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An economic analysis of crop diversification in Jabalpur district of Madhya Pradesh

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Abstract

Crop diversification is a necessity for agriculture-based economy like Madhya Pradesh since growing of staple food such as cereals alone cannot support the process of economic development and growth. Therefore, the study was done to measure the extent of changes in land utilization pattern, study the shift in cropping pattern, and extent of crop diversification in Jabalpur district of Madhya Pradesh using measures viz. absolute change, relative change, compound growth rate, Herfindahl index and Simpson index of diversification. The land use is under the head of cropping system found to decreased since base year was net cultivated area decreased by (-0.24%), followed by area sown more than once (-2.02%), total cropped area (-1.81%), current fallow (-7.48%), and total Rabi crop crops (-7.76%). The study revealed that among the total crops under study, the relative change in area found to positive for soybean (1176%). On the other hand, the area under Kharif crops shown increase of (44.48%). It is due to the lower value crops were shifted towards higher value crops or higher demanding crops respectively. The highest diversification was found in 2013, where value of Herfindahl index was observed (0.22) and Simpson index of diversification was to be found (0.78).

Keywords: Annual compound growth rate, crop diversification, production, productivity, Simpson index of diversification

1. Introduction

India is a country of about one billion people. More than 70 percent of India's population lives in rural areas where the main occupation is agriculture. Indian agriculture is characterized by small farm holdings. The average farm size is only 1.57 hectares. Around 93 percent of farmers have land holdings smaller than 4 ha and they cultivate nearly 55 percent of the arable land. On the other hand, only 1.6 percent of the farmers have operational land holdings above 10 ha and they utilize 17.4 percent of the total cultivated land. Economy of Madhya Pradesh is basically depending upon agriculture and allied activities, so it is important for farmers to adopt crop diversification to improve his economic status as well as fulfilment of their other requirements. Recently development of market infrastructure and certain price related supports by government also induce crop shift. Now farmers are shifting from cereals crops to cash crops for higher profitability and stability in their production. Crop diversification is an important tool to reduce risks due to climatic and biological variations in different regions of state. It is not only essential from the farmer's perspective but also for trade balance perspective. India imports huge quantity of edible oil from Indonesia and Malaysia, so increase in oil seeds farming in India may help curb the edible oil imports. Madhya Pradesh have huge potential to fulfil the requirements of oilseeds and pulses.

Thus, the study was conducted to analyse the extent of crop

diversification in Jabalpur district of Madhya Pradesh.

2. Methodology

The study was conducted in Jabalpur district of Madhya Pradesh. Looking to the significance of crop diversification in the district, nine prominent crops will be selected for study i.e., paddy, soybean, wheat, gram, pea, maize, pigeon pea, sesame, and mustard. The time series data from 2001-2015 used for analysis of absolute change, relative change, variability, trend analysis, growth rate, Simpson Index of Diversification and policy related to crop diversification. For estimation of given objectives, the science of statistics provides various tools to look into the variables at depth. The tools will be used in this study have been spelled out as follows:

1. Absolute Change = Current year – Base year
2. Relative Change = $\frac{\text{Current year} - \text{Base year}}{\text{Base year}} * 100$
3. Coefficient of Variation (%): $CV = \frac{SD}{\text{Mean value}} * 100$

$$SD(\sigma) = \sqrt{\frac{\sum Y^2 - \frac{(\sum Y)^2}{N}}{N}}$$

Where,

Y = Area, production and productivity

N = Number of observation (years)

4. Linear trend: $Y = a + bx$

Where,

Y = change in Production

a = intercept

b = Regression coefficient

x = independent variable

5. Simple Growth Rate: $SGR = \frac{b}{\bar{Y}} * 100$

6. Herfindahl Index: $HI = \sum_{i=1}^n (P_i)^2$

7. Simpson Index of Diversification: $SID = 1 - \sum_i P_i^2$

Where,

P_i = Proportionate area of i^{th} crop in the gross cropped area

Herfindahl index (H.I.) defined as the sum of squares of all n proportions is a measure of crop concentration. This measure is used to measure crop diversification on acreage proportion. The value of H.I. varies from zero to one. It takes the value of one when there is complete specialization and approaches zero when the number enterprises are more showing perfect diversification. But for direct interpretation

of results. Crop diversification index was worked out:

*Crop Diversification Index: C.D.I. = $1 - H.I.$

Where, H.I. = Herfindahl index

The C.D.I. has direct relationship with diversification. The zero value of C.D.I. indicates specialization and moving towards one showing increase in number of enterprises. It is also measured on acreage proportion.

3. Results and Discussion

It was revealed from comparative data of acreage under different major use as cropping system in Jabalpur district of Madhya Pradesh, that after lapse of 15 years the land use pattern under different cropping system shows some definite change. The land use is under the head of cropping system found to decreased since base year was net cultivated area decreased by (-0.24%), followed by area sown more than once (-2.02%), total cropped area (-1.81%), current fallow (-7.48%), and total Rabi crop crops (-7.76%). On the other hand, the area under Kharif crops shown increase of (44.48%), forest area (0.09%), Land put to non-agricultural uses (14.72%), Barren and uncultivable land (0.49%).

Table 1: Changes in Land utilization pattern of Jabalpur district

Particulars	Base year (TE 2003-04)	Current year (TE 2015-16)	Absolute change	Relative change (%)
Net sown Area	274.47	273.8	-0.67	-0.24
Area sown more than once	100.05	98	-2.05	-2.05
Total cropped area	374	367.2	-6.8	-1.81
Forest	77.63	77.7	0.07	0.09
Land put to non-agriculture uses	31.99	36.7	4.71	14.72
Barren and uncultivable land	36.82	37	0.18	0.49
Current fallow	17.51	16.2	-1.31	-7.48
Total Kharif crops	123.13	177.9	54.77	44.48
Total Rabi crops	274.46	253.14	-21.32	-7.76
Total Area	519.75	519.75	0	0

Area in "000" ha

Source: landrecords.mp.gov.in

Indices of crop diversification are presented in Table 2 under this proportion of area allocation and diversification index for the 2001-2015 production period are calculated. The year wise variation in values of Herfindahl index (HI), and Simpson index of diversification (SID) shows a similar

pattern for all the chosen crops. The highest diversification was found in 2013, where value of Herfindahl index was observed (0.22) and Simpson index of diversification was to be found (0.78).

Table 2: Extent of crop diversification in Jabalpur district

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
H. I.	0.23	0.24	0.24	0.24	0.24	0.25	0.24	0.25	0.25	0.23	0.23	0.25	0.22	0.24	0.24

Calculated by author based on source: mpkrishi.gov.in

The area of paddy was found to be increased by 33.23 percent from 64.53 thousand hectares (base year) to 85.97 thousand hectares (current year) with the fluctuation of 13.99 percent and annual growth of 2.61 (SGR) and 2.53 (CGR) per cent per year in Jabalpur during 2001 to 2015. The area of soybean was found to be increased 1176.01 percent from 2.68 thousand hectares (base year) to 34.13 thousand hectares (current year) with the fluctuation of 140.68 percent and annual growth of 21.27 (SGR) and 31.01 (CGR) per cent per year in Jabalpur during 2001 to 2015. The area of wheat was found to be increased 51.40 percent

from 86.00 thousand hectares (base year) to 130.20 thousand hectares (current year) with the fluctuation of 18.18 percent and annual growth of 3.61 (SGR) and 3.50 (CGR) per cent per year in Jabalpur during 2001 to 2015. The area of sesame was found to be increased 40.71 percent from 1.28 thousand hectares (base year) to 1.79 thousand hectares (current year) with the fluctuation of 33.19 percent and annual growth of 2.48 (SGR) and 1.62 (CGR) per cent per year in Jabalpur during 2001 to 2015. The area of Gram was found to be decreased -11.53 percent from 66.69 thousand hectares (base year) to 59.00 thousand hectares

(current year) with the fluctuation of 8.98 percent and annual growth of -0.96 (SGR) and -1.03 (CGR) per cent per year in Jabalpur during 2001 to 2015. The area of pea was found to be increased 13.65 percent from 29.30 thousand hectares (base year) to 33.30 thousand hectares (current year) with the fluctuation of 28.57 percent and annual growth of -0.41 (SGR) and -0.90 (CGR) per cent per year in Jabalpur during 2001 to 2015. The area of maize was found to be increased 51.63 percent from 4.46 thousand hectares (base year) to 6.77 thousand hectares (current year) with the fluctuation of 29.95 percent and annual growth of 3.19 (SGR) and 2.48 (CGR) per cent per year in Jabalpur during 2001 to 2015. The area of mustard was found to be decreased -3.79 percent from 3.81 thousand hectares (base year) to 3.67 thousand hectares (current year) with the fluctuation of 16.01 percent and annual growth of 0.17 (SGR) and 0.26 (CGR) per cent per year in Jabalpur during 2001 to 2015. The area of pigeon pea was found to be

increased 79.41 percent from 6.68 thousand hectares (base year) to 11.98 thousand hectares (current year) with the fluctuation of 42.56 percent and annual growth of 6.74 (SGR) and 7.60 (CGR) per cent per year in Jabalpur during 2001 to 2015. The study revealed that among the total crops under study, the relative change in area found to positive for soybean (1176%), followed by pigeon pea (79.41%), maize (51.63%), wheat (51.40%), sesame (40.71%) paddy (33.23%), pea (13.65%). The relative change in production found to be positive for soybean (995.83%) followed by paddy (186.42%), wheat (170.69%), pea (115.58%), maize (94.34%), sesame (86.95%), pigeon pea (81.64%) and mustard (26.82%). The data depicted that the total area under Kharif crops increased during the 15 years of period and among different Kharif crops area shifted to other Kharif crops. It is due to the lower value crops were shifted towards higher value crops or higher demanding crops respectively.

Table 3: Trend and growth rate in area, production and productivity of major crops in Jabalpur district

Crops		Base year	Current year	Absolute change	Relative change (%)	CGR
Paddy	Area	64.53	85.97	21.44	33.23	2.53***
	Production	58.1	166.41	108.31	186.42	8.59***
	Productivity	946.13	1948.67	1002.54	105.96	5.43**
Soybean	Area	2.68	34.13	31.46	1176.01	31.01***
	Production	2.5	27.4	24.9	995.83	29.34**
	Productivity	1011.75	689.48	-327.27	-32.35	-2.68
Wheat	Area	86	130.2	44.2	51.4	3.5***
	Production	149.08	403.53	254.46	170.69	9.35***
	Productivity	1899.75	3101.91	1202.16	63.28	4.46***
Sesame	Area	1.28	1.79	0.52	40.71	1.62
	Production	0.38	0.7	0.33	86.95	5.95**
	Productivity	296	467.36	171.36	57.89	3.79
Gram	Area	66.69	59	-7.69	-11.63	-1.03
	Production	65.18	54.75	-10.42	-15.99	-0.82
	Productivity	981.75	889.12	-92.63	-9.44	0.2
Pea	Area	29.3	33.3	4	13.65	-0.9
	Production	14.81	31.93	17.12	115.58	1.62
	Productivity	500.63	964.33	463.71	92.63	2.55
Maize	Area	4.46	6.77	2.3	51.63	2.48
	Production	8.04	15.62	7.58	94.34	0.96
	Productivity	1800.88	2157.3	356.43	19.79	-1.26
Mustard	Area	3.18	3.67	-0.14	-3.79	0.26
	Production	3.2	4.06	0.86	26.82	2.97
	Productivity	843.25	983.33	140.08	16.61	2.01
Pigeon pea	Area	6.68	11.98	5.3	79.41	7.6***
	Production	8.55	15.53	6.98	81.64	4.43
	Productivity	1285.88	870.56	-415.32	-32.3	-3.23**

*Significant at 10%, **Significant at 5%, ***Significant at 1%

4. Conclusions and Policy Implications

The study was conducted in Jabalpur district of Madhya Pradesh. Looking to the significance of crop diversification in the district. The time series data from 2001-2015 used for analysis of absolute change, relative change, variability, trend analysis, growth rate, Simpson Index of Diversification and policy related to crop diversification. Based on our study findings, we conclude that crop diversification is one viable option in smallholder farming that can ensure establishment of resilient agricultural systems that can contribute significantly to household food security. In terms of policy, the results imply that the current efforts by government of Madhya Pradesh to intensify

promotion of crop diversification should remain a priority policy direction due to the continued malnutrition and food insecurity threat. This is particularly so in this era of climate variability that poses an extra burden to farmers.

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