							
Dhulia	..	..	..	..	..	295	75·08	25·42
Nasik	..	..	..	..	..	243	44·23	18·21
Kolhapur	..	..	..	..	..	237	30·89	13·02
Sangli	..	..	..	..	..	224	29·27	13·05
Satara	..	..	..	..	..	220	15·72	7·14
Poona	..	..	..	..	..	174	11·04	6·33
Ahmednagar	..	..	..	..	..	169	33·78	19·95
Sholapur	..	..	..	..	..	131	48·89	37·24
					212	36·11	17·94

Kolhapur, Sangli and Satara districts while they fluctuate more in Ahmednagar, Sholapur, Poona, Dhulia and Nasik districts. A significant fact noticed in *rabi* jowar production in Poona, Sholapur and Ahmednagar districts is that where the average per acre yield is low indicating low productivity, the risk to its production is very high.

In bajri the range of yield variability is from 6.33 in Poona district to 37.24 in Sholapur district. The yields are more stable in Poona, Satara, Sangli and Kolhapur districts and more fluctuating in Sholapur, Ahmednagar, Nasik and Dhulia districts. Although yields in Sholapur and Ahmednagar districts are the lowest, the risk of production is comparatively very high.

Irrigated Vs. Unirrigated Crop

Since jowar is the staple food crop in Maharashtra *rabi* jowar is extensively grown under both irrigated and unirrigated conditions in dry farming areas to have assured grain supply, particularly for family consumption. Therefore, *rabi* jowar is selected for studying the effect of irrigation on the yield variability. Table II shows the comparative yield variability under irrigated and unirrigated conditions. From the table it appears that the per acre yield of irrigated jowar is four times more than the unirrigated jowar but the fluctuations in yield of the irrigated crop are necessarily lesser than the unirrigated crop. This means that risk to crop production of jowar under dry farming conditions is always greater than irrigated farming. In the selected districts average risk to the unirrigated crop of *rabi* jowar is nearly 46 per cent greater than the irrigated one.

TABLE II—COMPARISON OF YIELD VARIABILITY OF *Rabi* JOWAR UNDER IRRIGATED AND UNIRRIGATED CONDITIONS IN SELECTED DISTRICTS

District	Irrigated jowar		Unirrigated jowar	
	Mean yield (lbs./acre)	Coefficient of variation	Mean yield (lbs./acre)	Coefficient of variation
Sangli	904	14·07	321	15·22
Satara	904	11·34	292	13·05
Poona	881	15·15	178	24·60
Ahmednagar	990	13·98	136	31·74
Sholapur	792	19·93	149	27·62
Average	896	15·39	216	22·44
Increase (per cent)	310	—	—	45·80

Insurance Coverage and Premium Rate

Here an attempt is made to estimate the losses in yields at 75 per cent coverage and to determine premium rates for such losses in respect of selected crops (Table III). The coverage, premium rates and losses are also worked

District	12-year average yield (lbs./acre)	Coverage at 75 per cent of the average yield		Premium rate			Total loss in 12 years			Coefficient of variation
		(lbs./acre)	(Rs./acre)	(lbs./acre)	(Rs./acre)	Per cent of average yield	(lbs./(acre)	(Rs./acre)	No. of years	
Kharif jowar										
Kolhapur	513	385	107·80	1·50	0·42	0·29	18	5·04	1	9·94
Sangli	444	333	93·24	Nil	Nil	Nil	Nil	Nil	—	6·37
Satara	431	324	90·72	Nil	Nil	Nil	Nil	Nil	—	4·08
Poona	206	155	43·40	Nil	Nil	Nil	Nil	Nil	—	6·96
Ahmednagar	217	163	45·64	Nil	Nil	Nil	Nil	Nil	—	19·95
Nasik	317	238	66·64	1·75	0·49	0·55	21	5·88	1	23·70
Dhulia	421	316	88·48	16·16	4·52	3·83	194	54·32	2	14·34
Sholapur	203	153	42·84	1·82	0·51	0·89	20	5·60	1	8·21
	345	259	75·32	2·63	0·74	0·76	31·62	8·85	0·63	11·67
Rabi jowar										
Kolhapur	518	388	108·64	4·58	1·28	0·88	55	15·40	1	14·00
Sangli	321	241	67·48	2·33	0·65	0·97	28	7·84	1	15·22
Satara	292	219	61·32	1·17	0·33	0·53	14	3·92	1	13·05
Poona	180	135	37·80	5·92	1·66	3·29	71	19·88	2	24·60
Ahmednagar	136	102	28·56	7·50	2·10	5·51	90	25·20	2	31·74
Nasik	303	227	63·56	9·75	2·73	3·21	117	32·76	2	22·61
Dhulia	335	251	70·28	11·75	3·27	3·50	141	39·48	1	25·69
Sholapur	149	112	31·36	5·50	1·54	3·68	66	18·48	3	27·62
	279	209	58·52	5·90	1·69	2·11	75·25	20·37	1·68	21·81
Bajri										
Kolhapur	237	178	82·00	0·91	0·42	0·38	11	5·06	1	13·02
Sangli	224	168	77·00	Nil	Nil	Nil	Nil	Nil	—	13·05
Satara	220	165	76·00	Nil	Nil	Nil	Nil	Nil	—	7·14
Poona	174	131	60·00	Nil	Nil	Nil	Nil	Nil	—	6·33
Ahmednagar	169	127	58·00	3·82	1·76	2·26	42	19·32	1	19·95
Nasik	243	182	84·00	2·90	1·33	1·19	32	14·72	1	18·21
Dhulia	295	221	102·00	11·50	5·29	3·90	138	63·48	1	25·42
Sholapur	131	92	42·00	5·75	2·65	4·39	69	31·74	4	37·24
	212	159	73·00	3·07	1·41	1·45	36·50	16·79	0·63	17·94

out in money value. The prices considered are 28 paise per pound and 46 paise per pound for jowar and bajri respectively.

Kharif Jowar

The insurance coverage (at 75 per cent level of guarantee) is higher where the 12-year average yields are higher. The maximum insurance coverage is in Kolhapur (385 lbs.) and the minimum is in Sholapur district (153 lbs.). There is no loss in yield in the districts where the coefficient of variation is below 10 except in Kolhapur district, which indicates low risk. The maximum loss is in Dhulia district (194 lbs.) which has the highest co-efficient of variation (24.34) which means greater risk of production.

Since the premium rate is directly related to the degree of risk, the maximum rate is in Dhulia district (16.16 lbs.) and the minimum is in Kolhapur district (1.50 lbs.) although Kolhapur has the highest insurance coverage.

Rabi Jowar

Insurance coverage of *rabi* jowar is maximum in Kolhapur district (388 lbs.) and minimum in Ahmednagar district (102 lbs.) There is no loss in yield in districts where the yield variability in terms of the coefficient of variation is below 13. The maximum loss is in Dhulia (141 lbs.). Although Ahmednagar district has the highest yield variability (coefficient of variation 31.74) the loss is less than that of Dhulia. This is because the insurance coverage in Ahmednagar is only 102 lbs.

The premium rate is the highest in Dhulia district (11.75 lbs.) which has the maximum loss. Minimum premium is in Satara district (1.17 lbs.). Although Ahmednagar district has the highest yield variability the premium is more in Dhulia district which has higher coverage. This means that the size of premium is also directly related to the amount of production guaranteed. When the premia are expressed in terms of percentage of average yield, Ahmednagar has the highest premium rate (5.51 per cent). This seems to be very high from the point of view of paying capacity of the farmer; because per acre yield in this district is very low (136 lbs.).

Bajri

The maximum insurance coverage of bajri is 221 lbs. in Dhulia district and the minimum of 92 lbs. in Sholapur district. There is almost no loss in yield in the districts where yield variability in terms of the coefficient of variation is upto 13 which indicates low risk in production. The maximum loss of 138 lbs. is in Dhulia district which has the highest coverage (221 lbs.) and considerably high yield variability of 25.42. The minimum loss is in Kolhapur district (11 lbs.).

Since Dhulia has the maximum coverage the premium rate is also highest (11.50 lbs.) in that district, but in terms of percentage of average yield it may

TABLE IV—DISTRICTWISE AVERAGE YIELD, INSURANCE COVERAGE AND PREMIUM RATE FOR *Rabi* JOWAR UNDER UNIRRIGATED *Vs* IRRIGATED CONDITIONS

District	12-year average yield (lbs./acre)	Coverage at 75 per cent of the average yield		Premium rate			Total loss in 12 years			Coefficient of variation
		(lbs./acre)	(Rs./acre)	(lbs./acre)	(Rs./acre)	Per cent of average yield	(lbs./acre)	(Rs./acre)	No. of years	
Rabi jowar										
Unirrigated										
Sangli	321	241	67·00	2·33	0·65	0·97	28	7·84	1	15·22
Satara	292	219	61·00	1·17	0·33	0·53	14	3·92	1	13·05
Poona	180	135	38·00	5·92	1·66	3·29	71	19·88	2	24·60
Ahmednagar	136	102	29·00	7·50	2·10	5·59	90	25·20	2	31·74
Sholapur	149	112	31·00	5·50	1·54	3·68	66	18·48	3	27·62
	216	162	45·00	4·48	1·25	2·79	53·80	15·06	—	22·44
Irrigated										
Sangli	904	678	190·00	3·16	0·88	0·35	38	10·64	1	14·70
Satara	904	678	190·00	6·50	1·82	0·71	78	21·84	1	11·34
Poona	881	660	185·00	Nil	Nil	Nil	Nil	Nil	—	15·15
Ahmednagar	990	742	208·00	Nil	Nil	Nil	Nil	Nil	—	13·98
Sholapur	792	594	166·00	Nil	Nil	Nil	Nil	Nil	—	19·93
	896	672	188·00	1·97	0·55	0·22	23·20	6·50	—	15·39

be considered not very high. In Sholapur district which has the highest yield variability (coefficient of variation 37.24) the premium rate is 5.75 lbs. per acre. But in terms of percentage of average yield this rate appears a little high because the average yield of bajri in that district is very low (131 lbs.).

Irrigated Vs. Unirrigated Rabi Jowar

Earlier we have tried to measure the risk to production of *rabi* jowar under irrigated and unirrigated conditions. Here we shall try to know as to how the variation in risk affects insurance rating (Table IV). This aspect of comparative study will indicate the risk involved in crop production under dry farming conditions.

The average yield of irrigated *rabi* jowar is almost four times greater than unirrigated jowar in the selected districts. Consequently, the insurance coverage is also larger in the same proportion. However, the average total loss in the case of unirrigated jowar is 53.80 lbs. which is more than double over irrigated one (23.20 lbs.). Therefore, the premium rate is also more than double for unirrigated jowar. From the foregoing discussion it can be stated that producing *rabi* jowar under dry farming conditions involves about one and a half times greater risk than under irrigated conditions. The average per acre yield under dry farming conditions is very low (almost one-fourth) which means poor incomes to farmers which ultimately means very low ability of farmers to stand the risk of crop failure. Therefore, ironically it can be concluded that under dry farming conditions where the ability to stand the risk is low the chances of crop failure are always greater.

Conclusions

1. There are wide fluctuations in the yields of selected crops from district to district which is evident from Table V.

TABLE V—FLUCTUATIONS IN THE YIELDS OF SELECTED CROPS

Crop					Coefficient of variation		
					Minimum	Maximum	Average for the selected districts
Kharif jowar	..	..	..	..	4·08	24·34	11·67
Rabi jowar	..	..	..	..	13·05	31·74	21·81
Bajri	..	..	..	..	..	6·33	37·24	17·94

The fluctuations in the yield of *rabi* jowar are more compared to *kharif* jowar and bajri. In the case of *rabi* jowar yields under irrigated conditions are not only higher but they are also more stable than unirrigated jowar. Under dry farming condition the fluctuations are nearly 46 per cent more than under the irrigated condition.

2. Insurance coverage is associated directly with productivity. The level of guarantee is found to be higher in crops and districts where the per acre yields are high. In cases where yield variability is very high the 75 per cent coverage is too large which is indicated by very high premium rates. This shows that the level of guarantee is inversely related to the degree of risk involved.

3. There are no losses in yield where yields are stable indicated by low coefficient of variation. The total losses are directly associated with the level of guarantee and the degree of risk involved. Therefore, the rates are found to be low where both the level of guarantee and the degree of risk are low and they increased when either of the two or both increased.

4. Under typical dry farming conditions where the average per acre yields are very low the fluctuations in yields are also very wide indicating high risk of production.

5. Premium expressed in terms of percentage of average yield is useful to decide whether the size of premium is within the paying capacity of the farmer. Where premium rates are very low (below 1 per cent) the insurance benefits are very small and may not provide sufficient incentive to the farmers though premium rates seem to be quite attractive. Where the premium rates are between 1 per cent and 3 per cent of the average yield the insurance benefits are attractive at the same time the rates can be considered within the - capacity of farmers. Where the premium rates are above 3 per cent the insurance benefits are very attractive but the premia seem to be very high which means the 75 per cent level of guarantee is too high or sometimes superfluous.

6. Under dry farming conditions the average yields per acre are very low which means that the ability of the farmers to stand the risk is poor. But the chances of crop failure are greater and therefore, premia are high.