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Research Paper

Extent of Adoption of Banana Cultivation Technology by Farmers of Bihar

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ABSTRACT

Banana cultivation holds significant economic importance worldwide, serving as a major fruit crop and a significant source of income for farmers while contributing substantially to agricultural trade. In Bihar, India, banana cultivation plays a vital role in the agricultural landscape. Understanding the factors influencing farmers' adoption of new technologies is crucial for devising effective strategies. This research sheds light on the extent of adoption of banana cultivation technology by Bihar's farmers. Findings indicate varying levels of adoption across different aspects of banana cultivation practices, with factors such as age, experience, and training significantly influencing adoption levels. While certain variables show positive correlations with adoption, they do not exhibit significant associations. These insights underscore the importance of targeted interventions and training programs to enhance adoption rates, ultimately promoting sustainable and efficient banana cultivation, thereby improving productivity and livelihoods. Additionally, the identification of disparities in adoption rates between districts emphasizes the need for tailored strategies addressing unique challenges and opportunities in each area.

HIGHLIGHTS

- Certain factors such as age, experience, and training significantly influence the adoption levels of recommended banana cultivation technology, with training emerging as the most influential factor.

Keywords: Banana Cultivation, Technology Adoption, Bihar, Training of Farmers

Banana cultivation contributes significantly in economics of world, serving as a major fruit crop, a source of major income for farmers, and immensely contributes in agricultural trade. In Bihar, India, cultivation of banana acts a vital role in the agricultural scenery, contributing to the Bihar economy and livelihoods of large number of farmers. However, despite its economic importance, banana cultivation encounters a range of challenges that hamper its best possible productivity and economic benefits. One of the primary concerned facing banana production in Bihar is the traditional cultivation practices, leading to low banana yields and prone to pests and diseases infestation. In addition, not enough access to modern banana cultivation technologies aggravated these challenges furthermore, deterrent farmers' ability to improve productivity and prosperity. Recognizing the importance of addressing these issues, there has been a growing importance on promoting the adoption of superior banana farming technologies among farmers in Bihar. Considering the technology adoption prototype among farmers, it is

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critical for working out effective strategies to endorse new agricultural practices. Farmers' decisions to accept new technologies are impacted by various factors, including demographic profile, access to resources, and agricultural extension services. Scientists and extension workers play an paramount role in helping technology transfer and adoption by providing training, knowledge transfer, and technical assistance to banana farmers. Furthermore, banana cultivation in Bihar holds significant historical and cultural value, with references to its cultivation dating back centuries.

The commercialization, agricultural techniques, and sucker production systems were identified as the main restrictions in the growing of bananas. Climate change and other variables, such as financial support, limit production. Low pricing and market accessibility prevent commercialization (Dassou *et al.* 2021) of banana cultivation. Significant obstacles to banana cultivation include the growing price of pesticides, fertilisers, and fossil fuels (Dita *et al.* 2011). According to Jaiswal *et al.* (2015), the majority of banana farmers had a partial adoption gap, followed by a full adoption gap and none at all. The highest number of farmers had a medium level of adoption gap. Practices like variety selection, irrigation management, and cutting, pruning, and stacking as part of the propagation process were shown to have a high level of acceptance. By regularly visiting, educating, and advising farmers, extension agents and agricultural scientists may have increased banana production (Warshini *et al.* 2022). Planting material, the percentage of banana income to total farm income, per capita household expenditure, the farmer's location, occupation, family size, labour source, farm size, soil fertility, distance to banana market, use of manure in banana planting, and access to agricultural extension services all had a significant impact on the adoption of banana production technology (Wanyama *et al.* 2016).

MATERIALS AND METHODS

The present research was conducted in two districts of Bihar namely Bhagalpur and Khagaria. From each district one block was purposively selected based on the prevalence of banana cultivation. Then, four villages were randomly picked from each block, and from each village, 25 banana cultivators or farmers were randomly chosen, resulting in a total sample size of 200. For measurement of adoption quantitatively, the cultivation practices of bananas were considered. For this purpose, a list of the recommended cultivation practices for banana was prepared based on available literature. The objective type questions were framed on these identified recommended cultivation practices in banana. These questions were administered to the banana growers for obtaining their responses concerning the actual use of these practices by them. A numerical score of one was assigned for the actual use of each identified cultivation practice in banana and zero for non-adoption. The score of all the identified practices was summed up. This total was indicative of the adoption level of that particular respondent. Finally, this raw adoption score obtained by an individual banana grower was converted into an adoption level as below:

$$\text{Adoption Level} = \frac{\text{Actual obtained adoption score}}{\text{Maximum possible obtained adoption score}} * 100$$

RESULTS AND DISCUSSION

The respondent's adoption levels in the season of planting, planting material, and varieties showed that 38% of respondents had a rate of adoption between >33.33-50.00 percent. Additionally, 0.5% of respondents had a rate of adoption between >83.33-100 percent. Furthermore, 26.5% of respondents had a rate of adoption between >50.00-66.67 percent, 22% had a rate of adoption between 16.67-33.33 percent, and 14% had a rate of adoption between >66.67-83.33 percent (Table 1). It was also observed that 44.5% of respondents had a rate of adoption between 0.00-20.00 percent, while 0.5% had a rate of adoption between >80.00 percent. Moreover, 36.5% of respondents had a rate of adoption between >20.00-40.00 percent, 16.5% had a rate of adoption between >40.00-60.00 percent, and 2% had a rate of adoption between >60.00-80.00 percent (Table 2).

Table 1: Distribution of respondents according to their adoption of the season of planting, planting material, and varieties

Sl. No.	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	16.67-33.33	20.0	22.0	44 (22 %)
2	>33.33-50.00	41.0	35.0	76 (38 %)
3	>50.00-66.67	24.0	29.0	53 (26.5 %)
4	>66.67-83.33	15.0	13.0	28 (14 %)
5	>83.33-100	—	1.0	1 (0.5 %)
	Total	**100**	**100**	**200 (100 %)**

Table 2: Distribution of respondents according to their adoption of the land preparation techniques

Sl. No.	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	<20.00	43.0	46.0	89 (44.5 %)
2	>20.00-40.00	40.0	33.0	73 (36.5 %)
3	>40.00-60.00	16.0	17.0	33 (16.5 %)
4	>60.00-80.00	1.0	3.0	4 (2 %)
5	>80.00	—	1.0	1 (0.5 %)
	Total	**100**	**100**	**200 (100%)**

Table 3: Distribution of respondents according to their adoption of the nutrient management techniques

Sl. No.	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	>16.67	12.0	24.0	36 (18 %)
2	>16.67-33.33	27.0	26.0	53 (26.5 %)
3	>33.33-50.00	31.0	32.0	63 (31.5 %)
4	>50.00-66.67	19.0	13.0	32 (16 %)
5	>66.67-83.33	10.0	5.0	15 (7.5%)
6	>83.33	1.0	—	1 (0.5 %)
	Total	**100**	**100**	**200 (100 %)**

The respondent's adoption levels in the nutrient management techniques showed that 31.5% of respondents had a rate of adoption between >33.33-50.00 percent, while 0.5% had a rate of adoption greater than 83.33 percent. Additionally, 18% of respondents had a rate of adoption between 0.00-16.67 percent, 26.5% had a rate of adoption between >16.67-33.33 percent, 16% had a rate of adoption between >50.00-66.67 percent, and 7.5% had a rate of adoption between >66.67-83.33 percent (Table 3). The respondents' adoption level in the irrigation management techniques depicted that 77.5% of respondents had a rate of adoption between >33.33-66.67 percent, while 9.5% had a rate of adoption greater than 66.67 percent. Furthermore, 13% of respondents had a rate of adoption between 0.00-33.33 percent (Table 4).

Table 4: Distribution of respondents according to their adoption of the irrigation management techniques

Sl. No.	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	<33.33	12.0	14.0	26 (13 %)
2	>33.33-66.67	76.0	79.0	155 (77.5 %)
3	>66.67	12.0	7.0	19 (9.5 %)
	Total	**100**	**100**	**200 (100 %)**

The respondent's adoption level in the weed management techniques in Table 5 showed that 55.5% of respondents had a rate of adoption between <25.00 percent. Meanwhile, 30.5% had a rate of adoption between >25.00-50.00 percent. Additionally, 12% of respondents had a rate of adoption between >50.00-75.00 percent, and 2% had a rate of adoption greater than 75.00 percent.

Table 5: Distribution of respondents according to their adoption of the weed management techniques

Sl. No.	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	<25.00	57.0	54.0	111 (55.5 %)
2	>25.00-50.00	31.0	30.0	61 (30.5 %)
3	>50.00-75.00	10.0	14.0	24 (12 %)
4	>75.00	2.0	2.0	4 (2 %)
	Total	**100**	**100**	**200 (100 %)**

The respondents' adoption level in the maintenance of banana plants techniques showed that 32% of respondents had a rate of adoption between >20.00-40.00 percent. Conversely, 0.5% had a rate of adoption between >80.00-100.0 percent. Furthermore, 28.5% of respondents had a rate of adoption between >20.00 percent, again 28.5% had a rate of adoption between

>40.00-60.00 percent, and more than 11.5% had a rate of adoption between >60.00-80.00 percent (Table 6).

Table 6: Distribution of respondents according to their adoption of the maintenance of banana plants techniques

Sl. No.	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	<20.00	27.0	30.0	57 (28.5 %)
2	>20.00-40.00	34.0	30.0	64 (32 %)
3	>40.00-60.00	27.0	29.0	57 (28.5 %)
4	>60.00-80.00	12.0	10.0	22 (11.5 %)
5	>80.00	—	1.0	1 (0.5 %)
	Total	**100**	**100**	**200 (100 %)**

The respondents' adoption level in the harvesting practices in Table 7 showed that 36.5% of respondents had a rate of adoption between >40.00-60.00 percent. Conversely, 0.5% of respondents had a rate of adoption between >80.00 percent. Additionally, 26% of respondents had a rate of adoption between <20.00 percent, 24.5% had a rate of adoption between >40.00-60.00 percent, and 12.5% had a rate of adoption between >60.00-80.00 percent.

Table 7: Distribution of respondents according to their adoption of the harvesting practices

Sl. No.	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	<20.00	22.0	30.0	52 (26 %)
2	>20.00-40.00	30.0	19.0	49 (24.5 %)
3	>40.00-60.00	34.0	39.0	73 (36.5 %)
4	>60.00-80.00	14.0	11.0	25 (12.5 %)
5	>80.00	—	1.0	1 (0.5 %)
	Total	**100**	**100**	**200 (100 %)**

The respondents' adoption level in the adoption of recommended insecticides in Table 8 showed that 32.5% of respondents had a rate of adoption between >0.00-14.29 percent. In contrast, 1.5% of respondents had a rate of adoption between >71.43-85.71 percent. Furthermore, 23% of respondents had a rate of adoption between >14.29-28.57 percent, 18.5% had a rate of adoption between >28.57-42.86 percent, 20% had a rate of adoption between >42.86-57.14 percent, and 4.5% had a rate of adoption between >57.14-71.43 percent.

Table 8: Distribution of respondents according to the adoption of recommended insecticides

Sl. No.	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	<14.29	32.0	33.0	65 (32.5 %)
2	>14.29-28.57	29.0	17.0	46 (23 %)
3	>28.57-42.86	18.0	19.0	37 (18.5 %)
4	>42.86-57.14	17.0	23.0	40 (20 %)
5	>57.14-71.43	4.0	5.0	9 (4.5 %)
6	>71.43	—	3.0	3 (1.5 %)
	Total	**100**	**100**	**200 (100 %)**

Table 9: Distribution of respondents according to the adoption of recommended fungicides

Sl. No	Adoption levels (in Per cent)	Bhagalpur (n_1=100)	Khagaria (n_2=100)	Overall (n=200)
1	<25.00	33.0	79.0	112 (56 %)
2	>25.00-50.00	17.0	8.0	25 (12.5 %)
3	>50.00-75.00	19.0	8.0	27 (13.5 %)
4	>75.00	23.0	5.0	28 (14 %)
	Total	**100**	**100**	**200 (100 %)**

The respondents' adoption level in the adoption of recommended fungicides revealed that 56% of respondents had a rate of adoption less than 25.00 %. Meanwhile, 12.5% of respondents had a rate of adoption between >25.00-50.00 percent. Additionally, 13.5% of respondents had a rate of adoption between >50.00-75.00 percent, and 14% of respondents had a rate of adoption greater than 75.00 percent.

In this study, the production technology adoption percentage of farmers in the two districts was evaluated (Table 10). It showed that the average adoption rate in the selection of varieties was 54.97 per cent, followed by 46.3 per cent adoption in post-harvesting practices, 44.58 per cent adoption in nutrient management, 43.50 per cent adoption in the maintenance of banana plants, 36.75 per cent adoption in weed management, 34.50 per cent adoption in land preparation, 32.16 per cent adoption in irrigation management, 32.50 per cent adoption in the adoption of recommended insecticides, and 18.37 per cent adoption in the adoption of recommended fungicides. A two-sample z-test was conducted to compare the means of two populations, suggesting

Table 10: Adoption of recommended practices

Sl. No.	Production technology of Banana cultivation	Bhagalpur	Khagaria	Z value	P value	Overall
1	Planting material and varieties	54.33 %	55.50 %	0.46	0.640	54.91 %
2	Land preparation	34.20 %	34.80 %	0.23	0.810	34.50 %
3	Nutrient management	48.49 %	40.67 %	2.75	0.005	44.58 %
4	Irrigation management	33.33 %	30.99 %	1.04	0.29	32.16 %
5	Weed management	36.25 %	37.25 %	0.30	0.76	36.75 %
6	Maintenance of banana plants	43.40 %	43.60 %	0.06	0.94	43.50 %
7	Post harvesting practices	47.60 %	45.00 %	0.82	0.40	46.3 %
8	Recommended insecticides	31.00 %	34.00 %	0.95	0.33	32.5 %
9	Recommended fungicides	14.00 %	22.75 %	2.27	0.02	18.37 %

that the p-values of adoption of recommended nutrient management practices and fungicides were only less than 0.05, indicating a difference in the means of the two districts.

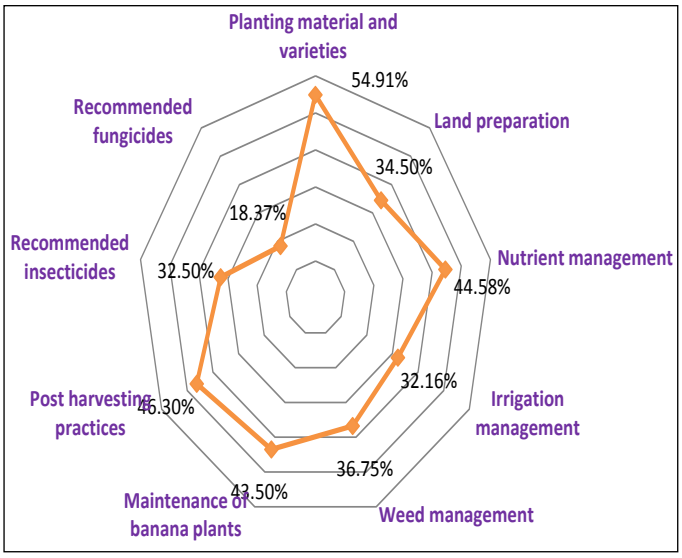

Fig. 1

Table 11 indicates that the correlation coefficient (r) results show a significant positive correlation between the independent variables, namely Age (X_1), Experience (X_4), and Training (X_{10}) of banana growers, and adoption level. On the other hand, variables such as Education (X_2), Family size (X_3), Land holding (X_5), Area under banana cultivation (X_6), Family income (X_7), Income from banana (X_8), and Extension exposure (X_9) were positively correlated but not significantly associated with the adoption level of recommended cultivation practices in banana.

Table 11: Correlation coefficient between Adoption level (Dependent variable) and socio-economic variables (independent variable)

Independent variables	Coefficients (r)
Age (X_1)	0.252**
Education (X_2)	0.09
Family size (X_3)	0.043
Experience (X_4)	0.257**
Land holding (X_5)	0.16
Area under banana cultivation (X_6)	0.33
Family income (X_7)	0.02
Income from banana (X_8)	0.044
Extension exposure (X_9)	0.13
Training (X_{10})	0.296**

***Correlation coefficient is significant at the 0.01 level.*

Table 12 reveals that among the eleven variables, only one variable, namely training, was significantly related to the adoption rate of banana growers. The regression coefficients suggest that a one-unit change in the training variable would result in a 0.271 unit change in the adoption of recommended banana cultivation practices.

Table 12: Effect of independent variables on recommended technology adoption by banana growers

Sl. No.	Variables entered	Standard Error	Regression coefficients	Sig.
1	Age	0.150	0.027	0.900
2	Education	0.427	0.098	0.202
3	Family size	0.578	0.013	0.897
4	Experience	0.188	0.208	0.322
5	Landholding	0.946	0.057	0.551

6	Area under Banana cultivation	2.578	0.172	0.630
7	Financial income	0.774	0.030	0.856
8	Financial income banana	2.344	-0.234	0.525
9	Information sources	0.044	-0.068	0.373
10	Extension exposure	0.040	0.006	0.932
11	Training	0.022	0.271	0.000
	R		0.391	
	R square		0.153	
	Adjusted R square		0.103	
	Dependent variable		**Adoption**	

CONCLUSION

In conclusion, this study provides valuable insights into the extent of adoption of banana cultivation technology by farmers in Bihar. The findings reveal varying levels of adoption across different aspects of banana cultivation practices, including planting, nutrient management, irrigation, weed management, maintenance of banana plants, harvesting practices, and the adoption of recommended pesticides and fungicides. Notably, the analysis demonstrates that certain factors such as age, experience, and training significantly influence the adoption levels of recommended cultivation practices, with training emerging as the most influential factor. While other variables such as education, family size, land holding, area under banana cultivation, family income, income from banana, and extension exposure show positive correlations with adoption, they do not exhibit significant associations. These findings underscore the importance of targeted interventions and training programs aimed at enhancing the adoption of best practices among banana growers in Bihar. By addressing the factors that contribute to higher adoption rates, stakeholders can promote sustainable and efficient banana cultivation, ultimately improving productivity and livelihoods in the region. Moreover, the identification of significant differences in adoption rates between districts (Bhagalpur and Khgaria) highlights the need for context-specific strategies tailored to the unique challenges and opportunities faced by farmers in each area.

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