



Measurement of Risk in Yield: An Expected Deviation Approach

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Abstract: The study was conducted to measure the risk in yield of Cotton, Tur (Pegion pea) and Sorghum crops of Akola District of Vidarbha region of Maharashtra state (India) over a period of 39 (1970-71 to 2009-2010) Years, Compound growth rates of Cotton, Tur and Sorghum yields were highly significant. Variability in yield is more in case of Cotton indicates the risk in production. Expected negative deviation in yield is more in case of Sorghum as compare to Cotton and Tur crops respectively. Risk in Tur production is found between Cotton and Sorghum.

Keywords: Risk, Probability, short fall, Expected negative deviation, CV, Yield

I. Introduction

The yield uncertainty arising due to vagaries of nature vitiates farmer's production programme and causes instability in production and income of the farmers.

The measurement of risk involved in Crop production is of paramount importance to suggest remedial measure of technical and social nature. Keeping in view the above aspects it is proposed to measure risk involved in the Yield of Cotton, Tur and Sorghum crops in Akola districts which is the major growing area of the Vidarbha region of Maharashtra of India.

An attempt was made to measure risk in yield of rice crop in Kokan region of Maharashtra. Three parameters of risk viz. Coefficient of variation, probability of crop failure and crop loss ratio were estimated [3].

Yield and price risk in crop production for social security were studied first time on selected crops for Vidarbha region. The risk associated with production and gross returns have been measured with help of the concept of coefficients of variations after diminution of underlying trends in data and probability of shortfall in yield and gross returns through appropriate underlying probability distributions [2].

II. Material and Methods

The scope of the present study is limited to the measurement of risk in the yield. The study is based on secondary time series data collected from various official publications of Govt. of Maharashtra. The time series data of yield is collected for the period of 39 years from 1970-71 to 2009-10 on important rain fade crops of Akola districts viz Cotton, Tur and Sorghum were used.

III. Measurement of risk

The yield trends were taken for the measurement of risk. Year to year changes in yield represent the variability or risk. The magnitude of risk in yield per hectare for selected crops of Akola districts was measured by coefficient of variation.

IV. Coefficient of Variation

$$C. V. = \frac{(\sum [(X_t - \hat{X}_t)^2] / n)^{1/2}}{\bar{X}} \times 100$$

Where,

X_t = Actual value in t^{th} year

$\hat{X}_t$ = Trend value in t^{th} year

$\bar{X}$ = Mean of X

n = Total number of years in the study period.

Year to year fluctuations of a character from its trend represents its variability or risk. Coefficient of Variation is a commonly used tool to quantify the risk. Different types of trend curves were attempted and the one giving highest R was finally chosen for obtaining data adjusted for trend and for computation of risk [4].

Besides coefficient of variation, the risk in terms of probability of obtaining yields below the 95 per cent of the trend have been computed with the help of one of the following probability distributions for Cotton, Tur and Sorghum crops respectively. The average probability was obtained by adopting the appropriate fitted distribution with goodness of fit criteria.

Any deviation (positive or negative) from the trend constitutes the risk. It is the negative deviation which is a deep concern to the farmers. Therefore any policy option for the protection of the interest of the farming community should take negative deviations into consideration. The expected negative deviation worked out on the basis of probability of short fall (by 95 percent of the trend value) and average absolute deviations (from trend) are used to derive "Risk in yield".

{Expected annual negative deviation} = {Average absolute deviation in yield} x {Probability of short fall in yield} (for yield risk)

Where average absolute deviation in yield = $\sum_{i=1}^n (X_i - \bar{X})/n$

Expected negative deviation indicates an estimated annual loss due to yield risk.

Result and discussion

Table 1 gives the fitted model for the crops under study along with the value of parameters and value of R.

Table 1: Crops, fitted model, parameters of fitted model, and R value

Crops	Cotton	Tur	Sorghum
Curve fitted	Linear	Harris model	Quadratic
Model	$Y = a + bX$	$Y = (1/a + b + X^2/c)$	$Y = a + b + cX^2$
Parameters	a = 41.40, b = 3.51.	a = 0.0184, b = -0.0165, c = 0.0130.	a = 130.021, b = 84.2623, c = -0.8554.
R value	0.70	0.66	0.86

From the table 1 it is observed that the Linear, Harris and Quadratic models were found suitable for Cotton, Tur and Sorghum crops respectively. The value of parameters for the fitted model is used for estimating the trend values.

Table 2: Crops, fitted probability density function, parameters and value of parameters and probability density function.

Crops	Cotton	Tur	Sorghum
Probability Distribution fitted	Uniform	Jonson SB	Uniform
Probability Density function	$= (1/b - a), a < x < b$	$= \delta/\lambda \sqrt{2\pi} z (1-z) \exp((-1/2)(\gamma + \delta \ln(z/(1-z)^2))$	$= (1/b - a), a < x < b$
Parameters	a = 44.329, b = 169.76	$\gamma = 0.9569$ $\delta = 0.8691$ $\lambda = 416.15$ $\xi = 394.84$	a = 458.13, b = 1790.9

From table 2 it is observed that for Cotton Tur and Sorghum the fitted probability density function were Uniform, Jonson and Uniform respectively the value of parameters is used for verifying goodness of fit criteria.

Table 3: Crops, Average yield (kg./ha.), Compound growth rates (%), Coefficient of variations (%), Probability of short fall and Expected negative deviation.

Crops	Cotton	Tur	Sorghum
Average Kg/ha.	112	738	1184
CGR %	2.93**	1.10**	3.81**
Coefficient of Variation (C. V.%)	38	23	25
Probability of short fall	0.50	0.49	0.50
Annual expected deviation	309.92	133.59	410.50
Expected negative deviation	154.96	65.45	205.24

** Significant at 1% level

The maximum and significant Compound growth rate were observed in case of Sorghum (3.81%) followed by Cotton(112%) and Tur (1.105%) respectively. The maximum coefficient of variations (38%) were observed in case of Cotton followed by Sorghum(25%) and Tur (23)indicates the risk in production of the crops. However, the maximum Expected negative deviation is found in case of Sorghum followed by Cotton and Tur respectively. Similar results were also obtained by [1], [5]- [6].

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