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IMPACT ANALYSIS OF TECHNOLOGY ADOPTION BY TRIBAL FARMERS OF MADHYA PRADESH

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Abstract: *The agricultural technologies developed in the country have generated more income and employment to the cultivators. However, tribal dominated regions of Madhya have not yet been able to derive benefit of technological innovation fully or even partly. A study was conducted to analyse technology adoption and its impact on farm income and income distribution in Tribal farming community in Santna districts of M.P. Total 120 tribal farmers from 10 villages of two blocks such as majhgawan and shohawal of Stana district were selected using stratified random sampling. The examination of technology adoption vis-à-vis resource endowment of the farmers revealed preponderance of low level of technology adoption. Further level of adoption increased with size of holding, use of family workers and maintenance of bullock pairs/machinery. Wheat and Soyabean were the predominant crops of the area under study with the highest percentage of area under HYVs compared to other crops. It was found that technology adoption have positive impact on income from the crops grown on sample farms. The disparity of income distribution was found to be the least among the farmers at low levels of adoption, marginally higher at medium level of adoption and the highest incase of high adoption. In order to increase adoption of modern inputs and siphon-out the farm products an efficient marketing infrastructure along with effective knowledge delivery system needs to be established. The paper recommends policy options for governments and aid agencies to increase the likelihood that a targeted community will adopt an introduced agricultural technology.*

Keywords*: technology adoption, impact, adoption index, Gini coefficient, income distribution, tribal, Satana.*

Introduction: Adoption of modern technology in production of cereals crops has long been attracting attention of researchers and policy makers due to food security concerns (Shende, 2016). Rogers and Shoemaker (1971) termed adoption process as 'Innovation Decision Process' consisting of four stages viz knowledge, persuasion, decision and confirmationRogers (1983).Though the technological breakthrough in Indian agriculture is no longer a new phenomenon, yet it has got a significant relevance particularly for the regions which are still lying in the embryonic stage of agricultural development. Tribal dominated regions falling under such conditions of agricultural backwardness have not yet been able to benefit from the fruits of technological innovation fully or even partly. Consequently, large number of researchers and economic analysis are concerned about knowing the potentialities created by new technology in the under developed regions and their implications for agricultural development policies and programmes in meeting the socioeconomic goals of these regions. The studies by Rawal (1981), Henery (1983) and Yadava and Gangwar (1987) revealed that economic prosperity, social mobilisation and favourable psychological orientation are instrumented in the adoption of new technology. Frankel (1971) has brought out that the large farmers have benefited more than the small ones from the technology. The Sen 1995advocated that while recommending any new technology the care should be taken that it should be income generating and remunerative because it has been observed that besides meeting subsistence requirements of food, fuel wood, timber, fodder, better economic use of fallow land etc; economic incentive has been one of the strong motivating factors for the farmers. Considerable efforts are required for providing extension support to convince the farmers to adoptfarm technology (Chand et al, 2011). The adoption of new agricultural technology is supposed to promote economic welfare of the farmers by increasing their income and employment opportunities resulting in greater saving and investment on the farm, which in turn brings more

prosperity. Besides, this it may also have direct positive impact on non-agricultural sector as well. Realizing the importance of adoption of new agricultural technology on tribal economy, a study on impact analysis of technology adoption by tribal farmers of Madhya Pradesh has been conducted.

Methodology

Sampling design: Using the three stages stratified random sampling technique blocks, villages and farm holdings as the first, second and third stages respectively, 120 tribal farmers, proportionate to their number in respective size groups were selected from Majhgawan and Sohawal blocks of Satna district of Madhya Pradesh. The holdings were classified into marginal (less than 1 ha), small (1 to 2 ha) and large (above 2 ha) categories for the purpose of detailed investigation. The distributions of selected sample holdings in marginal, small and large categories were 52, 38 and 30 respectively. Primary data on various aspects of crop production and management were collected by conventional survey method using specially structured and pre-tested schedule. The data pertained to agricultural year 2000-2001.

Analytical tools:

Level of technology adoption: In order to work out the level of adoption of new technology and adoption index of individual farmer, following mathematical tool was employed.

$$TAI_i = \sum_{j=1,i=1}^{m.n} \left(Waj \frac{AHji}{CAji} + Wbj \frac{FAji}{FRj} + Wcj \frac{IAji}{IRj} + Wdj \frac{PAji}{PRj} \right) \times \frac{}{\sum CAji} 100$$

Where, i = 1,2,3, n, and n = total number of farmers

j = 1,2,3,.....m and n = total number of crops (Paddy, Wheat, Gram, Arhar and Soyabean)

TAI_i = Technology adoption index of ith farmer AH_{ji} Area under HYVs/improved of j^{th} crop of i^{th} farmer

CA_{ji}= Cropped area (HYVs/improved + local varieties) of j^{th} crop of i^{th} farmer.

FA =Amount of chemical fertilizers (N+P+K) applied per unit ofarea in the cultivation of HYVs/improved for j^{th} crop by i^{th} farmer

FRj= Amount of chemical fertilizers (N+P+K) recommended for application per unit of area in the cultivation of HYVs/improved for j^{th} crop

IAji=Number of irrigation applied to j^{th} crop by i^{th} farmer. This variable was assigned zero value for the rainfed crops.

IRj = Number of irrigation recommended for j^{th} crop

PAji=Amount spent in rupees on using plant protection measures j^{th} crop by i^{th} farmer

PRj=Amount of money spent on recommended plant for protection chemicals in j^{th} crop

$\sum CAji$= Gross cropped area under all HYVs/improved crops of i^{th} farmer

Waj+Wbj+Wcj+Wdj=1

Waj = Share of cost of HYVs/improved seed of the j^{th} crop of i^{th}farmer's cost of cultivation.

Wbj = Share of cost of chemical fertilizers of the jth HYVs/improved crop of i^{th} farmers cost of cultivation.

Wcj = Share of cost of irrigation of the j^{th} HYVs/improved crop of i^{th} fanner's cost of cultivation.

Wdj = Share of cost of plant protection chemical of the j^{th} HYVs/improved crop of i^{th} farmer's cost of cultivation.

The adoption index (TAIi) varies from 0 to 100 percent depending upon the degree of adoption of new technology by farmers. On the basis of adoption index, all the 120 sample farmers were classified into three categories viz; low adopter (0 to 20 percent TAIi), medium adopter (21 to 40 per cent TAIi) and high adopter (above 40 percent TAIi).

Impact of modern technology on farm economics: impact of technology adoption assessed in terms of increase income from major crops with level of its adoption.

Operational cost=Cost of hired labour + cost of bullock/machinery labour

Input cost=sum of costs of physical inputs

Total cost (T.C.) = Operational cost+ Input cost

Estimation of income: The following income was estimated.

Gross income: farm receipt or output includes the following:

a. Cash received on account of the sale of farm produce.

b. Value of the produce, main or byproduct used for home consumption and for

Net income=Gross income –total cost

Input output ratio=Gross return/Total cost

c. Adoption of technology and income distribution: The adoption of new agricultural technology also leads to change in the income distribution pattern of the farmers. However, this change in income may or may not be evenly distributedamong farming community. Therefore, an inequality analysis was done using analytical tools Gini concentration ratio. The Gini coefficient is a measure of inequality of income distribution. The quantitative measure of Gini ratio is given as follows:

$$L = 1 - \sum P_i (I_i + I_{i-1})$$

Where,

P_i = cumulative proportion of population at ith class

I_i= cumulative proportion of total income at ith class

i= 1,2, _____n n

n = Number of classes in the distribution

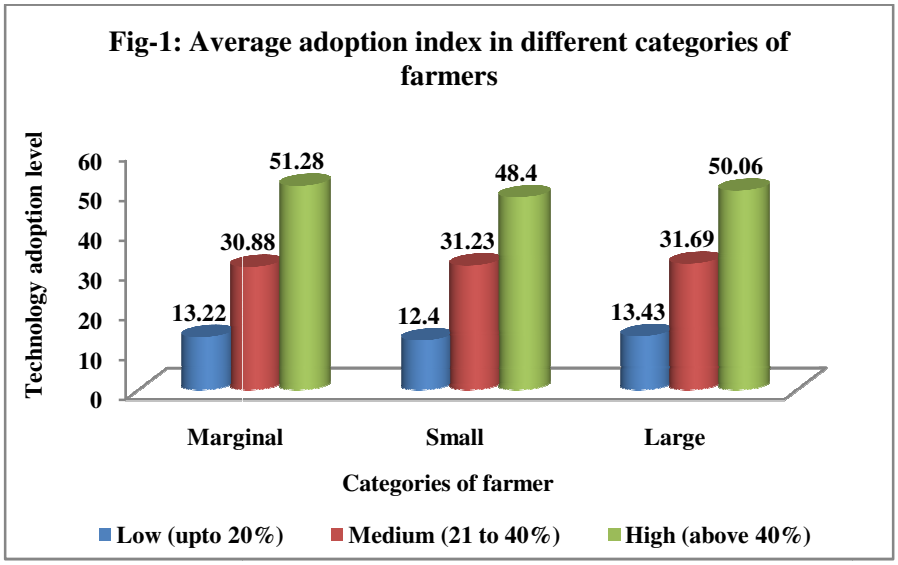
L = Gini coefficient

Results and discussion: In the Satna district of Madhya Pradesh, scheduled tribes population account for about 13.81 per cent. In blocks of Majhgawan and Sohawal total scheduled tribes population was noted 17.02 and 6.94 per cent respectively. Total geographical area of the district is 742432 hectare, out of which 17.68 per cent of area in the district was not available for cultivation. Net area sown in Satna district was 48.79 per cent of the total geographical area. Area sown more than once accounted for about 16.96 percent and total cropped area. Sohawal block about 50 per cent farmers comes under marginal group (less than l ha.), whereas they occupied only about 11.5 per cent of total land. Similar trend was also observed in Majhagawan block. In contrast to this the large farmers (more than 2 ha), covered only 1.5 to 2 percent of total number of farmers occupying more than 13 per cent of total land. The wheat occupied the highest area being 38.28 per cent followed by paddy 18.87 per cent and gram 13.49 per cent in Satna district. Millets and other pulses are nominally grown in the district. Sugarcane as cash crop and vegetables and fruits are also grown on nominal area. Substantial area under Soyabean and other oilseeds are given in the district. Tobacco and fibre crops are also grown the district but on a nominal area. The picture is similar in the two selected blocks also.

Technology adoption rate: Average adoption index for each category (holding size) farmers as well for different categories of farmers based on adoption level was worked out and presented in Table 1. Overall adoption index in marginal category of farmers was 26.16 where as it were 38.44 incase of large farmers indicating higher rate of technology adoption by large farmers (Fig-1). The reason may be poor resource base and lack of technical know-how in smaller farmers. Adoption index across the adopter group were 49.82, 31.16 and 13.06 in case of high, medium and low adopter, respectively, of the agricultural technology. Over all adoption rate is only 31.01 showing poor level of technology adoption in study area.

Table 1: Average adoption index in different categories of farmers

Category	Marginal	Small	Large	Overall
Low (upto 20%)	13.22	12.40	13.43	13.06
Medium (21 to 40%)	30.88	31.23	31.69	31.16
High (above 40%)	51.28	48.40	50.06	49.82
Total	26.16	31.78	38.44	31.01



Impact of technology adoption: It is now a well-established fact that new agricultural technologies and particularly high yielding variety (HYV) technology has become the mainspring to growth of farm yield and income. With the adoption of land-augmenting technology land becomes to be a critical or limiting factor to the same extent as before. Where land is already irrigated, the requirements of fixed capital such as bullocks or machinery per hectare may increase only marginally, where as the requirement of human labour may increase, especially for interculturing and harvesting, which will be less than proportionate to the increase in the output per hectare. The greatest (proportionate) cost-saving should, therefore, be on land followed by fixed capital and labour. However, in the event of farm mechanization, saving on the labour costs could be greater than on land and fixed capital. In the light of aforementioned facts, impact of technology adoption on farm income of tribal farming community of study are were examined. Estimated cost of cultivation for low, medium and high adopter for crops (paddy, wheat, gram, Arhar and Soyabean) are presented in Tables 2. When the costs of cultivations were compared across the levels of technology adoption for different crops, it was found that the percentage of total operation cost decreased with the increased in the level of technology adoption. The operational cost varies from 63.40 % to 89.49% in low level of adoption category of framers and 50.02% to 72.86% in high level of adoption. This is because of the fact that the proportion of total input cost increased due to the rise in use of quality seeds, fertilizers, irrigation and plant protection measures. All the components of total input cost increased with the ascending level of adoption thereby raising the share of total input cost owing to increased used of modern inputs operation in crop production.The gross income was highest (Rs. 13481.25/ha) in high technology adopter in paddy crop and it was lowest (Rs. 3913.25/ha) in case of low adopter in gram. Overall output-input ratio was found to be highest (1.86) in favour of high adopter and lowest in case of low adopter (1.52). Hence it is is clearly reflected that the technology adoption have positive impact on farm income of the farmers.

Table2: Cost and return structure of different crops in different categories of technology adopters

Crops/Category of technology adopter	Cost and Returns (Rs./ha)					
	Total operational cost (A)	Total input cost (B)	Total cost (A+B)	Gross income	Net return	Output input ratio
Paddy Low adopter	3502.5(77.67)	1006.94(22.33)	4509.44	7526	3016.56	1.67
Medium adopter	4363.75(73.43)	1578.69(26.57)	5942.44	10025	4082.56	1.69
High adopter	5386.25(68.55)	22471.38(31.45)	7857.63	13481.25	5623.62	1.72
Wheat low adopter	2980(64.85)	1615.5(35.15)	4595.5	7800	3204.5	1.69
Medium adopter	2667.5(53.77)	2293.46(46.23)	4960.96	9875	4914.04	1.99
High adopter	2670(50.02)	2667.66(49.98)	5337.66	11462.5	6124.84	2.13
Gram low adopter	2652.5(67.78)	1260.75(32.22)	3913.25	3913.25	1638.63	1.42
Medium adopter	2508.75(59.03)	1741(40.97)	4249.75	6571.88	2322.13	1.55
High adopter	2135.13(44.04)	2713.49(55.96)	4848.62	7828.13	2979.51	1.62
Pigeon pea low adopter	2758.75(89.49)	324.16(10.51)	3082.91	5406.25	2323.34	1.75
Medium adopter	2607.5(82.38)	557.77(17.62)	3165.27	5888.82	2723.55	1.86
High adopter	2573.75(72.86)	958.79(27.14)	3532.54	6848.44	3315.9	1.94
Soyabean low adopter	2612.5(63.4)	1508.03(36.6)	4120.53	5431.86	1311.33	1.32
Medium adopter	2531.25(59.01)	1758(40.99)	4289.25	6789.38	2500.13	1.58
High adopter	2433.2(50.36)	2398.07(49.64)	4831.27	9555	4723.73	1.93
Over all low adopter	2901.25(69.51)	1272.33(30.49)	4173.58	6343.19	2018.86	1.52
Medium adopter	2935.75(64.93)	1585.78(35.07)	4521.53	7830.02	3092.95	1.73
High adopter	3039.53(57.55)	2241.87(42.45)	5281.4	9835.07	4309.9	1.86

Technology adoption and income distribution in the recent years, there has been a great controversy over the benefits of technological developments in Indian agriculture. As a matter of fact, there are divergent views among the scientists regarding the benefits of new agricultural technology. Chowdhury (1970) and Griffin (1979) are of the view that the new technology has widened the gap between the rich and the poor, while Singh (1973), Singh and Kahlon (1983) and Bhat & Alam (1989) visualized that the new technology though in the initial phase of its introduction and diffusion increased the disparity of income distribution it has been later successful to some extent in reducing the same. They share the view that large farmers who were usually high adopters were the first to harness the benefits of the technological developments mainly because of their better resource position and easy accessibility to the institutional facilities such as credit and other inputs. However, during the subsequent periods, the small farmers were also able to reap the benefits of new technology to a great extent owing to concentrated extension efforts, availability of institutional credit on easy terms and conditions and technical guidance. The impact of agricultural technology adoption on income distribution pattern in study area were analysed through the Gini concentration ratio (Table 3). The Gini coefficient is a measure of inequality of income distribution.

Table 3: Gini concentration ratio for different categories of technology adopters

Categories of technology adopter	Sub categories based on income gourp	% share of farmers	% Share of Income	Gini coefficient
Low adopter	Bottom Group	14.29	7.50	0.192497
	Top Group	14.29	25.11	
Medium adopter	Bottom Group	9.62	3.94	0.253062
	Top Group	9.62	17.08	
High adopter	Bottom Group	15.15	5.310	0.340668
	Top Group	15.15	27.30	

It is evident from the results that the Gini Coefficent in case of low technology adopter was 0.192497 whereas in high adopter Gini Coefficent was 0.340668 indicating high income inequalities in high adopter group as compared to the low adopter group. Hence this study also revealed that in the study area technology adoption widened the gap income of the tribal farmers.

Conclusions: The examination of technology adoption vis-à-vis resource endowment of the farmers revealed that the area under study was characterized by preponderance of low level of technology adoption and smaller sized farms, the position of which in respect of adoption of new technology was quite disheartening. The increase in the level of adoption was accompanied by increase in the size of holding. Wheat and Soyabean were the predominant crops of the area under study with the highest percentage of area under HYVs compared to other crops. Further, it was observed that increase in the level of adoption was associated with increase in the level of income from the crops grown on sample farms. The disparity of income distribution was found to be the least among the farmers at low levels of adoption, marginally higher at medium level of adoption and the highest incase of high adoption like other earlier belief based on studies of various researchers that adoption of modern agricultural technology aggravates the income disparity. In order to increase adoption of modern inputs and siphon-out the farm products an efficient marketing infrastructure along with effective knowledge delivery system needs to be established. This would help farmers in sustainable agricultural production and marketing. The paper recommends policy options for governments and other agencies to increase the likelihood that a targeted community will adopt an introduced agricultural technology.

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