

# Analysis on Influencing Factors of Technology Adoption of Different Land Based Enterprises of Farmers under Diversified Farming System

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Received: June 27, 2011 Accepted: July 12, 2011 Online Published: December 21, 2011

doi:10.5539/jas.v4n2p139

URL: <http://dx.doi.org/10.5539/jas.v4n2p139>

## Abstract

The present study to assess the technology adoption behaviour of farmers of different land based enterprises under diversified farming system was conducted in Sonitpur district of Assam, India. A sample size of 135 farmer respondents was drawn from three Agricultural Sub-Divisions of the district by using proportionate random sampling technique. The study shows that among the socio-economic variables under study, except age, other variables namely; education, extension contact and annual income were found having positively significant correlation with technology adoption of all the selected enterprises, while the variable operational land holding had shown positive and significant relation with rice cultivation and dairy farming. The study further reveals that economic motivation and innovation proneness were the two psychological variables which had positive and significant correlation with technology adoption of all selected four enterprises. While variables-risk orientation, decision making ability and attitude towards farm diversification of the respondents had positively significant association with technology adoption of dairy and fishery, fishery and rice, vegetable and fishery respectively under diversified farming system.

**Keywords:** Technology adoption, Diversified farming system, Innovation, Rice cultivation, Vegetable cultivation, Dairy farming, Fishery

## 1. Introduction

The share of agriculture in the total GDP of India is likely to be reduced to 15percent by 2020 due to faster development of non-agriculture sectors. It is expected that the present employment of over 60 percent of total workforce in agricultural sector will further reduce to 45-50 percent by that time. The adverse effects of aberrant

weather, such as erratic and scanty rainfall and drought are very common in a vast area in agricultural production of the country. Incidence of flood in one part of the country and drought in the other part is a very frequent phenomenon in India. Under these aberrant weather situations, dependence on one or two major cereals (rice, wheat, etc.) is always risky. Diversification is the single most important source of poverty reduction for small farmers in South and South East Asia (FAO and World Bank, 2001). Diversification in agriculture has tremendous impact on the agro-socio-economic impact and uplifting of resource-poor farming communities. It implies the use of local resources in a larger mix of diverse cropping systems and livestock, aquaculture and other non-farm sectors in the rural areas. It generates income and employment for farmers and rural youth round the year for benefits of the farmers in the country. It also aims to improve soil health and a dynamic equilibrium of the agro-ecosystem.

Farm diversification has potential as an economic driver in agricultural regions of the country. It may prove to be of paramount importance in meeting challenges that arise from a post-green revolution scenario. In view of shrinkage of agricultural land and operational holdings due to expansion of urban centres and industries, changes in consumer food habits, exponential population growth rate etc., farmers are pressured to include or substitute additional crops into the cropping system. Hence, successful attainment of total agricultural development depends to a large extent on the farming systems approach (Therthaprasad *et. al.*, 2006).

Rice production is the main agricultural activity in North Eastern Region of India. Vegetables production, dairy farming, poultry rearing and fisheries form the main allied sector activities, which are maintained along with rice cultivation as mixed farming systems in the region. As such, the three out of existing twenty five major farming systems of the state were identified as the important rice-based farming systems for primary source of income and employment of farmers in the study area. These rice based farming systems according to their rank orders are:

- i. Rice+Vegetable+Dairy+Fishery (FS<sub>1</sub>)
- ii. Rice+Vegetable+Dairy+Poultry (FS<sub>2</sub>)
- iii. Rice+Dairy+Fishery+Poultry (FS<sub>3</sub>)

For the purpose of the study, the farming system i.e., Rice+Vegetable+Dairy+Fishery has been considered since this farming system was found to be the most important and commonly adopted one among the farmers of the study area. This study therefore, seeks to assess the technology adoption behaviour among farmers of different enterprises under diversified farming system in Assam state of India.

## 2. Research Background and significance

The diversification of farming in this study means that farmers would not only undertake seasonal crops farming, but also animal husbandry, fishing, dairy, horticulture etc. for economic activities as either self-employed or/ and supplementing their incomes. The average size of holdings of farmers in India is so low that it cannot generate adequate employment and income for their sustenance, based on crop cultivation only. The food and nutritional security of the farmers through sustainable agricultural development can not be guaranteed if the farmers use only traditional technology having local, low yielding crop varieties and low value subsistence crops and if they do not undertake other farm and non-farm activities including horticulture, animal husbandry, fishing, agro-forestry, agro-processing, agro-services etc. It is, therefore, true that combination of any particular crop cultivation with any other enterprise(s) may enable the farmers to develop managerial expertise and also reduce the per unit cost of production. While reviewing the adoption research, Loganandhan and Singh (2003) pointed out that adoption behavior of farmers is influenced by their socio-economic characteristics such as education, land holding, social participation and communication skills etc. This study, therefore, aimed to assess and identify those dominant factors which could determine the technology adoption behavior of farmers in different farm based enterprises.

### 2.1 Driving forces for Farm diversification

Farm diversification has potential as an economic driver in agricultural regions. It may prove to be of paramount importance in meeting challenges that arises from a post-green revolution scenario. In view of shrinkage of agricultural land and operational holdings due to expansion of urban centres, changes in consumer food habits, exponential population growth rate, farmers are pressured to include or substitute additional crops in to the cropping system. The farm diversification, which undertakes not only seasonal crops farming, but also animal husbandry, fishing, dairy, horticulture etc. ensures farmers' economic development through sustainable agricultural development.

The major driving forces for farm diversification are:

- Increasing income from small farm holdings.
- Mitigating ill-effects of aberrant weather.
- Balancing food demand and nutrients.
- Improving fodder for livestock animals.
- Conservation of natural resources (soil, water, etc.).
- Minimizing environmental pollution.
- Reducing dependence on off-farm inputs.
- Decreasing insect pests, diseases and weed problems.
- Increasing community Food security

### 2.2 Factors affecting technology adoption of farm based enterprises

Adoption of technologies of different enterprises is affected by certain factors. According to Goswami *et al.* (2010), annual income, land holding, extension contact, innovative proneness, risk orientation and economic motivation of fish farmers had positive significant relationship with their scientific fish culture practices. The study by Rousan (2007) showed that attitude towards change, educational level, farm income, farmers exposure, income level are the important socio-economic factors influencing adoption of farm innovations. Farmers' changes of technology use are usually influenced by need based and location specific technical training programmes and demonstrations followed by group discussion and field visits. Men usually use technologies for rice, fruit and fish production, and women use technology for pig, chicken production (Truong Thi Ngoc Chi and Ryuichi Yamada, 2002). Factors that trigger adoption of new technologies comprise of young and educated male farmers, higher income level, risk orientation and decision making ability of farmers. Factors limited adoption of technology included conservative old men, illiterate, weak belief on ensure high yield of new technology etc. According to Truong Thi Ngoc Chi (2008), factors affecting adoption of new technologies included farmers' perception and education, extension workers' knowledge, ways of organization and management of extension programs, and physical conditions of the area. Seyyed Ali Noorhossaini Niyaki and Mohammad Sadegh Allahyari (2010) found that effective socio-personal characteristics affecting an adoption of rice-fish culture in Western Guilanare family size, membership in social institutions, rate of participation in extension activities and number of extension contacts. Flordeliza H. Bordey *et al.* (2004) in their study on Socioeconomic Evaluation of Hybrid Rice Production in the Philippines revealed that the factors that were found to influence the probability of continuous adoption include: yield, price of rough rice, price of seed, pesticide cost, labor wage rate, education level of farmers, the availability of credit, and provincial location of farms. Indrajith Upul Mendis and Jumnonruk U. (2005) reported that education, land, land tenure, income, credit, sources of information, extension activities, extension officer visits and membership of farmer organizations were found to be the important factors affecting adoption of recommended crop management practices in paddy cultivation in Kalutara district, Sri Lanka. Kai-Xia Wang *et al.* (2011) in their study on influencing factors of farmers involving in Rural Social Endowment Insurance showed that farmers involving in rural social endowment insurance are affected by education, professional situation, land area, age, special experience and family size.

## 3. Main Objectives

The main objective of the study is to assess technology adoption behaviour farmers of different land based enterprises under diversified farming system.

### 3.1 Specific objectives

The following specific objectives were formulated to help achieve the main objective.

- To determine the various socio-economic traits of farmers affecting adoption of different land based enterprises under diversified farming system
- To determine the various psychological traits of farmers affecting adoption of different land based enterprises under diversified farming system

## 4. Materials and Methods

### 4.1 Planning and location of the study

The study was conducted in Sonitpur district of Assam, India. The district was selected according to the following criteria.

- The district was agriculturally progressive with potential scope of farm diversification.

- The farmers of the district adopt different diversified farming systems compared to other districts of the state as their primary source of income and employment.
- Practically no systematic research study was undertaken in the district to see the diffusion and adoption of improved diversified farming enterprises.

The district of Sonitpur consists of three Agricultural Sub-Divisions, namely; Tezpur, Biswanath Chariali and Gohpur. From each Sub-Division, three villages were randomly selected. These villages were Salaguri, Gereluachuk and Nandikeswar under Tezpur sub-division, Galia, Bhir and Panibharal under Biswanath Chariali sub-division and Chandamari Pathar, Chandamari Bangali and Karibil Nepali under Gohpur sub-division.

#### 4.2 Sample size and sampling procedure

In the present study, only those farmers who had been practicing the identified farming system i.e., Rice+Vegetable+Dairy+Fishery (FS<sub>1</sub>) for last five years as their primary source of income and employment were considered as respondents. For this purpose, a list of farmers was prepared in consultation with the local extension personnel, local leaders and local Non-Government Organisations separately for all the selected nine villages. From each village, a number of 15 respondents were selected by using proportionate random sampling technique, which consisted of 135 respondents as final size of sample.

#### 4.3 Pre-testing of data collection tools

In order to measure the extent of adoption of technology of different enterprises, a test schedule covering all aspects of improved practices of identified four enterprises under diversified farming system was prepared for data collection. The well structured schedule was then subjected to pre-testing on a group of 20 farmers of the study area by using 'test-retest' method to test its reliability. The calculated reliability coefficients was found highly significant ( $r_{tt}=0.754$ ), indicating that the schedule was reliable for studying the variable.

#### 4.4 Data collection procedure

The present study consisted of two phases of data collection. The first phase was through participatory methods for inventory of important farming systems in the study area. As many as 25 important rice based farming systems were identified in the district. Prioritization of the farming systems was done through participatory methods (Matrix ranking) according to set criteria including relative advantage of the farming systems, productivity, profitability, suitability in the area, compatibility with socio-economic and culture of the people etc. Cross-checking of data/ information thus generated through participatory methods such as semi-structured interview, group discussion, ranking and observation etc. was done in ways of changing methods, locations, timing and member groups as well as comparing the data with the secondary data and personal observation wherever possible. Thus, finally 3 (three) out of 25 farming systems were identified as the most important ones. The main tool used for collecting primary data in the present study was structured schedule in the second phase. For this purpose, an interview schedule was prepared for data collection from the respondents in the light of the objectives of the study. The data collection was made through personal interview method at their place of residence and / or farm.

#### 4.5 Data Analysis

The collected data were coded, tabulated and analysed by using appropriate statistical tests. The simple correlation and multiple regression analysis of dependent variables with the independent variables were done with the help of computer. Fisher 't' test was applied to respective co-efficients of correlation and multiple regression to identify the significant cause and effect relationship i.e, to ascertain the role of independent variables on the dependent variable.

#### 4.6 Variables and their measurement

Ten independent variables were selected for the present study. These independent variables were classified into two groups, namely; i. **Socio-economic variables**, which comprised of age, education, extension contact, annual income and operational land holding and ii. **Psychological variables** such as economic motivation, innovation proneness, risk orientation, decision making ability and attitude towards farm diversification. The variable age was measured in terms of the chronological age of the respondents rounded off to the nearest year. The Socio-Economic Status Scale (Rural) developed by Trivedi and Pareek (1964) was applied to measure education level of the respondents. While variables like extension contact, annual income and operational land holding were measured by developing structured schedules. Measurement scales developed by Singha (1991) were used for economic motivation, risk orientation and decision making ability with slight modification. Innovation proneness was tested by using Innovation Proneness Scale developed by Moulik and Rao (1965). While the variable- attitude towards farm diversification was measured with the help of the scale developed by Anand

Kumar et.al. (1997).

Extent of adoption of recommended practices of rice cultivation, vegetables cultivation, dairy farming and fishery by the farmers was studied by developing test schedules. Weightage of the practices was decided by the judge's rating. Extent of adoption was measured as "Full adoption", "Partial adoption" and "No adoption" with scores as 2, 1 and 0 respectively. Final adoption scores of the respondents were attained by multiplying the weightage of a practice with the corresponding extent of adoption scores.

## 5. Results and Discussion

The correlation analysis of independent variables of the respondents with their dependent variables under diversified farming system is given in Table-1.

### 5.1

The age of the respondents was not found significant on technology adoption of any of the selected enterprise under study. This indicates that adoption of technology of land based enterprises were not determined by the age of the respondents. This is attributed to the fact that most of the respondents under study were in the category of young ranging from 25 to 40 years.

### 5.2

The education level of the respondents was significant at the level of 5% and is positively correlated with all the selected four enterprises. It implies that those respondents with higher level of education would make more level of technology adoption of the selected enterprises. Farmers with higher level of education can easily learn and understand the importance of the technology from different sources. They were more receptive to other things and accept changes towards new innovations. The finding in case of education is in agreement with that of Ghosh et.al. (2004) as education of the respondents were significantly correlated with adoption of improved animal husbandry practices in West Bengal.

### 5.3

Extension contact of the respondents was found positively significant with the technology adoption of selected enterprises at 5% level of probability. With the higher level of extension contact, farmers are exposed to more interactions with the extension personnel of the department of agriculture and receive scientific guidance to access production and management practices from different sources which helped in higher adoption level in their farming systems. The variable was also found having significant influence on adoption of rice-fish culture (Seyyed Ali Noorhossaini Niyaki and Mohammad Sadegh Allahyari, 2010).

### 5.4

The table reveals that annual income of the respondents had significant and positive relationship with their technology adoption of selected enterprises. Since majority of the farmers in the study area were economically poor (<Rs.35,000/-), they faced hardship in procuring the recommended inputs and practices which hindered in adoption of technology in their farming situations. Thus, technology adoption by the farmers was significantly influenced by farmers' annual income generated from different sources. However, Kai-Xia Wang *et al.* (2011) in their study on influencing factors of farmers involving in Rural Social Endowment Insurance showed that annual income about household of farmers was not associated with the farmers' participation in Rural Social Endowment Insurance.

### 5.5

Size of operational land holding had positively significant relationship with respect to technology adoption of rice cultivation and dairy farming. Farmers who owned larger operational farm size tended to go for rice cultivation and dairy farming since the rice crop is the principal food grain of the people of the state. Rice as important field crop is largely cultivated by farmers who owned large farm size which also helped farmers to undergo dairy farming probably due to the reasons that farmers have limited access to pastures and this could lead to overgrazing and low milk production. With large scale production of rice, the vegetative parts of the crop can be used as fodder for livestock animals. Consequently, cow dung and other dairy wastes could be used as manures and compost for rice crop production.

### 5.6

Economic motivation of farmers had emerged positive and significant correlation with their technology adoption of the selected enterprises. Since most of the respondents under study were young and educated, their main intentions were to maximise net profit out of their investment incurred for technology adoption of different

enterprises by reducing inputs use and minimising risks of crops failure and uncertainty under diversified farming systems.

### 5.7

It is seen from the table that innovative mindsets of the farmers yielded higher technology adoption level of farmers in all the selected enterprises as it is evident having positive and significant relationship at 5% level of probability. High education level and more extension contact of the respondents could possible them to expose to different field visits/ exposure visits which helped to reinforce their knowledge and skills to enhance the accuracy of implementation of the technology packages.

### 5.8

Risk orientation level of the respondents had shown positive and significant correlation with their technology adoption in case of dairy farming and fisheries enterprises. While two enterprises namely, rice cultivation and vegetable cultivation had not shown any significant influence on their adoption level with the changes in risk orientation level of the respondents. This is because, farmers in the area did not want to take much risks of uncertainty and crop failure since the two enterprises were totally dependent on nature including rainfall, flood occurrence, drought, infestation by insects and diseases etc. compared to dairy farming and fishery which incurred relatively low risks involvement.

### 5.9

Except fishery enterprise under study, all other selected enterprises such as rice cultivation, vegetable cultivation and dairy farming were not found having any significant correlation with the respondents' decision making ability. The variable decision making ability of the respondents was observed having positively significant relationship with their extent of adoption of fish farming improved practices. Proper education and training on fisheries management practices coupled with field demonstrations are of paramount needs to tap potential in fisheries and aquaculture in the district. Therefore, there is the need for embarking on indigenous personnel training who understand the local eco-system and water resources with the utilization of adaptable technologies for ensuring reliability and sustainability of the system.

### 5.10

Enhancing favourable and positive attitude of the farmers could improve technology adoption level of farmers particularly in rice cultivation, vegetable and fisheries as shown by their corresponding positive and significant 'r' values (co-efficients of correlation). Awareness programmes followed by location specific and enterprise based training programmes on technology adoption and demonstrations are essential to enhance farmers' knowledge and acceptance of new innovations and adoption in their farming situations.

**Multiple regression analysis of selected independent variables with their extent of technology adoption of different enterprises under diversified farming systems is given in Table-2.**

The multiple regression analysis was employed to determine the relative influence of each independent variable in explaining the variation in the dependent variable. The ten independent variables, namely; age, education, extension contact, annual income, operational land holding, economic motivation, innovation proneness, risk orientation, decision making ability and attitude towards farm diversification were included for the purpose of this study and analysis was done separately for each of the selected enterprises. The predictive power of each multiple regression was estimated by working out the value of co-efficient of determination ( $R^2$ ). To test the statistical significant of the regression co-efficient, the 't' values were also calculated.

A perusal of the Table-2 reveals that 7 (seven) out of 10 selected independent variables viz; education, extension contact, annual income, operational land holding, economic motivation, innovation proneness and attitude towards farm diversification of the farmers had significant influence on extent of adoption of improved rice cultivation practices under the selected farming system as shown by their significant 't' values. The independent variables such as education, extension contact, annual income, economic motivation, innovation proneness and attitude towards farm diversification of the farmers had also significant contribution towards extent adoption of the selected vegetables cultivation practices by the farmers. The table also shows that in case of technology adoption of dairy farming, 6 (six) variables, namely; education, extension contact, annual income, operational land holding, economic motivation and innovation proneness were found positively significant 't' values, indicating that these variables had undoubtedly significant influence on the extent of adoption of dairy innovations. Barring age, all variables under the study had, as shown by their corresponding 't' values, yielded positive and significant influences on their technology adoption of fisheries enterprise. It can also be noted that other variables had also significant influence on technology adoption of selected enterprises under diversified

farming system as indicated by their significant “F” values (F=2.212\* in Rice, F=2.544\* in vegetable, F=2.930\*\* in Dairy and F=2.850\* in Fishery).

The co-efficients of determination ( $R^2$ ) with 10 independent variables were found to be 0.394, 0.558, 0.602 and 0.594 respectively for rice, vegetable, dairy and poultry, which implies that all the ten independent variables fitted together in the regression model could explain about 39.40%, 55.80%, 60.20% and 59.40% of the total variations in the extent of technology adoption of rice cultivation, vegetable cultivation, dairy farming and fishery under diversified farming system.

## 6. Conclusions and Recommendation

The findings from this study have significant implications on technology adoption of different selected land based enterprises under diversified farming system in the state of Assam, India. According to the results of this study, the main important factors on technology adoption of rice cultivation, vegetable cultivation, dairy farming and fisheries were education, extension contact, annual income, economic motivation and innovation proneness. There is a call for the extension agencies and other concerned departments to manipulate these crucial factors through both intensive and extensive training programmes and other extension efforts in order to bring about desirable changes in the adoption behaviour of farmers towards diversified farming, which can increase the tendency to the technology adoption of different enterprises. It can also be suggested that those significant independent variables under different enterprises should get more emphasis and care through concerted efforts while formulating different development strategies and programmes for farmers under diversified farming system in the area of study. Therefore, the socio-economic and psychological variables substantially influencing the technology adoption of different enterprises must be taken into consideration while accelerating the pace of technology adoption under diversified farming system.

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Table 1. Simple Correlation analysis of independent variables of the respondents with their extent of technology adoption of different enterprises under Rice based farming system

Sl. No.	Independent variables	Rice		Vegetable		Dairy		Fishery	
		'r' value	't' value						
1.	Age	0.117	0.763	-0.066	-0.430	0.125	1.379	-0.171	-1.106
2.	Education	0.601	3.150**	0.430	2.546*	0.333	2.059*	0.355	2.176*
3.	Extension Contact	0.342	2.107*	0.355	2.176*	0.333	2.059*	0.378	2.295*
4.	Annual Income	0.440	2.501*	0.340	2.097*	0.361	2.208*	0.399	2.399*
5.	Operational land holding	0.345	2.123*	0.299	1.871	0.393	2.370*	0.007	0.046
6.	Economic motivation	0.540	2.980**	0.376	2.285*	0.370	2.254*	0.337	2.081*
7.	Innovation proneness	0.376	2.285**	0.345	2.123*	0.388	2.345*	0.360	2.206*
8.	Risk orientation	-0.123	-0.801	0.037	0.243	0.339	2.091*	0.332	2.054*
9.	Decision making ability	0.150	0.974	-0.091	-0.596	0.313	1.947	0.356	2.182*
10.	Attitude towards farm diversification	0.376	2.285*	0.349	2.145*	-0.165	-1.067	0.376	2.285*

\* Significant at 0.05 level of probability

\*\* Significant at 0.01 level of probability

Table 2. Multiple regression analysis of independent variables of the respondents with their extent of technology adoption of different enterprises under Rice based farming system

Sl. No.	Independent variables	Rice		Vegetable		Dairy		Fishery	
		'b' value	't' value						
1.	Age	1.644	1.430	-3.629	-1.625	4.865	1.703	0.222	0.079
2.	Education	1.637	3.385*	4.364	2.116*	2.845	2.246*	2.244	2.349*
3.	Extension Contact	1.578	2.353*	2.245	2.316*	3.779	2.308*	4.113	2.537*
4.	Annual Income	4.421	2.784*	4.447	2.622*	4.008	3.229**	10.008	2.969**
5.	Operational land holding	2.676	2.105*	5.661	1.981	5.932	2.497*	7.754	2.170*
6.	Economic motivation	2.451	2.220*	2.665	2.444*	4.476	2.043*	6.003	2.196*
7.	Innovation proneness	2.267	2.062*	2.579	2.662*	3.507	2.149*	1.076	2.225*
8.	Risk orientation	-0.139	-0.524	0.413	0.800	3.518	0.819	3.419	2.077*
9.	Decision making ability	0.551	1.923	-0.495	10.89	0.939	1.501	3.146	4.522**
10.	Attitude towards farm diversification	2.101	3.532**	2.799	2.357*	-0.731	-2.272	4.254	2.457*
	R <sup>2</sup> (with 10 independent variables)	0.394		0.558		0.602		0.594	
	'F' value	2.212*		2.544*		2.930**		2.850*	

\* Significant at 0.05 level of probability

\*\* Significant at 0.01 level of probability