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What Motivates Rice Farmers to Adopt Hybrid Rice Technology in Assam, India?

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ABSTRACT

To feed the rising population there is need for improved technologies like hybrid rice cultivation which gives comparatively higher yield than other rice varieties. A study was conducted to find the factors affecting the adoption of hybrid rice in Nagaon district of Assam using logistic regression analysis in the year 2018. The results revealed that, adoption of hybrid rice was positively and significantly affected by socio-economic factors such as occupation, number of extension agent contact, while the age of the farmers and farm size were found to affect the rate of adoption negatively indicating that rate of adoption of hybrid rice was higher with main occupation as agriculture and more extension agent contact of the farmer whereas older famers and large farmers were reluctant to grow hybrid rice. The major problem faced by the hybrid rice adopters was rain during harvesting time and by the non-adopters was poor cooking quality of hybrid rice. For increasing the adoption of hybrid rice varieties, government need to consider the problems faced by the farmers in its adoption and provide community threshing floor, timely supply of seed in sufficient quantity and awareness on new technology to the farmers through the extension personnel.

INTRODUCTION

Rice (*Oryza sativa* L.) is the primary source of food for the millions of the people in the Asia-Pacific region. The majority of the people in India make out their existence directly or indirectly from farm-related economic activities (Pradhan et al., 2020). Rice is the one of the most important cereal crops in India and has been highly labour and energy-intensive crop (Bhatt & Singh, 2022). To meet the growing demand, rapid increase in the rice cultivation is needed and with the availability of modern farm inputs, it was possible for farmers to generate higher levels of income (Kisku & Ghosh, 2017). Therefore, some improved technologies like hybrid rice has the potential to transform rice cultivation in India as it could enhance rice productivity, increased on-farm incomes for smallholders (Spielman et al., 2014). Hybrid rice typically displays hybrid vigor such that when it is grown under the same conditions as comparable high-yielding inbred rice varieties it can produce up to 15-20 per cent more rice (Azam, 2014; Janaiah et al., 2010) and hybrid technology has contributed significantly to food security, environmental protection and employment opportunities (Yan et al., 2010).

Assam was producing 5127 million tonnes of rice during 2016-17 from an area of 24.67 lakh hectares. The highest total production was recorded during winter (*sali*), followed by Summer (*boro*) and autumn (*ahu*) seasons. Total area under high yielding variety rice was 19.18 lakh hectares during 2016-17 and area under hybrid rice was 160.5 thousand hectares (Government of Assam, 2018). Growth in Summer (*boro*) rice planting was getting momentum because, unlike the ahu and sali seasons, which were affected by flood, the boro rice season was relatively less risky, which means that improved rice production techniques could be adopted more fully, and there is ample scope for area expansion by bringing the chronically flood-affected and deep-water rice areas under *boro* rice cultivation by creating irrigation facilities. Hybrid rice was grown mainly in the boro season in the state under different schemes such as National Food Security Mission- Rice that was implemented for

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increasing food grains and pulse production through introduction of interventions in rice, wheat and pulses among targeted districts of the country (Mottaleb et al., 2014; Khatik et al., 2017) and Bringing Green Revolution to Eastern India (BGREI). The average yield of high yielding variety and hybrid variety of rice was reported to be 4.5-5.5 tonnes hactare^{-1} and 5.0-6.1 tonnes hactare^{-1} in the state (Government of Assam, 2015) showing the yield advantage of hybrid rice (Gogoi et al., 2020). However, still the adoption of hybrid rice was mostly confined to only central part of the state. Therefore, a question arises: what motivates the farmers of this part to adopt hybrid rice? With this background, the study was conducted to explore the factors affecting hybrid rice adoption and the problems faced by the farmers in its cultivation.

METHODOLOGY

A multi stage random sampling design was used for the present study. In the first stage Nagaon district was purposively selected as the district has the highest area (9547 ha during 2018) under hybrid rice in Assam. In the second stage, two blocks were selected from the district at random based on the number of farmers adopting hybrid rice cultivation. In the final stage, sixty farmers growing both hybrid rice and non-hybrid rice and thirty farmers growing only non- hybrid rice were selected from two blocks resulting in 90 sample respondents.

Farmer's adoption of hybrid rice was studied using the logistic regression model to empirically quantify the relative influence of various factors in the decision of the respondents to adopt hybrid rice varieties. This study postulated that the probability of a farmer adopting hybrid rice varieties (*Yi*) depends on the attributes like age, literacy level of farmers, farm size and number of extension agent contacts. The index variable Zi (Zi is a dichotomous variable) indicating whether a farmer was adopting hybrid rice varieties or not has been expressed as a linear function of the independent variables.

Thus, the logit regression model has been specified as the following equation:

The probability of adoption, P_i, for a given set of values of variables is given by the logit model

$$Zi = \ln\left(\frac{Pi}{1-Pi}\right) = \beta_\circ + \sum_{i=1}^{n} \beta i Xi + ui$$

The logistic model could be written in terms of the odds and log of odds, which helps to understand the interpretation of the coefficients. The odds ratio implies the ratio of the probability (Pi) that an individual would choose an alternative to the probability (1-Pi) that he/she would not choose it.

$$1 - Pi = \frac{1}{1 + e^{Zi}}$$

The odds ratio is expressed as

$$\frac{Pi}{1-Pi} = e^{Zi}$$

Where βi's are logit coefficients for the n explanatory variables Xi's, and u is the error term.

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$$

Where, *Yi*= Farmer's adoption of hybrid rice varieties (1 for adoption and 0 for non-adoption); and X_i= Independent variables (X_1= Literacy level of farmers; 1 if graduate; 0 if otherwise, X_2= Occupation; 1 if agriculture; 0 if non agriculture, X_3= Farm size; 1 if medium; 0 if marginal and small, X_4= Age of the respondents (years), X_5= Extension agent contacts; 1 if contact; 0 if otherwise)

Simple ranking technique was applied to measure the problems faced by the farmers in hybrid rice cultivation from study area and each farmer was asked to mention about the problems in hybrid rice cultivation in order of degree of difficulty.

RESULTS AND DISCUSSION

Estimation of the factors influencing adoption of hybrid rice cultivation

The adoption of hybrid rice cultivation was found to be affected by various factors (Table 1). The logit framework clearly indicated that occupation and number of extension agent contact were positive and statistically significant while education of farmers was found to be positive but not statistically significant. Similarly, Ghimire et al., (2015) mentioned that, education, farm size, seed access, extension service, yield potential and consumers' acceptability of rice varieties were the factors affecting the probability of adoption.

The odds-ratio of 2.580 for education implied that other things being kept constant, the odds-ratio in favour of adopting hybrid rice increased by 2.58 times as farmers' education level increased by one unit. Literate farmers were aware about the yield advantage of hybrid rice through different print and electronic media hence, literacy level of the farmers was found to have positive effect on adoption of hybrid rice and they were ready to face risks and experiment with the new technology. The study is in line with Nonvide (2020), where it was reported that farmers with more education were more likely to adopt improved rice varieties and have more ability in collecting information on new technologies than the non-educated farmers. Likewise, the contact with extension agent increased the adoption of hybrid rice technology by 3.493 times. The extension supports from government and other private sources enhanced the promotion of the technology through the provision of advice, information and technical support to farmers, thereby increasing the adoption rate (Shah et al., 2014a; Momtaz et al., 2020). The farmers depending on agriculture as main occupation increased the odds of adopting hybrid rice technology by 7.228 times. The age and farm size were found to affect the

Table 1. Parameter estimates for logit model

Variables	Coefficients	Standard Error	Odds ratio
Intercept	-0.834	1.382	0.000
Education	0.948	1.314	2.580
Occupation	1.978*	0.935	7.228
Farm size	-0.158	0.620	0.854
Age	-0.027	0.026	0.973
Extension agent contacts	1.251*	0.594	3.493

Source: Field survey, 2017-18

*Significant at 10 per cent probability level

Table 2. Problems faced by farmers adopting hybrid rice cultivation and non-adopter

Hybrid rice adopter		Non-adopter	
Types of problem	Percentage	Types of problem	Percentage
Rain during harvesting time	36.67	Poor cooking quality	33.33
Lack of threshing floor	21.67	High cost of seed	20.00
Higher requirement of labour and fertilizer	18.33	Low output price	16.67
Lower price due to grain quality	11.67	High incidence of pest and disease	13.33
Lack of storage facility	8.33	More labour intensive	10.00
High cost of irrigation	3.33	Lack of training and awareness	6.67

Source: Field survey, 2017-18

rate of adoption negatively and also not statistically significant. Older farmers were reluctant to embrace new technology outrightly, hence, adoption of hybrid rice was found to have negatively affected by age, though not significantly. The farmers with higher farm size were not interested to adopt hybrid rice cultivation because they grow different types of crops, but for farmers with smaller holding had to grow rice for household consumption. Further the government schemes mostly target the small farmers as beneficiary and thus the small farmers were adopting the technology. Similar findings were reported by Nirmala et al., (2016) where they mentioned that the farmers having small holdings of half to one acre grow rice for household consumption and have distinct preference for hybrid rice.

Problems faced by hybrid rice adopter and non-adopter

Hybrid rice cultivation was found to be 49.01 per cent of total rice area. Nearly 50 per cent of the area was yet to be covered under hybrid rice despite its yield advantage. It was observed that (Table 2) among adopters, the major problems observed was rain during harvesting time which makes the hybrid seed to sprout in the field if kept for more than one day in rain, followed by lack of threshing floor, labour intensive cultivation and also high requirement of fertilizer, lower price due to grain quality like broken rice during milling along its stickiness considered. The study was in line with Janaiah et al., (2002) where they mentioned that, although hybrid rice had a yield gain of about 15-20 per cent over the existing high-yielding modern varieties outside China, which was not attractive to farmers because of higher input costs and lower market prices due to its inferior grain quality. Lack of storage facility in case of high production from hybrid was a problem faced by farmers, high cost of irrigation because of more water requirement was mentioned by small percentage of the respondents. Difficulty in threshing of hybrid varieties was main complexity reported by all sampled farmers in the study conducted by Kumar et al., (2017) in Jammu. The fuel cost for irrigating the hybrid rice field was not bearable to the resource poor small adopter farmers hence appeared as a problem. Prakash et al., (2017); Pandit et al., 2017) reported similar findings where, the high seed cost of hybrid seed coupled with unawareness of management practices restricted farmers to adopt recommended hybrid rice production technology.

In case of non-adopters, it was observed that (Table 2), the poor cooking quality of hybrid rice was the major problem. Similar findings by Saeed et al., (2013) reported that the disadoption of hybrid rice was due to serious problem of marketing and lower price and also disliking of hybrid rice due to poor quality of grain and inferior taste. High cost of seed which was also needed to be purchased every year, low price of the hybrid rice per quintal compared to other rice varieties, overlooking the higher production, infestation of the pest and disease were also among the reported problems. Severe infestation of insects and pests and lack of irrigation facilities were the problems faced by farmers revealed in the findings of Singh et al., (2011); Shah et al., (2014b) and (Dasgupta & Roy, 2014).

CONCLUSION

Rice being the staple food crop in the state, farmers started adopting hybrid varieties to increase the yield. Farmers and extension personnel should have more contacts for better technical guidance frequently. Timely supply of hybrid seeds with associated input should be made available to the rice farmers. Provision should be made for covered community threshing floor at the village level to avoid the problem of rain. Proper research has to be done to improve the grain quality as well as early maturing variety to solve the problem of poor grain quality and rain during harvesting time in summer season, respectively. Exposure visit of farmers to demonstration plots is expected to accelerate the adoption. Government programs need to widen the scope to small and marginal farmer. Success story of hybrid rice growers need to be focused through various advertising media so as to attract the rice farmers to grow hybrid rice.

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