Minimization of Losses in Mango Production by Weather Based Crop Insurance Scheme in Maharashtra

P. J. Kshirsagar*, J. M. Talati, V. A. Thorat and N. A. Gaikwad
Department of Agricultural Economics, College of Agriculture, Dapoli.
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli - 415 712 (MS).

Abstract

The mango grower response to weather based insurance scheme is progressively expanding in Ratnagiri district of Maharashtra. The present study was undertaken with a sample of 100 beneficiaries' insurance scheme and 100 non- beneficiaries selected randomly.

The per hectare maintenance cost (Cost-C) of mango orchard on beneficiary farm was worked out to ₹ 153669.33 and non-beneficiary farm it was worked out to ₹ 140519.73. Per hectare yield of mango on beneficiary and non-beneficiary farm was 20.5 quintal (q) and 20.2 quintals, respectively. The per hectare return realized were ₹ 144000 and ₹ 141000 on beneficiary and non-beneficiary farm, respectively. The benefit cost ratio in mango production was1.03 and 1.07, respectively. The benefit cost ratio including insurance claims for beneficiary farms increased from 1.03 to 1.09. The result of the logit regression analysis showed that the membership of association and contacts with extension agents were found to be significant in influencing the farmers' participation in crop insurance scheme. Thus even though, the mango production in this region is subject to adversities of climatic change the mango farmers were able to compensate the losses from insurance claims to some extent.

Keywords: Crop insurance, minimization of losses, weather based, mango production.

Introduction

A number of crop insurance products are available to farmers in different geographical area and for different purposes. These include National Agriculture Insurance Scheme (NAIS), Weather Based Crop Insurance Scheme (WBCIS). Insurance products are available for plantation crop in specific geographical area such as Uttarakh and Seb Bima Yojana (Apple Insurance), Grape insurance, Rainfall insurance scheme for coffee growers (Coffee Insurance), Coconut, Rubber, Mango, Insurance for plantation crops in Specific geographical area (Anonymous 2013).

Maharashtra is one of the leading states in the country in Horticulture Development .The diverse agro-climatic conditions of the state are very congenial for cultivation of various horticultural crops. The area under fruit crops which was 2.42 lakh hectares in 1990 has gone up to 37.88 lakh hectare in 2013-14. Similarly, the area under various vegetables, spices crops and floriculture has also increased substantially. This is mainly due to the Government policies like establishment of separate Department of Horticulture in 1981 and linking horticulture development with Employment Guarantee Scheme in 1990. Creation of various infrastructure facilities like establishment of horticulture nurseries, irrigation facilities also helped for horticulture development (Anonymous 2015).

The weather based fruit crop insurance scheme is implemented from the year 2012 in Ratnagiri district to overcome and safeguard the mango growers from effect of climate change. In the year 2014, 1024 mango growers were distributed insurance benefit to the client of ₹ 2.73 corers followed by 1716 mango growers in the year 2015 received ₹ 4088 corers. The mango grower's response to insurance scheme for mango is progressively expanding which has major effect on minimization of losses due to

***Corresponding author :** sagartarang@rediffmail.com

adverse climate change (Anonymous 2014).

In view of this the study was purposively undertaken with a sample of beneficiaries of mango crop insurance scheme and non-beneficiaries from Ratnagiri district.

Material and Methods

The Ratnagiri district from Konkan region was selected purposively where large number of farmers availed mango crop insurance scheme. The Mango is grown in all part of Ratnagiri district, from the district Ratnagiri and Sangmeshwar tahsils were selected purposively, because of large number of total beneficiary and insurer beneficiaries of mango were observed in these tahsils. From these tahasils of agricultural offices the list of insurance beneficiaries & non beneficiaries was obtained from agricultural officers of respective tahasils.

Five villages from each tahsil were selected randomly. Thus, in all ten villages from two tahasils were selected for the present study. From each of the selected village, a list of mango insurance of beneficiary and non-beneficiary was prepared from village records with the revenue office. From each village 10 insurer and non-insurer mango growers were selected randomly. Thus, the final sample consisted of 2 tahasils, 10 villages and 100 insurance beneficiaries and 100 non beneficiaries' mango grower from Ratnagiri District.

The data obtained from sample mango growers categorized as beneficiaries and non- beneficiaries were processed with the help of simple statistical techniques like frequency, percentages for the awareness about insurance scheme. The maintenance cost of mango orchard was worked out by using standard cost concepts. The profitability in mango production was studied on both categories of mango farms and effects of benefits realized from crop insurance scheme were estimated.

Analytical Tools and Techniques: The probability of participation in mango insurance scheme was estimated by logit regression. The logit regression model is multivariate technique which allows for estimating the probability that an event occurs or not by predicting a binary dependent outcome from a set of independent variables. The logit model is based on cumulative logistic probability function and it is computationally tractable. According to Gujarati and Porter (2009), it is expressed as:

$$P_i = E(Y=1/X_i) = b_1 + b_2 X_i \quad \text{.... (1)}$$

For ease of estimation, equation (1) is further expressed as:

$$P_i = \frac{1}{1 + e^{-zi}} = \frac{e^z}{1} \quad \text{..... (2)}$$

Where:

Pi = Probability of an event occurring

$Z_i = B_1 + B_2 + X_i$

The empirical model of the logistic regression for this study assumed that the probability of the farmers' participation in insurance scheme is expressed as:

$$P_i = \frac{e^{b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+b_8x_8+b_9x_9+b_{10}x_{10}}}{1+e^{b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+b_8x_8+b_9x_9+b_{10}x_{10}}} \quad \text{.... (3)}$$

Pi ranges between zero and one and it is non linearly related to Zi. Zi is the stimulus index which ranges from minus infinity to plus infinity and it is expressed as:

$$Z_i = \ln(p_i/1-p_i) = e^{b_0+b_1x_1+b_2x_2+.....+b_9x_9+b_{10}x_{10}+u} \quad \text{.....(4)}$$

To obtain the value of Zi, the likelihood method of observing the sample was formed by introducing a dichotomous response variable. The explicit logit model was expressed as:

$$Y = e^{b_0+b_1x_1+b_2x_2+.....+b_9x_9+b_{10}x_{10}+u} \quad \text{.....(5)}$$

Where,

Y	=	Dichotomous response variable (1 for farmers who participated in insurance scheme; 0 otherwise)
X_1	=	Age of farmers (Years)
X_2	=	Educational level of farmers (years of schooling)
X_3	=	Farm size of farmers (hectares) / Proportion of area under mango
X_4	=	Household size (number)/ earning member
X_5	=	Membership of associations (number of associations a farmer belongs to)
X_6	=	Accessibility to credit (amount of loans a farmer accessed)

X_7 = Contact with extension agents (number of contacts)

X_8 = Income from agriculture

X_9 = Income for other sources

X_{10} = Dummy for occupation (if Agriculture Main Occupation = 1; Otherwise = 0)

b_1- b_{10} = Coefficients of variables

b_0 = Constant term

u = Error term

The logistic regression analysis was carried out in the advance standard software SAS 0.4 version.

Insurance trigger for crop failure: The following insurance triggers were observed in the study area through which farmer claims on mango insurance were settled.

Frequency distribution of crop failure using insurance trigger for mango orchards

Sr. No.	Particulars (Insurance trigger)	Duration
1	Unpredicted rain	1 Jan - 15 April
2	Low temperature	1 Dec - 28 Feb
3	Unpredicted rain	16 April - 15 May
4	High temperature	15 March - 31 May

Result and Discussion

Details of mango orchard of sample farmers: The information in respect to average age of the orchard, average size of the orchard and per farm number of bearing and non-bearing trees is given in table 1.

It is seen from table 1 that in beneficiaries group per farm, average age of the orchard was 17.88 years and average area under mango orchard was 1.82 ha. The proportion of bearing trees with the beneficiary farmer was found to be 96.84 per cent. Similarly, in non -beneficiary group, average age of the orchards was 22.05 years with average size of the orchard 1.74 ha. The proportion of bearing trees was estimated to 83.38 per cent.

Similar results were also observed by Mandape (2009) while studying resource use efficiency in mango production in Ratnagiri district (Maharashtra State).

Table 1 : Details of mango orchard of sample farmers.

Sr. No.	Particulars	Beneficiary (N=100)	Non beneficiary (N=100)
1.	Average age of the orchard (yrs.)	17.88	22.05
2.	Average size of the orchard (ha.)	1.82	1.74
3.	Average number of trees	173.27	165.30
a)	Per farm		
i.	Bearing	167.46 (96.40)	142.33 (86.10)
ii.	Non bearing	5.81 (3.60)	22.97 (13.90)
	Total	173.27 (100.00)	165.30 (100.00)
b)	Per hectare		
i.	Bearing	92.10 (96.84)	79.20 (83.38)
ii.	Non bearing	2.90 (3.16)	15.79 (16.62)
	Total	95.0 (100.00)	94.99 (100.00)

(Figures in the parentheses indicate percentage to the total)

Cost of maintenance of mango orchard: The per hectare itemwise cost of maintenance of mango orchard was worked out separately for beneficiary group and non-beneficiary group and is given in table 2.

It is seen from the table 2 that, on the beneficiary farm per hectare total cost of maintenance (Cost-C) worked out to ₹ 138620.87. Cost-A and Cost-B were estimated to ₹ 88869.43 and ₹ 125303.51, respectively. It was noticed that, in item wise cost of maintenance incurred by beneficiary farmer, the share of rental value of land was maximum (₹ 23646.66) followed by labour (₹ 20998.5), plant protection measures (₹ 3489), manures and fertilizers (₹ 36558.64). Only on beneficiary farm the cost incurred on insurance premium was observed to the tune of ₹ 5593.

The per hectare total cost of maintenance (Cost-C) on non-beneficiary farms was worked out to ₹ 130966.39. Cost-A and Cost-B were accounted to ₹ 84022.68 and ₹ 119119.13, respectively. As regards the item wise cost of maintenance it was found that the share of rental value of land was maximum (₹ 23296.66) followed by

Table 2 : Per hectare cost of production of sample mango orchard.

Sr. No.	Item of cost	Beneficiary (N=100)		Non beneficiary (N=100)	
		Quantity	Amount (₹)	Quantity	Amount (₹)
1.	Hired labour				
	a) Male (Days)	59.99	11998.0	60.68	12136.0
	b) Female (Days)	28.55	4282.50	35.29	5293.50
2.	Manures (Ton)	10	25000.0	10	25000.0
3.	Fertilizers				
	a) Nitrogen (kg)	310	2690.80	312	2708.16
	b) Phosphorus (kg)	316	3867.84	320	3916.80
	c) Potassium (kg)	200	5000.0	197	4925.0
4.	Plant protection chemicals				
	a) In kg.	28.24	1069.0	24.20	916.0
	b) In liter		2420.0		2415.0
5.	Paclobutrazol / Cultar (liter)	2.54	15244.0	2.60	15600.0
6.	Crop insurance	-	5592.0	-	-
	Total input cost	-	77164.14	-	72910.46
7.	Land revenue and other cessess		270.0		270.0
8.	Depreciation and repairing charges		2175.60		2092.97
9.	Interest on working capital (@12%)		9259.69		8749.25
	Cost – A		88869.43		84022.68
10.	Interest on fixed capital (@10%)		1904.30		1710.0
11.	Rental value of land (1/6th of the gross return - land revenue)		23646.66		23296.66
12.	Amortization value.		10883.12		10089.79
	Cost – B		125303.51		119119.13
13.	Family labour				
	a) Male	15.95	3190.0	14.30	2860.0
	b) Female	10.19	1528.50	3.90	585.0
14.	Supervision charges (@ 10% on cost A)		8598.86		8402.26
	Cost – C		138620.87		130966.39
15.	Total returns				
	a) Gross return (q)	20.50	143500	20.2	141400
	b) Sum beneficiary	-	21850		-
	Total		165350		141400
16.	Per quintal cost		6761.99		6483.48

labour (₹ 20874.50), plant protection measures (₹ 3331), manures and fertilizers (₹ 36549.96). Similar results were observed by Chavan (2006) in economic analysis of investment in mango orchard in Sindhudurg district.

Production of mango: The information about per farm and per hectare production for beneficiary and non-beneficiary is given in table 3.

It is observed from the table 3, that in case of beneficiary and non-beneficiary farms per farm area of mango orchard was 1.82 ha and 1.74 ha respectively. On beneficiary farm numbers of trees per farm were 173. The per farm production of mango fruits was observed to the tune of 37.31 q. On non-beneficiary farms numbers of trees were 165. The per farm production of mango fruits was estimated to 35.14 q. The, productivity

of mango orchard was found to be 20.5 and 20.2 quintal on beneficiary and non-beneficiary farms respectively. The mango productivity observed to be very low and there was no much difference in the productivity per hectare, due to heavy effect of weather parameters. The productivity of mango orchard very low was also reported by Chavan (2006).

Table 3 : Productivity of mango orchards in per farm, per unit area (ha) and per tree.

Sr. No.	Item of cost	Beneficiary (N=100)	Non-beneficiary (N=100)
1.	Per farm		
	a) Area of orchard (ha)	1.82	1.74
	b) Number of trees	173	165
	c) Production (q)	37.31	35.14
2.	Per hectare		
	a) Number of trees	95	94
	b) Production (q)	20.5	20.2
3.	Yield per tree (q)	0.21	0.21

Profitability : In beneficiary and non- beneficiary farms per hectare yields of mango orchards were 20.50 quintals and 20.2 quintals valued at ₹144000 and ₹141400 (Table 4) Additional ₹21850 were received as insurance claims on beneficiary farms. Therefore gross returns were ₹165350 for beneficiary farms. The profit at Cost-A was accounted to ₹75480.57 and ₹57377.32, Cost-B was accounted to ₹40046.49 and ₹22280.87, and Cost-C was accounted to ₹26729.13 and ₹10433.61, respectively. The benefit cost ratio of mango production was 1.03 and 1.07 in beneficiary and non-beneficiary farms.

The beneficiaries incurred cost of insurance premium to the tune of ₹5592 and realized insurance benefit of ₹21850 over and above production realized. As a result the benefit cost ratio was enhanced from 1.03 to 1.9. These finding were also observed by Mallikarjun (2005) for onion.

Thus even though, the mango production in this region is subject to adversities of climatic change the mango farmers were able to compensate the losses from insurance claims to some extent.

Table 4 : Profitability of mango orchards per unit area (ha)

Sr. No.	Item of cost	Beneficiary	Non beneficiary
1.	Yield (q)	20.5	20.2
2.	Gross returns (₹)	165350	141400
3.	Cost (₹)		
	1. Cost A (Farm business income)	88869.43	84022.68
	2. Cost B (Family labour income)	125303.51	119119.13
	3. Cost C (Net income)	138620.87	130966.39
4.	Profit at (₹)		
	1. Cost A	75480.57	57377.32
	2. Cost B	40046.49	22280.87
	3. Cost C	26729.13	10433.61
5.	Per quintal cost of cultivation (₹)		
	1. Cost A	4335.09	4159.53
	2. Cost B	6112.36	5896.98
	3. Cost C	6761.99	6483.48
6.	Benefit cost ratio		
	a) Production level	1:1.03	1: 1.07
	b) Insurance level	1:1.19	--

Estimates of insurance probability: The estimate of insurance probability is presented in table 5. The logistic regression analysis was carried out with independent variables such as age of farmers, education level, farm size, household size, membership of association, accessibility of credit, contact with extension agent, income from agriculture and income from other source.

Among the variables included in the model membership of association and contact with extension workers turned out to be significant. Odds ratios for membership of association indicated that with one unit increase in membership of association probability of participation in crop insurance scheme increases by 35 per cent. Similarly, with one unit increase in contact with extension workers the probability of crop insurance increases by 33 per cent. The probability estimates were similar to those observed by Karami *et al*. (2008), George *et al*. 2013, Abdulmalik *et al*. (2013) and Pambo and Olila (2014).

Table 5 : Logit regression estimates of insurance probability.

Sr. No.	Variable	Max. Likelihood Estimates	Odds ratio Estimates	Pr> Chi Sq
1	Intercept	0.7224	-	0.0250
2	Membership of Association	1.0491	0.350	0.0009
3	Contact with Extension farmer	1.1173	0.327	0.0009

Significant level at 1%, Chi Sq = 0.3242

Insurance trigger for crop failure : The frequencies of insurance trigger within the study area were studied and are presented in table 6. The farmers were asked about major risks which affected their crop production. In the study area natural calamities like cyclone, high temperature and variation in rainfall are the major reason for crop losses. The beneficiary farmer reported that major crop failure is due to temperature (44%), Variation of rainfall (31%), Humidity (9%) and cyclone (16%). The Non-beneficiary farmers opined that major crop failure is because of temperature (46%), Variation of rainfall (31%), humidity (8%) and cyclone (15%). Bharati et al (2014) observed similar result in their study in Bihar.

Table 6 : Frequency distribution of crop failure for the beneficiary and non-beneficiary farmer.

Sr. No.	Crop failure reason	Beneficiary (N=100)		Non-Beneficiary (N=100)
		Amount (₹)	Frequency	Frequency
1	Rainfall (Unpredicted rain)	30000	31	31
2	Temperature	20000	44	46
3	Humidity	15000	09	08
4	Precipitation	-	-	-
5	Pest and Disease	-	-	-
6	Cyclone	15000	16	15
7	Other	-	-	-
	Average	21850		

Constraints faced by mango farmers with respect to crop insurance scheme: The information regarding the constraints faced by beneficiary and non-beneficiary farmers in study area are presented table 7.

In case of beneficiary farmer, major problems faced were procedural difficulties and complex procedure and compensation received was not satisfactory. In case of non-beneficiary farmers, major problems faced were non awareness of crop insurance procedure and inadequate facilities, publicity and less time given for opting for insurance

Table 7 : Farmers' constraints in mango insurance

Sr. No.	Particulars	Beneficiary (N=100)	Non-Beneficiary (N=100)
1	Inadequate publicity and less time given for opting for insurance	15	82
2	Non awareness of crop insurance procedures and facilities available	10	60
3	Procedural difficulties and complex Procedure	40	67
4	Difficult to produce no-dues certificate from other banks	20	47
5	Wastage of time due to single staff allotted for insurance	33	35
6	Assessment of loss by officials was not satisfied	30	69
7	Compensation amount is inadequate	36	76

Conclusions

1. The per hectare maintenance cost (Cost-C) of mango orchard on beneficiary farm was worked out as ₹ 153669.33 and non-beneficiary farm it was worked out to ₹ 140519.73.
2. Yield of mango on beneficiary and non-beneficiary farms were 20.5qha^{-1} and 20.2qha^{-1}, respectively.

3. The per hectare return realized were ₹144000 and ₹141000 on beneficiary and non-beneficiary farm, respectively. The benefit: cost ratio in mango production was1.03 and 1.07, respectively.

4. The benefit: cost ratio including insurance claims for beneficiary farms increased from 1.03 to 1.09.

5. The result of the logit regression analysis showed that the membership of association and contacts with extension agents were found to be significant in influencing the farmers' participation in crop insurance scheme.

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