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FACTORS LIMITING ADOPTION OF RICE PRODUCTION TECHNOLOGIES IN LOKOMASAMA LITTLE SCARCIES RIVER MANGROVE SWAMP RICE FARMING COMMUNITY

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ABSTRACT
The poor rate of adoption of agricultural innovations in developing countries especially Sierra Leone, is caused by several factors including physical, technical, economic, and social factors. This paper reports investigation on the factors limiting the adoption of rice production technologies in Lokomasama Little Scarcies River Mangrove swamp rice farming community in Northern Sierra Leone. Multi-stage and purposive sampling and random sampling techniques were used to select the district, chiefdom and swamp farmers. The research adopted descriptive cross-sectional design with population of 110 swamp rice farmers. Questionnaires, informal interviews and focus group discussions were used to obtain the primary data. The research discovered that slightly over half of sample clients (51.0%) rejected and (49.0%) adopted some improved rice varieties. All sample farmers (100.0%) did not adopt power tillers and rice threshers due to their unavailability to clients. All sample clients (100.0%) indicated that recommended husbandry practices are difficult to adopt. Most farmers (70.0%) indicated that the improved hoes and sickles were easy to adopt. It was concluded that Farmers' participation in rice technology development and extension linkages between MAFFS, RRSR and rice farmers were absent. There is, therefore, the need for greater efforts by RRSR, MAFFS and NFASL to improve on the development and delivery of rice production innovations to mangrove swamp rice farmers in the area studied. It was recommended that the cost of improved seed rice should not be greater than the cost of indigenous seed rice, and that fertilizer must be affordable in order to enable resource poor farmers to purchase them; that farmers must be able to use recommended seed rates on their own without relying on external assistance; and that government should subsidize acquisition of improved tools (hoes and sickles) by farmers.

KEY WORDS: Adoption, Mangrove Swamp, Rice Farmers, Improve Innovations, Limiting Factors.

INTRODUCTION

Rice is the staple food of Sierra Leone, and is cultivated in three ecologies (upland, inland valley swamp (IVS) and mangrove swamp) in the Lokomasama side of the Little Scarcies River. Majority of the farmers are mangrove swamp farmers due to the preponderance of mangrove swamps along the Little Scarcies River and its tributaries. Most of the population in this region derives their major income from mangrove swamp farming for meeting their food, health, children's education and other social requirements (Spencer, 2010). The farmers consumed most of the rice they produced, the remainder they sell to meet other needs. It often sold outside Lokomasama region *i.e.* other regions like the western area. Thus, the availability of rice in none rice-producing regions of Sierra Leone would be enhanced by attainment of high rice yields by Lokomasama rice farmers. The importance of the adoption of improved rice production techniques in the mangrove swamp ecology, like in other rice ecologies, was recognized long before the independence of this country. Previous and present governments have involved in the generation and extension of improved rice production techniques since 1934, through the Rice Research Station, Rokupr (RRSR) and the Ministry of Agriculture, Forestry and Food Security (MAFFS). In spite of these efforts mangrove swamp rice yields remain low, 1.1ton/hectares (Spencer, 2009), and farmers continue to cultivate indigenous rice varieties and do not adopt appropriate farm machines, fertilizers and improved crop husbandry practices. Communities along the Little Scarcies River on the Lokomasama side are predominantly mangrove rice farming communities. Majority of these rice farmers are subsistence farmers that consume about 70% and sell about 30% of their rice outside the production area (PEMSD, 2013). Rice farming is the major source of income for most of the rice farmers and account for almost 29% of their total annual sales values (Spencer *et al*., 2009). Virtually, every person in these communities directly or indirectly depends on rice cultivation for satisfying their needs such as daily caloric intake, health, education, marriages, funerals and other social functions. Thus, bumper and poor rice harvests translate into rise and fall respectively of the standard of living of these communities in particular and the non-rice producing areas of Sierra Leone in general. As in the case, in most rural communities in Sierra Leone rice farming is the main form of employment for the people, since majority of these communities even lack schools and clinics. Good rice yields in these communities alleviate the government's rice import requirements because the rice cultivating communities would have large surpluses to sell outside the rice producing zones.

It is universally recognized that development in every sphere relies on research and adoption of innovations, to which rice production is no exception. Rice research and extension have long been an integral part of the country's agricultural sector since 1934 when the RRSR was established. Over the years, the RRSR (Now SLARI) developed several improved rice technology packages to increase productivity and income of farmers cultivating in the various agro-ecologies (including mangrove) in Sierra Leone. These include 33 improved high yield rice varieties, improved cultural practice for soil amelioration and crop husbandry, as well as labour saving devices for crop productivity and reduction of post-harvest losses.

Extension activities of improved rice innovations are carried out principally by the Ministry of Agriculture, Forestry and Food Security (MAFFS) and bilateral agricultural projects, as well as Non-Governmental Organizations (NGOs) such as the German-Sierra Leone Seed Multiplication project (SMP) and Community Action for Progress (CAP, local NGO). The adoption and spread of these new rice production packages among farming communities in the country has been extremely slow (Spencer *et al*., 2011). Since 1934 RRSR has been engaged in rice research and over the years it developed many rice technologies such as improved rice varieties; improved husbandry or agronomic practices like transplanting, straight line sowing, seed rates, regular spacing between hills, nursery area of 1/10 swamp area, Improved rice production tools, fertilizer application rates, appropriate use of farm machinery (power tillers and rice threshers); and post-harvest reduction methods. The conventional agricultural systems have for a long time promoted rice technology packages developed by the RRSR to a farmer audience through farmer group meetings or/and demonstration plots. However, small-scale resource poor farmers (including Lokomasama mangrove swamp rice farming communities) rarely implement the new technologies promoted by the agricultural extension messages (African Development Bank, 2005 WFP, 2008).

The very slow adoption and spread of the improved rice production technologies among farming communities in the country is indicative of the existence of factors that are preventing or limiting the adoption of improved rice techniques by farmers in Sierra Leone in general and the study area particular. The long period (over 60 years), it took for even the very low rates of adoptions and spread of rice innovations in the country buttress the existence of factors that are preventing or inhibiting the adoption of modern rice farming practices. The lack or slow rate of adoption of rice innovations is over 60 years of rice research and extension suggest that until these factors that are limiting the adoption and spread of rice innovation are identified and resolved or appropriately addressed rice-farming communities would never adopt improved rice farming techniques. And until improved rice technologies are adopted by rice farming communities in the country the very low rice yields, 1.1tonnes/hectare (UNICEF (2010). Consequently, these rice farming communities in particular and the nation in general would never attain self-sufficiency in rice and related high standard of living. This study is therefore, an attempt to assess the factors that are limiting the adoption of rice innovations by the Lokomasama Little Scarcies river mangrove swamp rice farming communities. It is hoped that this study will accelerate domestic rice production, which cannot be done through area increases but rather through intensification of existing rice production areas. It would assist researchers, extension staff and policy makers in particular in halting the slow rate of non-adoption of rice innovations by enhancing the development and adoption of appropriate and acceptable rice production techniques. Moreover, this study will help forward the career development of the researcher as an employee of RRSR, and it will assist the government to formulate and implement policy guidelines in the following: Coordination among researchers, extension staff and farmers. (b) Provision of credit programmes for agricultural inputs/services; and (c) Promotion of the membership of all farmers to the National Farmers Association. The main aim of the study is to assess the factors that are limiting the adoption of rice innovations by Lokomasama Little Scarcies river mangrove swamp rice farmers, in the Port Loko District, in Sierra Leone.

Objectives of the study

1. Identify the rice innovations that farmers adopted or rejected and reasons for their decisions.
2. To identify factors that militates against the adoption of rice innovations in relation to mangrove swamp rice cultivation.

General propositions of the study

The following general propositions were formulated, in order to achieve the objective of the study:

1. That the mangrove swamps rice farmers of the Lokomasama side of the Little Scarcies river adopted improved rice varieties.
2. That the mangrove swamps rice farmers of the Lokomasama side of the Little Scarcies river adopted the use of fertilizer.
3. That the mangrove swamps rice farmers of the Lokomasama side of the Little Scarcies river adopted improved tools (power tiller and rice threshers).
4. That the mangrove swamps rice farmers of the Lokomasama side of the Little Scarcies river are members of the National Farmers Association of Sierra Leone (NFASL).

METHODOLOGY

The Study Area

This study was done on the Little Scarcies river mangrove swamp rice farmers on the side of Lokomasama chiefdom in the Port Loko district, Northern Province of Sierra Leone. The Little Scarcies mangrove swamps spread through Lokomasama, Bureh and Sanda Magbolontor chiefdom in the Port Loko district and Manbolo chiefdom in Kambia district. The area studied shares common borders with Bureh chiefdom to the East; Mambolo chiefdom to the north; and the Atlantic Ocean to the west. Precisely it lies between latitude 8 and 35' and 8 52' North of the Equator, and longitude 12 52' and 13 15' West of Greenwich. Dry season and rainy season periods each lasting approximately 6 months characterizes the study area. The dry season commences in October/November and terminates in April/May. It is sub-divided into three seasons such as: (1) the pre-Harmattan (November and December); (2) the cold and dry Harmattan (January and

February); and (3) the hot and dry season (March and April). The rainy season starts in May/June and ends in October/November. The topography of the area is gently undulating and flat, with one principal river (The Little Scarcies River) that separates Lokomasama chiefdom in the Port Loko district and Mambolo chiefdom in Kambia district. The vegetation is principally forest with savanna grassland in few parts of the uplands, while the mangrove swamps are virtually treeless except few isolated, mangrove trees doted along the riverbank and tributaries and few sports in the mangrove swamps. Temne is the dominant ethnic group in the study area that has a population of approximately 7,000 farm families (SSL, 2004). These are farmers that also do other activities such as tailoring, trading and fishing.

Farming System in the Study Area

Rice is the sole crop cultivated in mangrove swamps and it account for about 90% of the area under cultivation in the study area. The rice-growing period is directly related to the distance of the rice cultivating areas from the sea. The length of the salt-free period increases with increasing distance away from the sea. Three mangrove-growing zones can be distinguished depending on the duration of the salt-free period: (1) long growing season zone: with salt-free periods of more than 6 months; (2) medium growing season zone: with salt-free periods of 4-6 months; and (3) short growing season zone: with salt-free periods of less than 4 months (Ghermandi, et al 2008; Rebelo *et al*., 2009). Mangrove swamps are continuously cultivated every rainy season and are influence by high and low tides. The river water at each high tide floods in the year. Saline water fills up the river and creeks in the dry season and floods the alluvial land along them. In the rainy season the flow of the river is greatly increased and fresh water floods the land at high tides. If short duration varieties are used, it could be possible to grow two rice crops in the upper reaches of the river (Wood, 2009),). This is not however done by the farmers. High tides contribute to the growing of rice in these swamps especially when the rains are less frequent at the close of the season. Rice could be grown in the swamps all the year round in the absence of salinity problem.

The range of tools and equipment owned by mangrove rice farmers is the same as on upland except for the hoes, and planting irons or sticks used by mangrove farmers. Hoes used in mangrove rice farming are usually the long handled type of mattock, not short handled type. Main tools used in mangrove swamp farming are: hand hoes, cutlasses, planting irons or sticks and harvesting knives.

Mangrove swamp rice cultivation stages or operations such as land preparation, planting and harvesting are the same as IVS, upland and bolilands rice cultivation except tending stage. Tending of mangrove swamps is virtually nil. There are no pest and weed control activities. Digging and saline condition of the swamps control weeds to a high degree. It is claimed that fencing along the bank of the river and creeks given some control for fish, farmers rarely employ this practice.

Mangrove swamp rice yield (1.1t/ha PEMSD, 2010) are higher than upland rice (0.8t/ha acre, 1983). KUATIK KUNDUR, ROK 5, ROK 10 and CP4 are probably the most widely grown improved rice varieties in the Great Scarcies river (Adesina & Zinna, 1993), and Zero Kent, Minique, Bundu, Dambaya and Marisa are among the most popular local rice varieties (Matsui *et al*., 2006).

Measurements of the Key Study Variables

Primary and secondary data was collected for the study. The former produced the main study variables consisting of innovations' parameters while the latter was the source of the general information of the farmer's extension staff and researchers. For successful development and dissemination of appropriate, affordable and sustainable rice innovations it is crucial to understand these demographic characteristics. The main indicators of rates of adoption of rice technologies used in the study include; age, education, membership of national farmers association, family size, non-farm activities, contact with extension agents, awareness of rice innovations, sources of information and contact with rice researcher (Wood, and van Halsema, 2008.). The 'yes' was assigned to a farmers who adopted rice innovations (*i.e.* improved rice varieties, fertilizers, improved tools, appropriate farm machines and husbandry practice) and 'no' to a non-adopter that represented the dependent variables. Among the independent variables, age was recorded as that given by the farmers in the year. It was difficult to get actual farmers' age due to lack of birth certificates and thus, age was only estimated based on historic events at the time of birth. The level attained in schooling (*i.e.* Primary, Secondary and Tertiary) was used to measure the level of education and Arabic regarded as non-formal education.

Sample Selection of Respondents

For the purpose of selecting the sample farmers, a combination of purposive and simple random sampling techniques were adopted. In order to have farmer respondents in each of the three mangrove rice-growing zones along the Little Scarcies river on the Lokomasama chiefdom side, six (6) villages were purposively selected in each of these mangrove rice-growing zones in the study area. Next, twenty (20) household head farmers were then selected per village using random sampling technique.

In all, 110 farmers were interviewed out of 120 selected and these provided most of the information on which the work is based on. It was not possible to interview ten (10) farmers because they had either moved to other places or died.

The chief in each of the six (6) villages supplied the names of household heads from which respondents were randomly selected.

Data Collection Methods: The main instruments used for collecting data were:

- Questionnaire
- Informal interviews and discussions; and
- Desk survey.

(a) Questionnaire: Structured questionnaires were one of the techniques employed to collect data from each of the selected rice sample farmers. The mangrove rice farmers were pre-tested with the developed questionnaires in the study area. The practice offered the chance to evaluate the appropriateness of the survey instrument, discover concepts that may not be clear to farmers and correct ambiguous questions of omissions. A mixture of both open-ended and pre-determined questions was used in the questionnaire Adams *et al.* (2015) discussed the advantages and disadvantages of using both types of questions. The open-ended questions are difficult to collate but give access to more information that cannot be readily available from structured questionnaire. The structured questions enhance the comparison of results. Also, because the information they give is channeled and restricted, they are easier to collate.

The administration of the questionnaire to sample mangrove rice farmers was done in face-to-face due to their high illiteracy level.

(b) Informal Interviews and Discussions: Non-formal discussions were held with some farmers, Rice research Station Scientists and extension staff of the Ministry of Agriculture, Forestry and Food Security.

The main reason for employing this technique is that some information can hardly be obtained through the administration of questionnaires. During informal conversations, persons' expressions and body movements or gesture could reveal a lot especially when he/she has no fear.

(c) Desk Survey: Published literature on research, extension and adoption of agricultural production techniques were read by the researcher. This was done in order to be aware of past and current methods employed in the promotion of agricultural production as well as works of other people in order to facilitate this exercise.

Data Analysis Techniques: Many tools that offered the framework for the analysis of survey data exist. In order to handle the research problem in section 1.4, the following analytical methods were used namely; (1) Descriptive statistics; and (2) Chi-square test.

(a) Descriptive Statistics: To achieve the first objective of the study, descriptive statistics was used. This was done in order to compare the demographic characteristics of users and non-users of rice innovations. The information collected was first summarized to give raw scores. Some of the raw scores were now converted into percentages and presented in tabular forms. Descriptive statistics techniques were employed to calculate means, modal values and rage.

(b) Chi-square Test: The four hypothesis of the study were analyzed using the Chi-square test. This statistical tool was used to either confirm or reject each hypothesis of the research. Three applications of the Chi-square test exist for the analysis of attribute data namely:

1. Fixed ratio hypothesis
2. Independence in a contingency table, and
3. Homogeneity of ratio

The second type of the application of the chi-square test ("Test for independence in a contingency Table") (Gomez & Gomez, 1976) was utilized in this study. The level of significance chosen for this study was 5% (0.05). The number of classes in the data was based on two classification criteria, one with row (r) classes and the other with column (c) classes. The final data formed an r x c contingency Table. Researcher looked at the adoption of rice innovations in six villages and wished to know if villages based on mangrove rice growing zones of farmers affected adoption. There were three distinct classes of rice growing season status (the first classification criterion)- (1) Long season zone; (2) medium season zone; and (3) short season zone (two villages were selected from each of these rice growing zones)- and two classes of adoption status (the second classification criterion- (1) adopter and (2) non-adopter- the resulting data formed a 3 x 2 contingency table. With that contingency table, it was asked whether or not the ratio of the various classes in the first classification criterion remained the same over all classes of the second classification criterion. If the answer was yes, the two classification criteria were said to be dependent. The question for this study was whether the ratio of adopters to non-adopters remained the same for all classes of growing zone status or whether the farmers' adoption of the rice innovation was independent of zone status. The chi-square test for independence in a contingency Table was the appropriate procedure for answering the question.

The chi-square test is based on a family of distributions, where the shape of distribution is based on degrees of freedom. In general degrees of freedom associated with chi-square may be determined by the formula:

(Row-1) (Column-1)=degrees of freedom.

The chi-square formula was applied to the data as they appeared in the tables. The formula involves a summation of the squared differences between each observer (O) frequency and its associated expected (E) frequency, divided by the expected frequency (E)

Therefore;

$$x^2 = \frac{(\mathrm{O} - \mathrm{E})(\mathrm{O} - \mathrm{E})}{\mathrm{E}}$$

Note:

- Row variables are used with classes and column variables with c classes in a r x c contingency table.
- Nij denote observed value in i^{th} class of the row variable and j^{th} class of the column variable; or the $(i,j)^{th}$ cell.

Procedure for chi-square;

First step: Calculate the

a) Row totals (R)
b) Column totals (C)
c) Grand totals (G)

Second step: calculate the expected value of each of the r x c cells like this:

$$E_{ij} = \sum\sum \frac{(\mathrm{n_{ij\sim}\, E_{ij}})2}{\mathrm{Eij}}$$

Fourth step: The calculated X^2 value is compared with the tabular X^2 values. The null hypotheses were rejected at the 5% (0.05) level of significance if the computed X^2 value was equal to or exceeded the corresponding tabular x^2 value. But the null hypotheses were not rejected at the 5% level of significance if the computed x^2 value were not equal to or greater than the corresponding tabular x^2 value.

Limitations and Constraints of the Study

There are hardly ideal condition/situation for any research due to the possibility of factors that may inhibit the study. The following limitation and constraints were incurred in the study:

- Scope of the study
- Problem of meeting farmers
- Inadequate funding; and

- Problem of transportation

(a) Scope of the Study: The scope of the research was the main limitation of the study. Only farmers in six villages were investigated in Lokomasama chiefdom, Port Loko district, Northern Province. Other mangrove swamp rice growing regions in the country could have been covered if the researcher had sufficient funds, time and personnel.

(b) Problems of Meeting Farmers: For appointments or interviews some of the farmers were met at home, while others were met on their farms. In all villages non-return visits were made during which they were interviewed.

Some farmers refused to be interviewed when first approached. However, when they understood that the research was neither for government purpose, nor for NGO project, but was absolutely for academic exercise they fully cooperated.

(c) Inadequate Funding: The field data was collected with the assistance of two field enumerators, as a consequence of insufficient funds.

Financial constraints were incurred in the research in the research especially in acquisition of stationeries, printing of questionnaires and travelling to the research area.

(d) Problem of Transportation: Transportation problems encountered were of two types:

- The road transportation; and
- The river transportation.

The roads from Lungi airport towards the Little Scarcies river were unpaved, dusty, bumpy, narrow and hazardous.

Travelling between villages along the Little Scarcies river can only be done through boats which were not regular and were very slow. In some cases the researcher had to walk on foot from one village to the other and in most cases had to spend at least a night in the villages to conduct interviews.

RESULTS

1. R**ice innovations that farmers adopted or rejected and reasons for their decisions**

Low total rates of farmers (7.0%) with highest numbers of 12.5% in Rombe, and the lowest numbers of 5.0% in Patifu and 5.0% in Katik – in case of RRSR/WARDA; and 4.0% with highest number of 6.3% in Rombe and lowest numbers of 0.0% in Konta and 0.0% in Katoma – in case of radio were aware of innovations.

On the whole, fellow farmers/family members were the predominant source of farmers' information for improved rice innovations.

TABLE 1: Distributions of farmers' sources of information of rice innovations and villages

Sources of Information	**VILLAGES**						
	Patifu (N=20)	Katik (N=20)	Konta (N=16)	Rombe (N=16)	Katoma (N=18)	Katonga (N=20)	Total (N=110)
	No.(%)	No. (%)	No. (%)	No. (%)	No.(%)	No.(%)	No. (%)
Extension staff	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
NFASL	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
RRSR/WARDA	1(5.0%)	1(5.0%)	1(6.3%)	2(12.5%)	1(5.5%)	2(10.0%)	8(7.0%)
Radio	1(5.0%)	1(5.0%)	0(0.0%)	1(6.3%)	0(0.0%)	1(5.0%)	4(4.0%)
Fellow farmer/Family member	15(75.0%)	14(70.0%)	13(81.3%)	11(68.3%)	14(77.8%)	13(65.0%)	80(73.0%)
CAP	3(15.0%)	4(20.0%)	2(12.5%)	2(12.5)	3(16.7%)	4(20.0%)	18(16.0%)
Total	20(100.0%)	20(100.0%)	16(100.0%)	16(100.0%)	18(100.0%)	20(100.0%)	110(100.0%)

Source: Field survey 2015

Researchers' and Extension Staff's Awareness and Correct Knowledge of Farmers' Local Mangrove Swamp Rice Farming Practices

In other to determine whether or not extension staff and researchers were really knowledgeable about farmers' local mangrove rice farming practices, they were asked to respond to questions of farmers' practices that they perceived to be curious (*i.e.* better than some of the recommendations from RRSR/WARDA) and to indicate the best local mangrove rice varieties according to farmers' preferences. For the extension agents, 22.0% of the respondents indicated that they were of local mangrove rice farming practices that were better than RRSR/WARDA recommendations, and just one of them had correct knowledge of at least local Little Scarcies river mangrove swamp rice varieties which were rated by farmers. Eighteen percent of the researchers were of local mangrove rice farming practices that were superior to some of the practices recommended by RRSR. However, when they were asked to name at least two of the best local Little Scarcies mangrove swamp rice varieties, none of them had correct knowledge of any of the varieties that farmers rated highly. On the whole, extension staffs of MAFFS and RRSR scientists were not much aware of farmers' good local mangrove swamp farming practices and highly rated local rice varieties.

Adoption/Rejection of Improved Rice Production Techniques: Determining whether or not the farmers of the study area were growing improved rice varieties, and also using improved husbandry techniques, tools and appropriate farm machines is vital in this study. Thus, sample farmers were asked whether they were adopting or not adopting the improved rice techniques they were aware of, and to give reasons for their decisions.

Adoption/Rejection of Improved Rice Varieties: The farmers were surveyed whether they adopted or rejected the improved rice varieties. The results are presented in the table below. The table shows that slightly below half (49.0%) had adopted the improved rice varieties and the number was highest in Katik (60.0%) and lowest in Rombe (43.8%). Over half (51.0%) did not adopt the improved rice varieties and the number was highest in Rombe (56.2%) and the lowest in Katik (40.0%).Overall, over half of the sample farmers did not adopt the improved rice varieties. Most of the farmers adopted/rejected more than one improved rice variety. The results are presented in the table below.

TABLE 2a: Numbers of sample farmers that adopted or did not adopt improved rice varieties

State of Adoption of Rice	VILLAGES						
	Patifu(N=20)	Katik(N=20)	Konta(N=16)	Rombe(N=18)	Katoma(N=18)	Katonga(N=20)	Total
	No. (%)	No.(%)	No.(%)	No.(%)	No.(%)	No. (%)	No.(%)
Adopted	9(45.0%)	12(60.0%)	8(50.0%)	7(43.8%)	9(50.0%)	9(45.0%)	54(49.0%)
Not Adopted	11(55.0%)	8((40.0%)	8(50.0%)	9(56.2%)	9(50.0%)	11(55.0%)	56(51.0%)

Source: Field survey 2015

Four improved rice varieties were widely adopted, namely ROK5, ROK10, Kuatik Kundur and CP4. Their total adoption rates were 49% with high numbers in Katik (60.0%) in Konta (50.0%) and in Katoma (50.0%), and low numbers in Rombe (43.8%), in Patifu (45.0%), and in Katonga (45.0%) for ROK5; 48% with high numbers in Rombe (37.5%), in Katoma (44.4%) and in Patifu (45.0%) in the case of ROK10; 5% with high numbers in Patifu (10.0%), in Katonga (10.0%) and in Rombe (6.3%), and none in Katik (0.0%), in Konta (0.0%) and in Katoma (0.0%), in the case of KUATIC KUNDUR; and 34% with high numbers in Katonga (40.0%) and in Katoma (38.9%), and low numbers in Patifu (30.0%), in Katik (30.0%), in Konta (31.3%) and in Rombe (31.3%) in the case of CP4. Other improved rice varieties, ROK 23, BD2 and SR 26 had low total adoption rates of 4% with high numbers in Rombe (12.5%), in Katoma (5.6%) and in Katonga (5.0%). And none in Patifu (0.0%), and Konta (0.0%) in the case of ROK23; 3% with high numbers in Konta (6.3%), in Patifu (5.0%) and in Katonga (5.0%), and none in Katik (0.0%), Rombe (0.0%) and Katoma (0.0%) in the case f BD2; and 2% with high numbers in Katoma (5.6%) and in Katik (5.0%), none in Patifu (0.0%), Konta (0.0%), Rombe (0.0%) and Katoma (0.0%) in the case of SR26.

Reasons for their adoption of some of the improved rice varieties in the Lokomasama side of the Little Scarcies zone were: a short duration rice variety (<4months) and thus matures at the hunger period i.e. when popular long varieties are not ready; its yield is as high as their native rice varieties, and in some farmers' field higher than their local varieties; ROK 10, ROK 23, KUATIK KUNDUR, CP4, BD2 and SR26 are medium and long duration varieties (>4 months), are high tillering and high yielding. Farmers also reported that they do well as their local varieties in nurseries under their management practices; and ROK 5 and 10 were been aggressively promoted by CAP in the study area zone. The table also indicates that all the sample farmers (100.0%) – (i.e. 100.0% in each of the villages (Patifu, Katik, Konta, Rombe, Katoma, and Katonga) absolutely rejected the nine improved rice varieties (ROKs 3, 8, 9, 11, 22, 28, 29 and WAR 115-1-2-2). Other improved rice varieties, ROK23, BD2 and SR26 had high rejection rates of 96.0% with high numbers in Patifu (100.0%), Katik (100.0%) and Konta (100.0%), and relatively low numbers in Katonga (95.0%), Katoma (94.4%), and Rombe (87.5%) in the case of ROK23; 97.0% with high numbers in Katik (100.0%), in Rombe (100.0%) and in Katoma (100.0%), and relatively low numbers in Katoma (95.0%), in Patifu (95.0%), and in Konta (93.7%) for BD2; and 98.0% with high numbers in Patifu (100.0%), in Konta (100.0%), in Rombe (100.0%) and in Katoma (100.0%), and relatively low numbers in Katik (95.0%) and in Katoma (94.4%) in the case of SR26.

TABLE 2b: Distribution of sample farmers per variety adopting and not-adopting improved varieties and villages

Improved Rice Variety	VILLAGES						
	Patifu(N=20)	Katik(N=20)	Konta(N=16)	Rombe(N=16)	Katoma(N=18)	Katonga(N=20)	Total
	No. (%)	No. (%)	No.(%)	No.(%)	No.(%)	No. (%)	No.(%)
ROK 29							
Adopting	0(0.0%)	0(0.0%)	0(0.0%)	00.0%)	0(0.0%)	0(0.0%)	0(0.0%)
Not Adopting	20(100.0%)	20(100.0%)	16(100.0%)	16(100.0%)	18(100.0%)	20(100.0%)	110(100.0%)
BD2							
Adopting	1(5.0%)	0(0.0%)	1(6.3%)	0(0.0%)	0(0.0%)	1(5.1%	3(3.0%)
Not Adopting	19(95.0%)	20(100.0%)	15(93.7%)	16(100.0%)	18(100.0%)	19(95.0%)	107(98.0%)
SR 26							
Adopting	0(0.0%)	1(5.0%)	0(0.0%)	0(0.0%)	1(5.6%)	0(0.0%)	2(2.0%)
Not Adopting	20(100.0%)	19(95.0%)	16(100.0%)	16(100.0%	17(94.4%)	20(100.0%)	108(98.0%)
CP4							
Adopting	6(30.0)	6(30.0%)	5(31.3%)	5(31.3%)	7(38.9%)	8(40.0%)	37(34.0%)
Not Adopting	14(70.0%)	14(70.0%)	11(68.7%)	11(68.7%)	11(61.1%)	12(60.0%)	73(66.0%)
KAUTIK-KUNDUR							
Adopting	2(10.0%	2(10.0%	0(0.0%)	0(0.0%)	00.0%)	2(10.0%)	5(5.0%)
Not Adopting	18(90.0%)	1890.0%)	16(100.0%)	16(100.0%)	18(100.0%)	18(90.0%)	105(95.0%)
WAR11-5-1-2-2							
Adopting	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
Not Adopting	20100.0%)	20(100.0%)	16(100.0%)	16(100.0%)	18(100.0%)	20(20.0%)	110(100.0%)

Source: Field survey 2015

ROKs 5 and 10, CP4 and Kuatik Kundur had relatively moderate non-adoption rates. Their total rejection rates were 49.0% with high numbers in Rombe (56.2%), in Patifu (55.0%), in Konta (50.0%) and in Katoma (50.0%), and low numbers in Katonga (45.0%) and in Katik (40.0%) in the case of ROK5; 52.0% with high numbers in Rombe (62.5%), in Katoma (55.6%) and in Patifu (55.0%), and low numbers in Konta (5.0%), in Katonga (50.0%) and in Katik (40.0%), with respect to ROK10; 66.0% with high numbers in Patifu (70.0%), in Konta (68.7%)< and in Rombe (68.7%), and low numbers in Katoma 61.1%) and in Katonga (60.0%) for CP4; and 95.0% with high numbers in Katik (100.0%), in Konta (100.0%) and in Katoma (100.0%), and low numbers in Rombe (93.0%), in Patifu (95.0%) and in Katonga (90.0%) in the case of Kuatik Kundur. The rejection rate of improved rice varieties by sample mangrove swamp rice farmers was on the whole high and significant. Reasons for the rejection or non-adoption of some of the improved rice varieties were: grain yield of the rejected rice varieties were lower than the local rice varieties; improved rice varieties did not do well in nurseries as local rice varieties under normal farmers' condition (without fertilizer application); farmers were not aware of some of the improved rice varieties; they lacked access to fertilizers, which facilitate the good performance of improved varieties in Nurseries; and improved rice varieties were low tillering and easily succumbed to crab damage.

Adoption/Rejection of Fertilizers

Farmers were studied for adoption of fertilizers and the results are presented in the table below: The table shows that the use of chemical fertilizers by mangrove swamp farmers was low. A rate of 32.0% with the highest number in Katoma (44.4%), and the lowest number in Konta (18.8%) of the sample farmers adopted the use of UREA and NPK in their rice nurseries and vegetable gardening. Reason for their use of fertilizers in the study was that fertilizers facilitated the good growth of rice nurseries and vegetables.

Above two-third of the farmers (68.0%) with high numbers in Konta (81.3%), in Katik (70.0%) and in Katonga (70.0%), and low numbers in Katoma (55.6%), in Patifu (65.0%) and in Rombe (68.8%) of sample farmers rejected the use of fertilizers. On the whole, the use of fertilizers by farmers in mangrove swamp rice farming was very low and insignificant. Majority of sample mangrove swamp rice farmers rejected or did not adopt the application of fertilizers in rice farming. Reasons given for the high non-adoption rates of fertilizers were; there are no credit opportunities for the acquisition of fertilizers; and farmers do not apply fertilizers in their mangrove swamp rice crop because of the lack of water control as a consequence of tidal effects.

TABLE 3: Distribution of sample farmers by adoption and non-adoption of fertilizers and villages

State of Fertilizer Adoption	VILLAGES						
	Patifu(N=20)	Katik(N=20)	Konta(N=16)	Rombe(N=16)	Katoma (N=18)	Katonga(N=20)	Total
	No (%)	No (%)	No(%)	No(%%)	No(%)	No(%)	No(%%)
Adopted	7(35.0%)	6(30.0%)	3(18.8%)	5(31.3%)	8(44.4%)	6(30.0%)	35(32.0%)
Not adopted	1365.0%)	14(70.0%)	13(81.2%)	11(68.7%)	10(55.6%)	14(70.0%)	75(68.0%)

Source: Field survey 2015

Adoption/Rejection of Improved Tools and Appropriate Farm Machines

Farmers were interviewed for the use/non-use of four improved rice production tools and appropriate farm machines. The results are given in the table below: The majority of sample farmers (60.0%) adopted tools and the number was highest in Katik (75.0%) and lowest in Katonga (25.0%). About two-fifths (40.0%) did not adopt the tools and the number was highest in Katonga (75.0%) and lowest in Katik (25.0%). On the whole, the majority of the sample farmers adopted the innovations.

TABLE 4a: Distribution of sample farmers by adoption and non-adoption of improved rice production tools and villages

Adoption Status	VILLAGES													
	Patifu(N=20)		Katik(N=20)		Konta(N=16)		Rombe(N=16)		Katoma (N=18)		Katonga (N=20)		Total(N=110)	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Adopted	14	70.0	15	75.0	10	62.5	9	62.5	13	72.2	5	25.0	66	60.0
Not adopted	6	30.0	5	25.0	6	37.5	7	37.5	5	27.8	15	75.0	44	40.0

Source: Field survey 2015.

Farmers were surveyed for the use/non-use of the various improved tools and the results are shown in the table below: The table shows that the sickle had a fairly good adoption rate of 60% with highest number in Katik (75.0%), and lowest number in Katonga (25.0%). It had a non-adoption rate of 40% in which the highest number was in Katonga (75.0%), and the lowest number was in Katik (25.0%). The improved how had an adoption rate of 44% with highest number in Katoma (72.2%), and lowest number in Katonga (25.0%) of sample farmers. Its non-adoption rate was 56% in which the highest number was in Katonga (75.0%), and the lowest number was in Katoma (27.8%). None of the sample farmers (0.0%) adopted the power tiller and rice thresher. Reasons for the adoption of improved tools were: the improved hoe was lighter than the local hoe, and it reduced drudgery in the ploughing and puddling of the heavy mangrove swamp soils, thus enhancing farmer's efficiency in land preparation; sickle is appropriate for the Temne rice harvesting method practiced by the farmers, which involves clutching many rice plants close to the panicles in one hand and harvesting them with a single cut with the native knife or sickle; and the local blacksmith could make the adapter form of the sickle.

On the other hand, reasons for rejection of improved tools were: black smiths could not make improved hoes locally; improved hoes could not often be acquired locally except in big towns; rice threshers were also absolutely not available to farmers; and sickles were more costly than the native harvesting knife.

On the whole, the improved hoe and sickle had appreciable of fairly good and significant adoption rates.

TABLE 4b: Distribution of sample farmers by adoption and non-adoption of various improved rice production tools and appropriate farm machines and villages

Adoption Status	VILLAGES						
	Patifu (N=20)	Katik (N=20)	Konta (N=16)	Rombe (N=16)	Katoma (N=18)	Katonga (N=20)	Total (N=110)
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
Improved Hoe							
Adopted	12(60.0%)	14(70.0%)	8(50.0%)	7(43.7%)	13(72.2%)	5(25.0%)	
Not Adopted	8(40.0%)	6(30.0%)	8(50.0%)	9(56.3%)	5(27.8%)	15(75.0%)	
Power Tiller							
Adopted	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
Not Adopted	20(100.0%)	20(100.0%)	16(100.0%)	16(100.0%)	18(100.0%)	20(100.0%)	110(100.0%)
Rice Thresher							
Adopted	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
Not Adopted	20(100.0%)	20(100.0%)	16(100.0%)	16(100.0%)	18(100.0%)	20(100.0%)	110(100.0%)
Sickle .							
Adopted	14(70.0%)	15(75.0%)	10(62.5%)	9(56.3%)	13(72.2%)	5(25.0%)	66(60.0%)
Not Adopted	6(30.0%)	5(25.0%)	6(37.5%)	7(43.7%)	5(27.8%)	15(75.0%)	44(40.0%)

Source: Field survey 2015

Adoption/Rejection of Improved Rice Husbandry Practice

All of the sample farmers, (100.0%) (i.e. 100.0% in each of the villages – Patifu, Katik, Konta, Rombe, Katoma and Katonga) adopted none (rejected all) of the four rice husbandry practices – seed rate, nursery area, regular spacing between hills of transplanted rice and straight line transplanting.

Reasons for rejection of husbandry practices were: majority of the farmers were not aware of the improved rice husbandry practices, especially seed rate and nursery area techniques; the practices (such as regular spacing in transplanted rice and straight line transplanting) were difficult or complex; and farmers lacked adequate knowledge about them.

Factors Militating Against Adoption of Rice Innovations

Determining the factors that inhibit farmers in their adoption of rice innovations is pivotal in facilitating the use of improved rice techniques by mangrove swamp rice cultivators. In order to do this, farmers were assessed on the innovations complexity, appropriateness, cost, availability, farmers' participation in development of rice innovations, activities of the national extension system and role of social organizations (such as National Farmers Association of Sierra Leone – NFASL) in technology dissemination.

Complexity of Innovations

Farmers were assessed on the ease/difficulty of application of rice innovations and the results are presented in the table that follow. Table 17 shows that majority of the sample farmers (67.0%) did not find it difficult to adopt the improved seed rice and the number was highest in Katik (75.0%), and lowest in Katoma (61.1%); 69% with high numbers in Katik (75.0%), and in Katoma (72.2%) and low numbers in Konta (62.5%) and in Rombe (62.5%) in the case of fertilizers; 70% with high numbers in Patifu (75.0%) and in Katik (75.0%) and low number in Rombe (62.5%) in the case of improved hoe; and 73% with high numbers in Patifu (75.0%), and in Katonga (75.0%), and low numbers in Konta (68.8%) and in Rombe (68.8%) in the case of sickle. The rice thresher and power tiller had low rates of 5% each with high number in Katik (15.0%), and low numbers in Rombe (0.0%) and in Katoma (0.0%) in the case of rice thresher; and with high numbers in Katik (15.0%), and low numbers in Konta (0.0%), in Katoma (0.0%) and in Katonga (0.0%) in the case of power tiller.

High rates of 95% with high numbers in Patifu (95.0%), in Rombe (100.0%) and in Katonga (100.0%), and relatively low numbers in Katik (85.0%), in Konta (93.7%) and in Katoma (94.4%); and 95% with high numbers in Konta (100.0%), in Katoma (100.0%) and in Katonga (100.0%), and low numbers in Patifu (95.0%), in Katik (85.0%) and in Rombe (93.7%) of sample farmers informed that rice threshers and power tillers respectively were difficult to adopt. The table also shows that all the rice husbandry practices (seed rate, nursery area, straight line transplanting and regular spacing between hills) advanced by farmers were difficult to adopt.

On the whole, improved rice varieties and the sickle were least difficult to adopt, followed by fertilizers and improved hoe. While the power tiller and rice thresher and husbandry practice were difficult to understand and adopt.

Appropriateness of Innovations

Farmers were investigated whether the various rice innovations were appropriate or not appropriate. The results are given in the table below. The table shows rates of sample farmers that responded yes (y) when questioned whether improved rice innovations were more appropriate than local rice techniques as follows: 29% with highest number in Patifu (60.0%), and lowest number in Konta (50.0%) in case of hoes; and 57% with highest number in Rombe (62.5%), and lowest numbers in Patifu (55.0%) and in Katonga (55.0%) in the case of sickles.

The table also shows rates of sample farmers that said improved rice techniques were not (N) more appropriate than local rice techniques as follows: 71% with highest number in Rombe (80.0%), and lowest number in Patifu (65.0%) in case of improved rice varieties; 45% with highest number in Konta (50.0%), and lowest number in Patifu (40.0%) in case of improved hoes; and 43% with highest numbers in Katik (45.0%) and in Katonga (45.0%), and lowest number in Rombe (37.5%) in case of sickles. Appropriate farm machine (power tillers and rice threshers) and rice husbandry practices are not included in Table 4 and the other tables in this subject (i.e. factors limiting/affecting adoption of rice innovations) because these innovations have never been introduced in the study area. Also, fertilizers are excluded as a consequence of sample farmers not using them in mangrove swamp rice farming due to tidal influence.

On the whole, improved rice varieties, improved hoes and sickles were technologies whose appropriateness was significant and recognized by mangrove swamp rice farmers.

TABLE 5: Distribution of sample farmers by indication of ease and difficulty of adoption of rice production innovations and villages

	VILLAGES						
	Patifu (N=20)	Katik (N=20)	Konta (N=16)	Rombe (N=16)	Katoma (N=18)	Katonga (N=20)	Total (N=110)
Rice Innovations	No (%)	No (%)	No (%)	No (%)	No (%)	No (%%)	No (%)
Seed rice Improved							
Easy to adopt	14 (7 0.0)	15(75.0)	11(68.8)	10(62.5)	11(61.1)	13(65.0)	74(67.0)
Difficult to adopt	6(30.0)	5(25.0)	5(31.2)	6(37.5)	7(38.9)	7(35.0)	36(33.0)
Seed rate (80kg/ha)							
Easy to adopt	0(0.0)	15(75.0)	10(62.5)	10(62.5)	13(72.2)	14(70.0)	76(69.0)
Difficult to adopt	20(100.0)	5(25.0)	6(37.5)	6(37.5)	5(27.8)	6(30.0)	34(31.0)
Nursery Area							
Easy to adopt	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Difficult to adopt	20(100.0)	20(100.0)	16(100.0)	16(100.0)	18(100.0)	20(100.0)	110(100.0)
Straight-line Transplanting							
Easy to adopt	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Difficult to adopt	20(100.0)	20(100.0)	16(100.0)	16(100.0)	18(100.0)	20(100.0)	110(100.0)
Regular Spacing							
Easy to adopt	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Difficult to adopt	20(100.0)	20(100.0)	16(100.0)	16(100.0)	18(100.0)	20(100.0)	110(100.0)
Improved Hoe							
Easy to adopt	15(75.0)	15(75.0)	11(68.8)	10(62.5)	13(72.2)	13(65.0)	77(70.0)
Difficult to adopt	5(25.0)	5(25.0)	5(31.2)	6(37.5)	5(27.8)	7(35.0)	33(30.0)
Power Tiller							
Easy to adopt	1(5.0)	3(15.0)	0(0.0)	1(6.3)	0(0.0)	0(0.0)	5(5.0)
Difficult to adopt	19(95.0)	17(85.0)	16(100.0)	15(93.7)	18(100.0)	20(100.0)	105(95.0)
Sickle							
Easy to adopt	15(75.0)	15(75.0)	11(68.8)	11(68.8)	13(72.2)	15(75.0)	80(73.0)
Difficult to adopt	5(25.0)	5(25.0)	5(31.2)	5(31.2)	5(27.8)	5(25.0)	30(27.0)
Rice Thresher							
Easy to adopt	1(5.0)	3(15.0)	1(6.3)	0(0.0)	1(5.6)	0(0.0)	6(5.0)
Difficult to adopt	19(95.0)	17(85.0)	15(93.7)	16(100.0)	17(94.4)	20(100. 0)	104(95.0)

Source: Field survey 2015

TABLE 6: Distribution of sample farmers by Yes and No responses when asked whether improved technologies were more appropriate than local rice techniques

Mentioned Conditions	VILLAGES						
	Patifu (N=20)	Katik (N=20)	Konta (N=16)	Rombe (N=16)	Katoma (N=18)	Katonga (N=20)	Total (N=110)
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
Improved Variety more appropriate than local variety							
Yes	7(35.0%)	6(30.0%)	5(31.3%)	5(31.3%)	5(27.8%)	4(20.0%)	32(29.0%)
No	13(65.0%)	14(70.0%)	11(68.7%)	11(68.7%)	13(72.2%)	16(80.0%)	78(71.0%)
Improved hoe more appropriate than local hoe							
Yes	12(60.0%)	11(55.0%)	8(50.0%)	9(56.2%)	10(55.6%)	11(55.0%)	61(55.0%)
No	8(40.0%)	9(45.0%)	8(50.0%)	7(43.8%)	8(44.4%)	9(45.0%)	49(45.0%)
Sickle more appropriate than local knife							
Yes	12(60.0%)	11(55.0%)	9(56.2%)	10(62.5%)	10(55.6%)	11(55.0%)	63(57.0%)
No	8(40.0%)	9(45.0%)	7(43.8%)	6(37.5%)	8(44.4%)	9(45.0%)	47(43.0%)

Source: Field survey 2015

Cost of Innovations

Farmers were interviewed for the cost of rice innovations. The results are presented in the table below. Regarding respondent farmers that said improved rice techniques were expensive (Y), Table 4.4.3 shows that 69% with high numbers in Konta (75.0%), in Katik (70.0%) and in Katonga (70.0%), and low numbers in Patifu (65.0%), in Rombe (68.8%) and in Katoma (66.7%) in case of fertilizers; 65% with high numbers in Patifu (70.0%), in Konta (68.8%), in Katik (65.0%) and in Katonga (65.0%), and low numbers in Rombe (62.5%) and in Katoma (61.1%) in case of improved seed rice; 45% with high numbers in Konta (56.3%), in Rombe (56.3%), and low numbers in Patifu (40.0%), in Katik (45.0%), in Katoma (38.9%) and in Katonga (40.0%) in case of improved hoes; and 45% with high numbers in Katik (50.0%) and in Rombe (50.0%), and low numbers in Patifu (35.0%), in Konta (43.7%), in Katoma (44.4%) and in Katonga (45.0%) in case of sickles. The table further shows that rice innovations were not (N) expensive were as follows: 45% with high numbers in Patifu (65.0%), in Konta (56.3%), in Katoma (55.6%) and in Katonga (55.0%), and low numbers in Katik (50.0%) and in Rombe (50.0%) in case of sickles; 55% with high numbers in Katoma (61.1%), in Katonga (60.0%), and in Patifu (60.0%), and low numbers in Katik (55.0%), in Konta (43.7%) and in Rombe (43.7%) in case of improved hoes; 31% with high numbers in Patifu (35.0%), in Katoma (33.3%) and in Rombe (31.2%), and low numbers in Katik (30.0%), in Konta (25.5%) and in Katoma (30.0%) in case of fertilizers; and 35% with high numbers in Katoma (38.9%), in Rombe (37.0%), in Katik (35.0%) and in

Katonga (35.0%). And low numbers in Patifu (30.0%) and in Konta (31.2%) in case of improved rice seed.

On the whole, sample farmers considered most of the improved technologies to be expensive and beyond their reach.

TABLE 7: Distribution of sample farmers by Yes and No responses when asked whether the cost of rice innovations was expensive and villages

Rice Innovation and Cost	VILLAGES						
	Patifu (N=20)	Katik (N=20)	Konta (N=16)	Rombe (N=16)	Katoma (N=18)	Katonga (N=20)	Total (N=110)
	No(%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
Rice Varieties Expensive							
Yes	14(70.0%)	13(65.0%)	11(68.8%)	10(62.5%)	11(61.1%)	13(65.0%)	72(65.0%)
No	6(30.0%)	7(35.0%)	5(31.2%)	6(37.5%)	7(38.9%)	7(35.0%)	38(35.0%)
Fertilizers Expensive							
Yes	13(65.0%)	14(70.0%)	12(75.0%)	11(68.8%)	12(66.7%)	14(70.0%)	76(69.0%)
No	7(35.0%)	6(30.0%)	4(25.0%)	5(31.2%)	6(33.3%)	6(30.0%)	34(31.0%)
Improved Hoe Expensive							
No	8(40.0%)	9(45.0%)	9(56.3%)	9(56.3%)	7(38.9%)	8(40.0%)	50(45.0%)
Yes	12(60.0%)	11(55.0%)	7(43.7%)	7(43.7%)	11(61.1%)	12(60.0%)	60(55.0%)
Sickles Expensive							
Yes	7(35.0%)	10(50.0%)	7(43.7%)	8(50.0%)	8(44.4%)	9(45.0%)	49(45.0%)
No	13(65.0%)	10(50.0%)	9(56.3%)	8(50.0%)	10(55.6%)	11(55.0%)	61(55.0%)

Source: Field survey 2015

Availability of Rice Innovations

Farmers were surveyed for availability of improved rice techniques/innovations and the results are shown in the table below. The table show rates of sample farmers that informed the researcher that rice innovations were available in the study area were as follows: 63% with highest number in Rombe (68.7%), and lowest number in Patifu (55.0%) in case of sickles; 44% with highest number in Katonga (55.0%), and lowest number in Rombe (37.5%) in case of improved hoes; 42% with highest number in Katik (55.0%), and lowest number in Rombe (31.3%) in case of improved seed rice; and 30.0% with highest number in Katoma (33.3%), and lowest number in Patifu (25.0%) in case of fertilizers. The Table also shows rates of sample farmers who indicated that rice innovations were not available to them locally were as follows: 70% with highest number in Patifu (75.0%) and lowest number in Katoma (66.7%), in case of fertilizers; 58% with highest number in Rombe (68.7%), and lowest number in Katonga (50.0%) in case of improved seed rice; 56% with highest number in Rombe (62.5%), and lowest number in Katoma (45.0%) in case of improved hoes; and 37% with highest number in Katik (45.0%), and lowest number in Rombe (31.2%) in case of sickles.

On the whole, improved rice production technologies were significantly not available to farmers.

TABLE 8: Distribution of sample farmers by Yes and No responses when required to indicate whether rice innovations were available and villages

Rice Innovation Service	Villages						
	Patifu (N=20)	Katik (N=20)	Konta (N=16)	Rombe (N=16)	Katoma (N=18)	Katonga (N=20)	Total (N=110)
	No(%)	No(%)	No(%)	No(%)	No(%)	No(%)	No(%)
Improved Seed rice							
	8(40.0%)	9(45.0%)	6(37.5%)	5(31.3%)	8(44.4%)	10(50.0%)	46(42.0%)
	12(60.0%)	11(55.0%)	10(62.5%)	11(68.7%)	10(55.6	10(50.0%)	64(58.0%)
Fertilizer							
Yes	5(25.0%)	6(30.0%)	5(31.3%)	5(31.3%)	6(33.3%)	6(30.0%)	33(30.0%)
No	15(75.0%)	14(70.0%)	11(68.7%)	11(68.7%)	12(66.7	14(70.0%)	77(70.0%)
Improved Hoe							
Yes	9(45.0%)	8(40.0%)	7(43.8%)	6(37.5%)	7(38.9%)	11(55.0%)	48(44.4%)
No	11(55.0%)	12(60.0%)	9(56.2%)	10(62.5%)	11(61.1%)	9(45.0%)	62(56.0%)
Sickle							
Yes	12(60.0%)	11(55.0%)	10(62.5%)	11(68.7%)	12(66.7%)	13(65.0%)	69(63.0%)
No	8(40.0%)	9(45.0%)	6(37.5%)	5(31.3%)	6(33.3%)	7(35.0%)	41(37.0%)

Source: Field survey 2015

Farmers' Participation in Rice Technology Development

Farmers were investigated on whether or not specific linkages (such as: attendance at joint research-extension meetings; participation in on-farm trials; and participation in farmers' training programmes) existed between them and rice researchers. The results are given in the table below. The table shows that very few sample farmers (10.0%) with low numbers in Rombe (37.5%) and Katonga (25.0%), and none in Patifu (0.0%), Katik (0.0%), Konta (0.0%) and Katonga (0.0%) participated in rice research programmes. Majority of the sample farmers (90.0%) with high numbers in Patifu (100.0%), in Katik (100.0%), in Konta (100.0%) and in Katonga (100.0%), and relatively low numbers in Rombe (62.5%) and in Katonga (75.0%) never participated in any RRSR/WARDA programmes. Sample farmers' participation in rice technology development was negligible and on the whole extremely poor, deplorable and insignificant

TABLE 9: Distribution of sample farmers by participation (P) and non-participation (NP) in rice technology development programmes of RRSR/WARDA.

Farmers Role in Rice Research	VILLAGES						
	Patifu (N=20)	Katik (N=20)	Konta (N=16)	Rombe (N=16)	Katoma (N=18)	Katonga (N=20)	Total (N=110)
	No(%)	No(%)	No(%)	No(%)	No(%)	No.(%)	No(%)
Participated	0(0.0%)	0(0.0%)	0(0.0%)	6(37.5%)	0(0.0%)	5(25.0%)	11(10.0%)
Not Participated	20(100.0%)	20(100.0%)	16(100.0%)	10(62.5%)	18(100.0)	15(75.0%)	99(90.0%)

Source: Field survey 2015

Farmers' Membership of Farmers' Associations

Farmers were interviewed on their membership of the National Farmers Association of Sierra Leone (NFASL). The table below shows the result. The results in the table show that none of the sample farmers (0.0%) in all sample villages (Patifu, Katik, Rombe, Katoma and Katonga) reported being members of NAFSL. Reason generally given by sample rice farmers for not belonging to NFASL was that this organization has never been introduced in their communities.

On the whole, mangrove swamp rice farmers in the study area were not members of NFASL.

TABLE 10: distribution of sample farmers by NFASL-membership and NFASL-Non-membership and villages

Types of Organization	VILLAGES						
	Patifu (N= 20)	Katik (N=20)	Konta (N= 16)	Rombe (N= 16)	Katoma (N=18)	Katonga (N= 20)	Total (N=110)
	No. (%)	No. (%)	No. (%)	No.(%)	No.(%)	No.(%)	No.(%)
NFASL-Member	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
NFASL-Non-member	20(100.0%)	20(100.0%)	16(100.0%)	16(100.0%)	18(100.0%)	20(100.0%)	110(100.0%)

Source: Field survey 2015

National Agricultural Extension System

Farmers were studied for extension of rice innovations by the national extension system. The results are presented in the table below. The table indicates that no sample farmer in the four villages (Patifu, Katik, Katoma and Katonga) reported the existence of any improved rice production extension programme been promoted by the NAES. Low rates (7.0%) with high numbers in Rombe (31.3%) and in Konta (18.8%) and none in Patifu (0.0%), in Katik (0.0%), in Katoma (0.0%) and in Katonga (0.0%) indicated that improved rice production services (fertilizers) were been extended by some MAFFS staff. While high rates (93.0%) with high numbers in Patifu (100.0%), in Katoma (100.0%) and in Katonga (100.0%), and low numbers in Konta (81.2%) and in Rombe (68.7%) informed that no NAES extension activities in relation to improved rice production techniques were promoted in their community.

On the whole, NAES activities regarding rice production were not extended to mangrove swamp rice farmers in the study area.

TABLE 11: Distribution of sample farmers by YES and NO responses when asked whether the national agricultural extension system (NAES) rendered rice production extension services in their community

Response	Villages						
	Patifu (N=20)	Katik (N=20	Konta (N=16)	Rombe (N=16)	Katoma (N=18)	Katonga (N=20	Total
	No.(%)	No.(%)	No.(%)	No.(%)	No.(%)	No.(%)	No.(%)
Yes	0(0.0%)	0(0.0%)	3(18.8%)	5(31.3%)	0(0.0%)	0(0.0%)	8(7.0%)
No	20(100.0%)	20(100.0%)	13(81.2%)	11(68.7%)	18(100.0%)	20(100.0%)	102(93.0%)

Source: Field survey 2015

DISCUSSION

Adoption/Rejection of Rice Varieties

Improved rice varieties: Sall et al., (1998) indicated that most of improved rice varieties in Senegal performed poorer than local varieties under poor production environments, but better than local varieties under good growing conditions. It is concluded that the breeding programme needs to develop varieties better adapted to the environments under which farmers operated in Senegal. African Development Bank (2003) indicated that traditional upland rice varieties mature in 150 to 170 days. Improved semi dwarf rice varieties in Africa mature in 120 to 140 days. But NERICA varieties mature in 90- 100 days. The shorter time allows farmers to grow two crops during one rainy season. The second crop can be a legume such as Soybean or vegetables. Under farm conditions, where minimal inputs are applied, the NERICA varieties have raised the yields of upland rice by more than 50%. NERICA varieties yielded more than 1.5metric tons per ha. NERICA varieties offer an opportunity for sustainable intensification of upland rice production systems because they have wide, droopy leaves and tend to grow vigorously at seedling and vegetative stages. These characteristics help to smother weeds, thereby reducing the requirement for weeding. This in turn reduces the pressure on women and children who are directly involved in these operations. Furthermore, NERICA varieties posses such agronomic traits such as disease and pest resistance, intermediate to fall stature and lodging resistance.

Farmers' adoption/rejection rates of improved rice innovations were mixed. Rice varieties like ROK 5, ROK 10, and CPS have had relatively high rates of 40%, 48% and 34% respectively. The adoption rates were possible because there was economic assistance, in the form of improved rice provision in credit, available to farmers for these varieties from CAP. Other improved rice varieties which did not have similar facilities but were liked or admired by farmers had low adoption rates 3%, 2%, and 5% for BD 2, SR26 and Kuatik Kundur respectively. The difference in adoption rates between improved rice varieties that had credit facility and did not leave credit opportunity indicated that credit provision and/or other social/physical incentives enhance adoption of rice innovations by resource-poor farmers. Other equally vital factors in facilitating high adoption rates/rejection rates are the inherent properties of the improved rice varieties depending on farmers' perception of those properties. For example, short duration varieties like ROK 5 that matured (< 4 months duration) during the hunger period when farmers long duration varieties are not due had high adoption rate. Farmers in Sierra Leone are mainly concerned with quantity in rice production. Grain yield is the most important motivating factor for their adoption of improved varieties. Any rice, character that enhanced high yield grain positively influences its adoption by farmers. Varieties rejected by farmers were those they perceived as:

i) Low tillering: Tillering is the character responsible for the compensatory of rice varieties, which is favoured by mangrove farmers. It enables mangrove varieties to counteract the effect of crab damage on transplanted rice seedlings. Thus, farmers reject improved rice varieties they identified as none or low tillering such as ROK 3, ROK 8, ROK 9 and ROK 11.

ii) Stunted growth in nursery: Most of the sample farmers do not apply fertilizers to their rice nurseries, and most improved rice varieties only grow well when fertilized. Most rice varieties that do not grow well like local rice varieties in nurseries without fertilizers were rejected by farmers. Mangrove farmers like rice varieties that grew well in nurseries because they provide big and most robust seedlings that withstand the menace of crabs. Varieties like ROK 21, ROK 22, ROK 23, ROK 28, ROK 29, BD2, and SR26 were reported by sample farmers for not doing well in nurseries under their normal nursery condition of non-fertilization.

iii) Fertilizers: Tadesse and Krishanamoorthy (1997) states that in Tamil Nadu 90% of the variation in output of paddy farms is due to differences in technical efficiency. Land, animal power and fertilizers have significant influence on the level of paddy production. Rebelo *et al.* (2009) indicated that fertilizer levels accounted for most of the differences between potential (experiential) and actual yields at farm level, followed by varieties. The African development Bank/African development Fund (2003) stated that traditional upland rice varieties as well as some of the improved varieties being used by small-holder farmers generally yielded about 0.5 metric tons per ha in the traditional farming system without the use of fertilizers. The potential under farmers' condition is more than 4 metric tons per ha, where fertilizers and other inputs are applied. In this study, adoption of fertilizers was low, 12 percent. Factors responsible for poor adoption of fertilizers in mangrove swamp rice farming are not the same as those responsible for the poor adoption of improved rice varieties. Farmers do not use fertilizers in their mangrove rice crops due to ecological consequences such as high tides and alluvial deposits. High tides flood the entire mangroves and will carry any fertilizer broadcasted in the rice crops. Because of this reason, mangrove farmers cannot broadcast fertilizers in their mangrove crops. The high tides, however, brought alluvial deposit, which enrich the fertility of mangrove swamps. The complex role of the tides made mangrove farmers not keen to use fertilizers in their rice crops. However, they expressed interest in applying fertilizers in their nurseries and vegetables.

iv) Improved tools and farm machines: McCartney and van Koppen (2004), reported that transplanting by machines saved approximately 45% cost and 60% labour compared to manual transplanting. Consequently, it was decided to introduce about 200 machines into Indian Punjab during the 1995 paddy transplanting season by providing a 50% subsidy in the cost from the state government. McCartney and Acreman (2009) informed that machines were used to perform various practices such as planting, intercultural, fertilizer application, earthling up, weed control, and stubble shaving. These machines/implements have proven to be an effective and multipurpose aid to farmers, especially in developing countries, for substantially increasing the yield of sugar cane crops. Also, Matsui, *et al*. (2006), reported of 60% reduction in sowing cost of oil seed crops, cotton, and sunflower as a result of the introduction of the pneumatic planter in Pakistan.

Improved hoes and sickles had relatively high adoption rates of 44% and 60% respectively. This was so because they were efficient, locally available and affordable to farmers. Mangrove swamps soils are heavy which require light tool, like the improved hoe, for ploughing in order to reduce drudgery and enhance efficiency. Similarly, the sickle is good for the method of harvesting (Temne harvesting) practiced in mangrove swamp rice farms of the region. Also, results of this work showed that sickles were affordable and locally available factors which facilitated their adoption by resource-poor farmers.

The power tiller and rice thresher was the farm machines absolutely not used in the study area. This does not mean that the farmers hated them but rather that they were not available in the study area. All the farmers were interested in having the opportunity to use the machines, especially the power tiller. But these machines cannot be easily acquired by farmers on their own, without substantial external assistance both in their procurement (because they are costly) and operation, which also require finance and know-how.

Husbandry practice: Masiyandima, McCartney, and van Koppen (2004), indicated that the number of farmers using the various recommended husbandry practices in Southern Thailand was low. They concluded that an extension programme was needed to encourage the use of recommended husbandry. Maltby (2009) illustrated that rehabilitation of home gardens by the use of cattle manure and proper crop and livestock husbandry practices give home gardens the highest net value and make them less sensitive to changes in prices of inputs and outputs. Sample farmers adopted none of the husbandry practices. They said the practices did not work in their situations, and did not target their problem, which was to save labour. In reality, they reiterated that the husbandry practices required more labour, additional materials, know-how and retarded efficiency.

Indeed it is easier to transplant randomly than to transplant in straight line or in regular spacing between hills. And it is also easier to broadcast seed rice directly in the mangrove swamp than to transplant. Adopting nursery area of 1/10 swamp area requires measurement of mangrove swamps and nursery areas and computing the various areas by farmers who must have numeracy knowledge (formal education) that almost all of them lacked. Likewise, the use of seed rate technique also requires formal education and resources in terms of weighing equipments, which is an obstacle for peasant farmers like mangrove swamp rice cultivators. However, even the very few farmers with formal education were not aware of seed-rate and nursery area techniques. It indicated their lack of contact with extension agencies and RRSR. Nonetheless, the farmers do not consider seed rate as a problem because they inherit the seed rates of their various mangrove swamps in the form of numbers of bushels (a unit of volume measurement) of rice to be nursed for their various mangrove swamps from their ancestors, which are passed on from generation to generation. And they are used to estimating their nursery areas. Sample farmers rejected the entire improved husbandry practices because they are not appropriate to their circumstances. Kashaigili (2006) and International Water Management Institute (IWMI) (2006), support these observations. They emphasize extension contact, formal education and appropriateness of innovation to be significantly correlated with adoption.

Factors Militating Against the Adoption of Rice Production Innovations

Complexity of Innovations: According to Ghermandi *et al.* (2008), the socioeconomic factors related to adoption and non-adoptions of innovations are many and varied. But essentially, they include the complexity of the practice or change involved. The ease and difficulty of use of rice innovations were found to be positively and negatively correlated respectively with adoption of rice innovations by sample farmers. Over 60% of sample farmers indicated that rice varieties, fertilizers, improved hoes and sickles were easy to adopt. This relative high percentage of respondents that indicated the ease of use of these technologies was reflected in their relative high adoption rates. Batz *et al* (1999) showed that in Kenya, the process of adoption and diffusion was significantly influenced by relative complexity, relative risk and relative investment. Husbandry practices, power tillers and rice threshers identified by nearly all respondents to be difficult to adopt were not adopted by any sample farmers. This indicates that farmers adopt rice innovations that are not difficult or complex to use. The use of application of improved rice varieties, improved hoes and sickles in the field is not different from their indigenous/local counterparts and were therefore easily adopted by farmers. While the use of improved husbandry practices required additional inputs like measuring tapes, literate labour, pegs, scales and ropes, which all need finance that, is not easy to get by resource-poor clients. Unlike rice varieties that do not require special operational technique by farmers to adopt power tillers, rice threshers and husbandry practices need complex knowledge and extra resources that inhibit their adoption by farmers.

Appropriateness of Rice Innovations: According to Finlayson and D'Cruz (2005), subsistence pressure and unsuitable or inappropriateness are identified as vital constraints affecting the adoption of agricultural technologies. There were mixed responses by the respondents about the appropriateness or the lack of it in some of the rice innovations. The results show that 31% of the sample farmers indicated that improved seed rice varieties do not grow better than the local rice varieties in nurseries without fertilization. For resource-poor farmers, the good nursery performance of rice varieties without the application of fertilizer is crucial in attracting its adoption. The farmers thus consider most of the improved rice varieties not appropriate for them because they do not grow well in nurseries without fertilizer application, which most farmers cannot afford. Mills and Karanja, (1997) in Kenya present the application of a rigorous process for setting national commodity programme, research priority both spatially and by major research theme that involves programmes stakeholders in order to develop appropriate agricultural technologies. And in India Otsuka, (2000) reports that to reduce poverty, agricultural research should aim to ensure the development of yield increasing, labour-using and appropriate technologies. Thus, the appropriateness of an innovation greatly facilitates its adoption and its absence militates against adoption. All the sample farmers (100%) identified the inapplicability of improved husbandry techniques like regular spacing, nursery area of 1/10 swamp area, straight line transplanting and seed rate of 80kg/ha under their rice production circumstances as a major reason for their non adoption. Also, the use of husbandry practice requires some significant level of literacy by farmers due to the integral aspects of measurement and weighing involved. Since literacy level of farmers are very low, thus adoption of improved husbandry techniques was unlikely. The few literate farmers also found it impossible to adopt improved husbandry practice because of the additional man-hours required to implement these practices. Because labour is always inadequate in mangrove swamp rice farming as a consequence of the manual nature of all its activities, improved husbandry practices that require additional labour will not attract for adoption by farmers. Regarding the improved hoe, most of the sample farmers (29%) considered it appropriate because of its light weight, which enhances farmers' efficiency in ploughing and puddling the heavy mangrove swamp for transplanting. Similarly, the sickle was considered appropriate by a big proportion of farmers (39%), because its fits into the farmers; common harvesting practice (Temne harvesting method) and it were therefore widely adopted by farmers.

Cost of Innovations: FAO (2008), show that in Australia the financial cost of an agricultural technology greatly influence its being adopted by farmers. Neville, et al.(1998) report that in the Philippines, natural vegetation and grass strips are more attractive to farmers because of lower establishment costs, and provide intermediate steps to adoption. In Malawi and Zimbabwe, Snapp *et al* (1998) found that challenges to adoption of agricultural technologies include cost. Also, in Kenya, Batz *et al*. (1999) report that the adoption of dairy technologies is significantly influenced by relative investment characteristics on adoption. According to Harris *et al.* (2001) in the study conducted in India and Zimbabwe in on-farm seed priming, low cost and low risk technologies produce an immediate benefit, unlock the farming system and give the farmers reasonable access to further benefits. Thus, the sited works buttress the fact that cost of innovations does affect the rate of adoption of agricultural techniques. The results in this study show that 65%, 69%, 45% and 45% of sample farmers indicated that improved rice varieties, fertilizers, improved hoe and sickles respectively were expensive. This indicates that a great numbers of the respondents could not afford these technologies and that this was preventing most farmers from using them.

Availability of Improved Rice Innovations: FAO (2005), identify the reliability in supply and availability of technologies to be some of the key determinant component of the adoption of technologies in developing regions. Food and Agriculture Organization of the United Nations (FAO) (2004), demonstrate in India that the availability of improved technology facilitated area expansion of chickpea. In this study, majority of the sample farmers (70%) reported that fertilizers were not available in the study area, while (58.0%) said improve rice varieties were not available, and a similar percentage (56.0%) indicated that the improved hoe was not available. Appropriate farm machines (power tillers and rice threshers) were absolutely not available anywhere in the study area. In any case, improve agricultural inputs are not always locally available in the said zone except sickles which could be fabricated or made by local blacksmiths. The unavailability of improved rice production technologies locally is therefore deterrent to their adoption by respondents.

Farmers' Participation in Rice Technology Development: has show that taking user-innovations and then adopting them, or adaptation of innovations in consultation with users, or with the help of users, is seen to have additional advantage such as: (a) assisting to further advance indigenous knowledge. Emerton and Bos (2004) and skills (b) avoiding the dying out f indigenous skills and knowledge. (c) making sure that the innovation is appropriate to the needs of users. Emerton (2005.) emphasize that the participation of resource-limiting farmers in agricultural research can help ensure adoption and sustenance of farm technologies. Also, Debrah et al, (1998) in Mali; Neville *et al.* (1998) in Guinea; Sall *et al*., (2000) in Senegal; and Faminow *et al*. (2000) in India report of the vitality of integrating farmers' participation in technology development in their research which resulted in understanding the farmers' attitudes, constraints and opportunities for the development of sustainable technologies suitable for a wide range of farming conditions. They recommend a strategy for technology development that is farmer-led testing, where farmers themselves select technologies, implement the field test and assume responsibility for disseminating the results locally. It is argued that qualifying farmers' perceptions in the manner suggested makes them more agreeable to station-based researchers used to chief type of analysis.

All clients in the study claimed that they had never participated in: (a) research-extension meeting, (b) on farm trials and (c) farmers' training programmes. This precisely means that the respondents did not participate in the development of rice technologies. The survey results indicate that all farmers were not in direct contact with researchers and extension staff. Only 10% of farmers respondents in just two of the study villages claimed to have been in contact with RRSR. And the contact took place mainly on annual research field days in which researchers demonstrated new technologies to farmers and extension staff. Thirty seven point five percent and 25.0% of the farmers in Rombe and Katonga respectively claimed to have participated in RRSR/WARDA programmes. It is not surprising that none of the farmers adopted any of the husbandry practices. These results suggest that most of the 49.0%,; 48.0%; 4.0%; 3.0%; 2.0%; 35.0%; 34.0%; and 5.0% adopters of ROKs 5; 10 and 23; BD2; SR26; ADNY301; CP4; and Kuatik Kundur, respectively, did so independent of contact with extension staff and/or RRSR/WARDA. This is a shortcoming on the part of RRSR, which works contrary to what is currently advocated worldwide for agricultural research bodies to actively involve farmers in research.

National Agricultural Extension System's Role: de Voogt *et al.* (2000) in their study of factors affecting the adoption of modern rice varieties in Bangladesh identified subsistence pressure, land unsuitability, timing and inadequate extension contact as important constraints to the adoption of improved rice varieties. Also, in Tanzania Chuma *et al.* (2009) found that adoption of improved maize seed and fertilizer is positively affected by visits of extension agents. Comprehensive Assessment of Water Management in Agriculture (CA) (2007) in their study of Bangladesh potato farmers adoption of improved practices indicated that farm size, potato farm area, extension contact and attitude towards improved practices were significantly related with the adoption of improved practice of potato. Nguyen-Khoa (2008), in their work on 'Farmers" perceptions and adoption of soil management technologies in western Kenya, report that significant in explaining adoption were farmers' participation in agricultural seminars and workshops, and contact with extension. Adesina *et al*. (2000) indicate that Cameroon adoption of alley farming is higher for farmers with contact with extension agencies working on agroforestry.

All the sample farmers (except 8 in two villages) reported of their absolute unawareness of agricultural extension activities of the MAFFS in the study area. This implies that farmers in this zone did not have contact with this vital component responsible for disseminating improved rice production technologies in the country. This was a serious lapse constituting a major inhibiting factor of adoption. This is therefore not surprising that these farmers were not aware of most of the improved husbandry practices. Lack of contact with extension agencies is recognized to be major factor limiting adoption of agricultural innovations in developing regions.

Farmers' Membership of Farmers Organization(s): Baran (2005), report that in Taiwan farmers organization played crucial role in increasing agricultural production through the introduction of new technologies and improvement in the efficiency of inputs markets. Adekola, *et al*. (2009) report that in Guinea as association of farmers developed 500 hectares of lowlands on which small-scale rice growers double output, with yields greater than 3t/ha.

McCartney (2008) in determining factors affecting the adoption of alley farmers in Cameroon shows that adoption is higher for farmers with contact with extension agencies working on agro forestry technologies and for farmers belonging to farmers associations. Maltby (2009), report that the creation and/or expansion of farmers' organizations such as cooperatives were important in consolidating adoption of soybean in Brazil.
The results obtained in this study show that none of the sample farmers were members of the NAFSL. The high number of sample farmers without membership of NFASL is not encouraging and does not indicate promotion of farming in the region by MAFFS. It thus signifies lack of concern for mangrove swamp farmers in the study area. Farmers associations are vital forum for dissemination of improved agricultural techniques. And their absence in the study area does negatively affect the adoption of improved rice production techniques.

CONCLUSION

Sample mangrove swamp rice farmers adopted or rejected improved rice production technologies based on farmer's situations, the complexity, cost, appropriateness, availability of the innovations and extension services rendered to them. Farmers' participation in rice technology development and extension linkages between MAFFS, RRSR and rice farmers were absent. There is therefore the need for greater efforts by RRSR, MAFFS and NFASL to improve on the development and delivery of rice production innovations to mangrove swamp rice farmers in the area studied.

RECOMMENDATIONS

Based on the findings, the following recommendations are advanced in relation to improving technology development, extension delivery system and thus, the adoption of rice innovations by farmers to improve on the production of mangrove rice:

1. The cost of improved seed rice should not be greater than the cost of indigenous seed rice. It must be affordable by every farmer.
2. Improved seed rice should do well in nurseries as the native rice without fertilizer application, and be locally available to each and every interested farmer and yields higher than native rice varieties in farmers' usual condition of fertilizer use.
3. Fertilizer must be affordable in order to enable resource poor farmers to purchase them.
4. Farmers must be able to use recommended seed rate on their own without having to rely on external assistance, i.e. the unit used for seed rate should be calibrated in unit familiar to farmers. Preferably bushels/acre and farmers taught to estimate their mangrove swamp areas in acres.
5. Straight line transplanting and regular spacing between hills techniques must be tailored so as not to reduce the efficiency of transplanters slow transplanting in the field and must not be expensive to use in terms of materials and know-how.
6. The government should subsidize the acquisition of the improved tools (hoes and sickles) by farmers.
7. Farmers should be provided with better access to credit through the micro-credit schemes to enable them increase and sustain the use of improved technologies in the product of rice.
8. The state should mandate the membership of mangrove swamp farmers in the NAFSL.
9. Extension agents should endeavor to establish contact with mangrove swamp rice farmers and build their capacity.
10. It should be made a policy to base the evaluation and promotion of rice researchers (scientists) on how closely and effectively they work with farmers and extension staff and not only on publications.

REFERENCES

ACRE (1993) Baseline Socio-economic Survey Report of Agriculture in Sierra Leone: ACRE Project, MAFFS/USAID.

Adams, A., Gore, J., Musser, F., Cook, D., Catchot, A., Walker, T. and. Awuni, G.A. (2015) Impact of water management on efficacy of insecticidal seed treatments against rice water weevil (Coleoptera: Curculionidae) in Mississippi rice. J. Econ. Entomol. 108: 1078–1085.

Adekola, O.; Morardet, S., de Groot, R., Grelot, F.(2008), The economic and livelihood value of provisioning services of the Ga-Mampa wetland, South Africa. Montpellier: World Water Congress.

Adesina, A.A & Zinna, M.M. (1993) Research –Extension –Farmer –Linkages within the context of the Generation, Transfer and Adoption of Improved Mangrove Swamp Rice Technology in West Africa . Quarterly Journal of International Agriculture. Vol 31 No 2 pp 201- 212.

African Development Bank/African Development Fund (2003) Multinational NERICA Dissemination Project (Sierra Leone), Ministry of Agriculture Forestry and Food Security – Format for Terms of Reference for training on NERICA technologies for field personnel and farmers. Agricultural and Rural development Central and West Region (OCAR).

African Development Bank (2005): Sierra Leone 2005-2009 Country Strategy Paper. www.daco-%sl.org/ encyclopedia/4_part/4_1/adb_sl_strategy_paper.pdf

Baran, E. (2005) Cambodian inland fisheries: Facts, figures and context. Phnom Penh, Cambodia: World Fish Center and Inland Fisheries Research and Development Institute, 49p. B.

Batz, F. J., Peters, K.J. & Janssen, W. (1999)The influence of technology characteristics on the rate of and speed of Adoption" Agricultural Economics. 9,21(2):121-130.

CA (Comprehensive Assessment of Water Management in Agriculture). 2007. Water for food, water for life: A comprehensive assessment of water management in agriculture. London: Earthscan, Colombo, Sri Lanka: International Water Management Institute (IWMI), 645p.

Chuma, E., Masiyandima, M., Finlayson, M., McCartney, M., Jogo, W. (2009) Guideline for sustainable wetland management and utilization: Key cornerstones. Draft report for the CGIAR Challenge Program on Water and Food (CPWF)

Debrah, S.K., Defoer, T. & Bengaly, M. (1998) Integrating farmers' knowledge, attitude, and practices in the development of sustainable striga control interventions in Southern Mali". Netherlands Journal of Agricultural Science 46(1) 65-75.

de Voogt, K., Kite, G., Droogers, P., Murray-Rust, H. (2000) Modeling water allocation between wetlands and irrigated agriculture: case study of the Gediz Basin, Turkey. Colombo, Sri Lanka: International Water Management Institute. 62p. (IWMI Working Paper 001) www.iwmi.org/Publications/WorkingPapers /working/WOR1.pdf

Emerton, L. (2005) Values and rewards: Counting and capturing ecosystem water services for sustainable development. IUCN Water, Nature and Economics Technical Paper No. 1. Gland, Switzerland: International Union for Conservation of Nature (IUCN), Ecosystems and Livelihoods Group, Asia, 93p.

Emerton, L., Bos, E. (2004) Value. Counting ecosystems as an economic part of water. Gland, Switzerland, Cambridge, UK: IUCN, 88p.

FAO (2013) FAO Initiative in souring food prices, Sierra Leone.Http://www.fao.org/isfp/country-information /sierra - leone/en / [Accessed 2nd June 2013].

FAO (2012) State of Food Insecurity in the World (2010). Http://www.fao.org/docrep/016/i3027e/i3027e.pdf *[Accessed 17th April 2013]*

FAO (2012) Nutrition-Sensitive Agriculture and Food-Based Approaches. Http://www.fao.org/food/nutrition-sensitive-agriculture-and-food-basedapproaches/en/ [Accessed 20th May 2013].

Falkenmark, M., Finlayson, C.M., Gordon, L.J. (2007) Agriculture, water and ecosystems: Avoiding the costs of going too far. In: Water for food, water for life: Comprehensive assessment of water management in agriculture, ed. Molden, D. London: Earthscan; Colombo, Sri Lanka: International Water Management Institute.

Faminow, M.D., Klein, K.K. & India Project operations Unit (2000) Adoption of agroforestry in Nagaland India using farmer-led technology development and dissemination". Canadian Journal of Agricultural Economics 48(4):585-595.

Finlayson, C.M., D'Cruz, R. (2005) Inland water systems. In: Ecosystems and human well-being: Current state and trends, ed., Hassan, R.; Scholes, R.; Ash, N. Findings of the Condition and Trends Working Group. Washington, DC: Island Press.

Galbraith, H., Amerasinghe, P., Huber-Lee, A. (2005) The effects of agricultural irrigation on wetland ecosystems in developing countries: a literature review. Colombo, Sri Lanka: International Water Management Institute (IWMI), Comprehensive Assessment Secretariat. 28p. (Comprehensive Assessment of Water Management in Agriculture Discussion Paper 1) www.iwmi.org/ assessment/ files new/publications/ Discussion% 20 Paper / CADiscussionPaper1.pdf

Ghermandi, A., van den Bergh, J.C.J.M., Brander, L.M., de Groot, H.L.F., Nunes, P.A.L.D. (2008) The economic value of wetland conservation and creation: A meta analysis. FEEM Working Paper. Available at http:// www. feem.it/getpage.aspx?id=73&sez= Publications & padre= 20&tab=1 (accessed 01 June 2009).

Harris, D., Pathan, A. K., Gothkar, P., Josh, A., Chivasa, W & Njamudeza, P (2001) "On-farm seed priming, using participatory methods to revive and refine a key technology" Agricultural System. 69 (1/2) 151-164.

IWMI (International Water Management Institute).(2006), Working wetlands: a new approach to balancing agricultural development with environmental protection. Colombo, Sri Lanka: International Water Management Institute (IWMI). 6p. (IWMI Water Policy Briefing 021) www.iwmi.org/Publications/Water Policy Briefs/ PDF/ WPB21.pdf

Kashaigili, J. J., McCartney, M., Mahoo, H.F., Lankford, B.A., Mbilinyi, B.P., Yawson, D.K., Tumbo, S.D. (2006) Use of a hydrological model for environmental management of the Usangu Wetlands, Tanzania. Colombo, Sri Lanka: International Water Management Institute. 39p. (IWMI Research Report 104) www.iwmi.org/ Publications /IWMI_Research_Reports/PDF/pub104/RR104.pdf

MAFFS (2011) Market bulletin. April-June 2011. Http://home.wfp.org/stellent/groups/public/ documents/ ena/wfp 240556.pdf [Accessed 2ndJune 2013]

Maltby, E., ed. (2009) Functional assessment of wetlands: Towards evaluation of ecosystem services. Boca Raton, USA: CRC Press, Cambridge, UK: Woodhead Publishing Ltd.

Masiyandima, M., McCartney, M.P., van Koppen, B. (2004), Wetland contributions to livelihoods in Zambia. Netherlands Partnership Programme: Sustainable Development and Management of Wetlands. Rome: FAO.

Matsui, S., Keskinen, M., Sokhem, P., Nakamura, M. (2006) Tonle Sap - Experience and lessons learned brief. Kasatsu, Japan: International Lake Environment Committee Foundation.

McCartney, M.P., Acreman, M.C. (2009) Wetlands and water resources. In: The Wetlands Handbook, ed., Maltby, E., Barker, T. Oxford: Wiley-Blackwells, pp. 357-381.

McCartney, M.P., van Koppen, B. (2004) Wetland contributions to livelihoods in United Republic of Tanzania. Netherlands Partnership Programme: Sustainable Development and Management of Wetlands. Rome: FAO.

McCartney, M.P., Masiyandima, M., Houghton-Carr, H. A. (2005) Working wetlands: classifying wetland potential for agriculture. Colombo, Sri Lanka: International Water Management Institute (IWMI). 40p. (IWMI Research Report 090) www.iwmi.org/ Publications/ IWMI_ Research_ Reports/PDF/pub090/RR90. pdf

McCartney, M.P., Kashaigili, J.J., Lankford, B.A., Mahoo, H.F. (2008) Hydrological modelling to assist water management in the Usangu wetlands, Tanzania. International Journal of River Basin Management 6(1): 51-61.

Mills, B. & Kamanja D.D. (1997) Processes and methods for research programme priority setting: the experience of Kenya Agricultural Research Institute Wheat Programme" Food Policy, 22(1). 63- 79.

Neville, A., Herniou, C., Fontaine, G., Marnat, E. & Petitprez (1998) Lowland development in forest Guinea: the AFVP experience in the rice project" Agricultural and Development: No.9. 54- 61.

Nguyen-Khoa, S., van Brakel, M., Beveridge, M. (2008) Is water productivity relevant in fisheries and aquaculture? Proceedings of the 2nd International Forum on Water and Food, Addis Ababa,, November 9-14, 2008, Vol. II, 6-10pp

Otsuka, K. (2000)"Role of agricultural research in poverty reduction lessons from the Asian experience". Food Policy. 25(4) 447-462.

Planning, Evaluation, Monitoring and Statistics Division (PEMSD)(2013)"The Report and Recommendations of the Rice availability and Market Survey in Wala Rice producing Areas(Wala Bolilands) in Northwestern Region (Kambia and Port Loko Districts in Sierra Leone.

Planning, Evaluation, Monitoring and Statistics Division (PEMSD)(2010) Household Food Security Survey Conducted for sustainable Agricultural development, Ministry of Agriculture, Forestry and Food Security, Freetown, Sierra Leone.

Rebelo, L-M., Finlayson, C.M., Nagabhatla, N. (2009) Remote sensing and GIS for wetland inventory, mapping and change analysis. Journal of Environmental Management 90(2009): 2144-2153.

Rebelo, L-M., McCartney, M.P., Finlayson, C.M. (2009) Wetlands of sub-Saharan Africa: Distribution and contribution of agriculture to livelihoods. Wetlands Ecology and Management 18(5): 557-572.

Resurreccion, B.P. (2008) Gender, legitimacy and patronage-driven participation: Fisheries management in the Tonle Sap Great Lake, Cambodia. In: Gender and natural resource management. Livelihoods, mobility and interventions, ed., Resurreccion, B.P., Elmhirst, R. London, UK: Earthscan and IDRC, 288p.

Sall, S., Norman, D. & Featherstone, A.M. (1998) "Adaptability of improved rice varieties in Senegal" Agricultural Systems 57(1). 101-114.

Sampa, J. (2008) Sustainable dambo cultivation. Report of Striking a Balance (SAB) Project. Maintaining seasonal wetlands and their livelihood contributions in central southern Africa. Report of Wetland Action, Self Help Africa, MALEZA (Malawi Enterprise Zone Association) and NLWCCDP (North Luangwa Wildlife Conservation and Community Development Programme).

Schuyt, K., Brander, L. (2004) The economic values of the world's wetlands. Gland, Switzerland: World Wide Fund for Nature (WWF).

Senaratna Sellamuttu, S., de Silva, S. (2009) Assessing the role of alternate livelihood initiatives and the influence of institutional frameworks in sustainable wetland planning and management in the Sangiang Plains, Heilongjiang Province, China. Mid-term Report submitted to the Asian Development Bank (ADB) Water Trust Fund.

Senaratna Sellamuttu, S., Smith, L., Nguyen-Khoa, S. (2008) Integration of fisheries in commune agro-ecosystem analysis. Livelihoods and governance component. Water allocation in the Tonle Sap wetland system. CPWF Project Number 71 (PN71).

Senaratna Sellamuttu, S., de Silva, S., Nguyen-Khoa, S., Samarakoon, J. (2008) Good practices and lessons learned in integrating ecosystem conservation and poverty reduction objectives in wetlands. Colombo, Sri Lanka: International Water Management Institute, Wageningen, Netherlands: Wetlands International, 73 p., on behalf of, and funded by, Wetlands International's Wetlands and Poverty Reduction Project.

Seng, S. (2007) Floods are good. But their irregularity leads to changing rural livelihood systems. Presented at the International Conference on Mainstreaming Human Security. The Asian Contribution. Bangkok, Thailand.

Snapp, S.S, Mafongaya, P.L. & Waddington, S. (1998) Organic matter Technologies for integrated nutrient management in smallholder cropping systems of southern Africa. Agriculture, Ecosystems and Environment. 7(1/3) 185-200

Spencer, D.S.C. (2009) Farmer Perceptions, Child Labour, and Economics of Tree Crops Production and Marketing in Kailahun, Kenema and Kono Districts of Sierra Leone. www.eds sl.com/docs/ EDSFarmer Perceptions_ ChildL abour_EconsofTreeCrops- Mar2011.pdf

Spencer, D.S.C., Deen, S.S., and Wilson, C.E. (2009) Economics of Rice Production in Sierra Leone, Report of a Survey in Three Northern Districts. Enterprises Development Services, Ltd., Funded by the Soros Economic Development Fund (SEDF), New York, U.S.A

.www.edssl.com/docs/ED's%20- %20 Economics% 20 of% 20Rice%20Prodn% 20in%20 Sierra% 20Leone% 20- %20 June%202009.pdf

Spencer, D.S.C. (2010) Farmers Assessment of Rice Varieties in Northern Sierra Leone, Report of a survey for CARE, December 15, 2010. www.edssl.com/ docs/ Farmers AssessmentofRiceVarietiesinNorthern Sierra Leone. pdf

Spencer, D.S.C., Wilson, C.E., Kpolie, E. (2011) Baseline Study For The Sustainable Nutrition And Agricultural Promotion (SNAP) Program In Sierra Leone, Enterprise Development services, Ltd, Freetown, Sierra Leone

Tadesse, B. & Krishanamoorthy, S. (1997) "Technical efficiency in paddy farms of Tamil Nadu: an analysis based on farm size and ecological zone" Agricultural Economics. 16(3) 185 -192.

Terer, T., Ndiritu, G.G., Gichuki, N.N. (2004) Socio-economic values and traditional strategies of managing wetland resources in Lower Tana River, Kenya. Hydrobiology 527: 3-14.

The East African.(2007), Tanzania: Dar is killing the fatted calf. Editorial, April 10, 2007. Nairobi. Posted to the web April 10, 2007 http:// allafrica. com/ stories/ printable/ 200704100362.html (accessed April 22 2007).

UNICEF (2010), The Nutritional Situation in Sierra Leone: UNICEF ANNUAL REPORT for Sierra Leone, Thieved from: http://www.unicef.org/ about/ annualreport/ files/ Sierra_Leone_COAR_2010.pdf

WFP (2008) Household Food Security Survey in Rural Areas. World Food Programme, Vulnerability Analysis and Mapping Branch (ODAV), Sierra Leone.

Wood, A. (2009), Valuing wetlands for livelihoods as the basis for sustainable management: The SAB approach. Striking a balance. Policy Briefing Note 1. UK: Wetland Action & the Centre for Wetlands, Environment & Livelihoods at the University of Huddersfield.

Wood, A., van Halsema, G.E. (2008) Scoping agriculture-wetland interactions: Towards a sustainable multiple response strategy. FAO Water Report 33. Rome, Italy: Food and Agriculture Organization of the United Nations.