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Determinants of farmers' adoption of improved cassava and sweetpotato varieties in Sierra Leone

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Abstract. The capacity of most African countries to produce enough food for their people is declining in the face of a rapidly increasing population and civil conflicts leading to dependence on food imports and food aid. Adoption and sustenance of farm technologies that can help enhance food production remain a major challenge for research and development agencies in many African countries. Over the years, the Institute of Agricultural Research (IAR) has made substantial efforts in improving the productivity of small-scale farmers in Sierra Leone through the development of improved technologies. This paper is based on a survey of 280 farmers in six operational zones of IAR in Sierra Leone. The results show that improved cassava and sweetpotato varieties developed by the institute have been adopted not only by farmers who have collaborated with IAR in developing and testing these technologies, but by other farmers too. The results however indicate that among other constraints, the adoption of the improved varieties is inhibited considerably by limited finance and lack of high yielding and disease-free planting materials acceptable by both the producers and consumers. The findings further suggest that farmers' religion, marital status, sex, income sources outside agriculture and collaboration in on-farm research are important in influencing adoption and should therefore be taken into consideration by research and development agencies in the promotion of root and tubers crops in Sierra Leone.

Introduction

The capacity of most African countries to produce enough food for their people is declining in the face of a rapidly increasing population and civil conflicts leading to dependence on food imports and food aid. Adoption and sustenance of farm technologies that can help enhance food production remains a major challenge for research and development agencies in many African countries (Chitere and Kiros, 1996). The goal of agricultural research centres is to generate technologies for improving productivity, farmers' welfare, and household nutritional status (Sangiga *et al.*, 1999).

In Sierra, like in most African countries, agriculture is of vital importance to the livelihood of millions of people as a source of food, employment and foreign exchange. The ten years war in Sierra Leone has aggravated the food situation problem as a large number of farm families were forced to flee bringing their agricultural activities to a halt. Even before the war, agricultural production was declining. Although the war is over, food production has not regained pre war levels. The country depends a lot on imported food (especially for the staple food rice) and on food aid (FAO, 200).

Over the years, the Institute of Agricultural Research (IAR) has made substantial efforts in improving the productivity of small-scale farmers who make up the bulk of food producers in Sierra Leone, through the development of improved

technologies which involve the introduction of high yielding plant materials that are resistant to pests and diseases, and the use of improved agronomic and management practices. IAR has the mandate to conduct research on the improvement of cassava, sweetpotato, yams, maize, groundnut, cowpea, and soybean.

However, the ultimate usefulness of these technologies is determined by their adoption by their adoption levels by the small scale farmers (Inaizumi *et al.*, 1999). The adoption of a new agricultural technology is important for evaluating the impact of agricultural research investments, guiding technology development to satisfy the needs of clients, and also helps bring out potential impact at the farm household level (Sanginga, 1988, Inaizumi *et al*., 1999). It is therefore important to assess the technological packages to find out if they meet the farmers' objectives. This will contribute immensely to technology transfer and facilitate the task of addressing the objectives of food security, malnutrition and poverty alleviation.

The objective of this paper is to assess the determinants of farmers' adoption of improved varieties of cassava and sweetpotato. In particular, the paper examines the rates of adoption of these varieties, the constraints that limit the adoption and the factors determining adoption .The basic hypothesis formulated for this study is that the socio- economic characteristics of farmers are important in explaining their adoption behaviour.

Materials and methods

The survey was conducted in six operational zones of IAR. These include: Njala, and Bo in the Southern Province, Kenema in the Eastern Province and Rokupr, Makeni and Kabala in the Northern Province. The zones are representative of the ecological and traditional diversity in Sierra Leone. Twenty five IAR contact farmers and 25 non IAR contact farmers were then randomly selected per zone and involved in the study. Questionnaires were then administered to the farmers to collect information on their socio economic and demographic characteristic, rate of adoption of improved IAR cassava and sweetpotato varieties, effect of socio economic and demographic characteristic of farmers on adoption, production constraints, etc. Data were analysed using descriptive statistics such as averages and percentages as well as a logistic regression analysis to examine the effect of the socio –economic characteristics of farmers on the rate of adoption of IAR technologies.

Results and discussions

Socio economic characteristics of sampled farmers. Twenty farmers never returned the questionnaires. So the analysis is based on 280 farmers. Table 1 presents a summary of selected socio-economic characteristics of farmers interviewed. This table reveals that contact farmers had a mean household size of 9.5persons compared to 7.9persons for non-contact farmers. The higher family size for contact farmers is an indication of the potential labour force as well as the number of people to be fed. The mean age in the case of contact farmers was 43. 2 years and 43.0 years in the case of non contact farmers, indicating that the respondents are in the active producer age group and could contribute greatly to productive work on the farm.

There were more women among non-contact farmers (29.3%) as compared to contact farmers (15.78%), which might be due to the fact that the number of female IAR contact farmers is low when compared to their male counterparts, a situation which IAR is trying to correct by deliberately targeting women as contact farmers. On the whole, the number of women farmers was very low (22.5%) compared to male farmers (77.5%). Majority of the farmers were married (95.7% of contact farmers and 90% of non contact farmers). This might not be surprising since marital status tends to influence the potential

Table1: Selected socio economic characteristics of farmers.

Characteristics	Total				Total number of farmers	
	Contact farmers (N=140)		Non contact farmers (N=140)			
Household size						
Mean	9.5			7.9	9.3	
Standard deviation	4.9			4.4	4.6	
Min	1			3	1	
Max	39			29	39	
Age						
Mean	43.2			43.0	43.1	
Standard deviation	11.3			5.7	11.1	
Min	17			19	17	
Max	80			72	80	
Gender	N	%			N	%
Male	118	84.3	99	70.7	217	77.5
Female	22	15.7	41	29.3	63	22.5
Marital status	N	%	N	%	N	%
Married	134	95.7	126	90	260	92.9
Not married	6	4.3	14	10	20	7.1
Literacy level	N	%			N	%
None	42	30	42	30	84	30
literate	98	70	98	70	196	70
Occupation	N	%	N	%	N	%
Full time farmer	104	74.3	81	57.9	185	66.1
Part time farmer	36	25.7	59	42.1	95	33.9

availability of family labour, which is very important for the farm families.

Both contact and non-contact farmers have a very high literacy level (70 %). Literacy in this study is defined as being capable to read and write a small text in English, Arabic or any of the local languages and therefore includes both formal and informal education. This might probably account for the high literacy level reported in this study, which is higher than the national average (30%). When education was disaggregated however, only 48% of the contact farmers and 45% of the non contact farmers had formal schooling. More contact farmers were full time farmers (74.3%) as compared to non contact farmers (57.9%), probably indicating a higher interest of full time farmers in improved IAR technologies.

Level of adoption of IAR improved cassava and sweetpotato technologies. When the IAR improved cassava and sweetpotato technologies were disaggregated, it was discovered that the majority of the respondents who reported using the technologies were more interested in the varieties (62,5%), recommended time of planting (39.2%) and recommended land preparation methods (37.5%). The other aspects such as spacing, fertilizer application, weed and pest management, etc. were not widely used (Table 2). The perceived superior quality of IAR improved cassava and sweetpotato varieties by contact farmers might explain their widespread use. The respondents reported combining improved varieties and their traditional farming practices. The unavailability of the necessary

resources and lack of knowledge (especially for non contact farmers) were some of the reasons given by respondents regarding this combination.

Rate of adoption of improved IAR cassava and sweetpotato varieties. Sanginga *et al* (1999) has shown that estimating the rate of adoption is very important in evaluating technologies. Adoption in this study is defined as the proportion of farmers who had used improved varieties of cassava and sweetpotatoes for at least three consecutive years and were willing to continue using them. Table 3 shows the rates of adoption of improved IAR varieties of cassava and sweetpotato by category of farmer (contact and non contact farmers). Out of the 280 farmers surveyed, 62.5% and 57.1% had adopted improved varieties of sweetpotato and cassava, respectively. However, differences exist in the adoption rates for contact and non- contact farmers. The adoption rates (more than 80%) for contact farmers for both cassava and sweetpotato were significantly higher than for non contact farmers. This is not surprising because contact farmers play significant roles in the testing, evaluation and dissemination of improved planting materials. More respondents (contact and non-contact farmers) reported using improved planting materials of sweetpotato than cassava. Farmers reported that the lower adoption rate for cassava was due to the fact that improved cassava planting materials are not readily available (especially for non contact farmers) as compared to sweetpotato. This may be due to the low multiplication factor (10) of cassava.

Furthermore, differences exist in the adoption rates across zones (Figure 1). Adoption rates for both cassava and sweetpotato were highest in Njala, followed by Makeni, Bo. Kenema, Rokupr and Kabala. The case of Njala is not surprising since IAR has its headquarters at Njala.

Analysis of the factors determining adoption is essential to discover what category of farmers has benefited from the adoption of improved varieties (Sanginga *et*

Table 2: Farmers' use of improved IAR sweet potato and cassava technologies (%).

Technology	Contact farmer (N = 140)	Non- contact farmer (N = 140)	All farmers (N = 280)
Improved varieties	89.3	35.1	62.5
Land preparation	57.1	21.4	39.2
Time of planting	57.1	17.8	37.5
Spacing	42.9	14.3	28.6
Fertilizer application	28.6	7.1	25
Weed management	39.3	6.4	21.1
Pest management	35.7	5.7	20.7

Table 3: Rate of adoption of improved IAR varieties by category of farmer.

Category of farmer	Proportion of respondents that have adopted improved cassava varieties (%)	Proportion of respondents that have adopted improved sweet potato varieties (%)
Contact farmer	85.7	89.3
Non contact farmer	28.6	35.7
All farmers	57.1	62.5

al., 1999). An analysis of the factors determining adoption was done using a logistic regression model. This model has the ability to handle a binary dependent variable and multiple continuous and categorical variables in an economic analysis. The results of the logistic regression are shown in Table 4. A farmers' age has no influence on the adoption of IAR improved varieties of cassava and sweetpotato. The negative sign associated with the gender factor suggests that women farmers have a lower adoption probability of the improved varieties than male farmers. Religion has a positive and significant effect. Education does not appear to be a prerequisite for adopting IAR improved

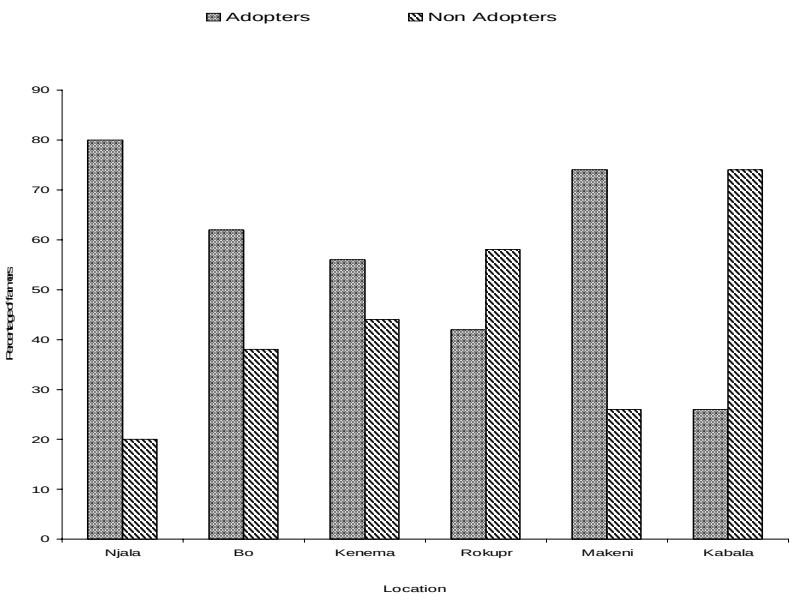

Figure 1: Rate of adoptionof improved cassava varieties by zone.

Table 4: An analysis of the socio-economic characteristics determining adoption of improved varieties: Results of Logistic regression.

Explanatory variable	Coefficients
Age	0.011
Gender**, Female =1, male =0	-1.897
Religion, Christian = 1, otherwise = 0	1.042
Literacy, Literate = 1, otherwise = 0	0.280
Marital status**, Married = 1, otherwise = 0	-2.536
Non agricultural income**, Non agriculture income source = 1, otherwise = 0	-1.351
Household size	0.055
Household head, Head of household = 1, Otherwise = 0	-0.099
Land access, access to land = 1, otherwise = 0	-0.618
Labour availability*, Labour available = 1, Otherwise = 0	1.360
Contact farmer**, Contact farmer = 1,) otherwise = 0	3.7590
Years of extension contact	0.030
Constant	2.508

Note: **, * denote significance at 0.01 and 0.05 respectively. Adopt = 1, Non adopt = 0.

varieties of cassava and sweetpotato. Its coefficient in the equation is positive, though not significant. Marital status has a negative and significant coefficient. Being married does not give any advantage in terms of higher probability of adoption.

Farmers who derive part of their income from non agricultural sources are less likely to adopt IAR improved varieties. The coefficient for this variable is therefore negative and highly significant. The household size and being the head of the household appear to have no influence on adoption. Access to land is negative but insignificant. The positive and significant labour parameter indicates a positive probability to adopt improved varieties when farmers have access to labour. The high and positive coefficient for being a contact farmer indicates that contact farmers are more likely to adopt improved IAR varieties as compared to non contact farmers. Farmers' years of extension contact was surprisingly found to have no effect on the probability of adoption. Sangiga *et al.* (1999) and Lahai (1997) also discovered similar results. Although extension services might help farmers to be more aware of innovations in general, the extension services considered in this research constitute IAR extension staff and those of the Ministry of Agriculture, Forestry and Food Security and NGO's. The Ministry and NGO extension services might have little or no effect on the adoption of IAR improved varieties.

Constraints to farmers' adoption of IAR improved varieties of cassava and sweetpotato. Farmers' willingness to adopt new technologies is largely a function of available resources. Table 5 shows that more than 80% of contact and non contact farmers reported that limited finance, limited availability of high yielding and disease-free planting materials acceptable by both the producers and consumers and labour shortage were major constraints. Of the three constraints, however, limited finance was considered to be the major constraint when all the farmers are aggregated. This might not be unconnected with the fact that finance is necessary for buying all other farm inputs. More than 70% of contact and non contact farmers considered the unavailability of tools as a serious problem. This might be associated with the loss of tools and other productive resources by farmers during the war. Food shortage was another constraint experienced by 69.1% of contact farmers and 72.1% of non contact farmers. This is a situation that might have been aggravated by the war as farmers had to depend on donor agencies for "food for work" as well as planting materials. 67.9% of farmers considered limited availability of improved planting materials and unavailability of fertilizer to be problems but few (18.6% of

Table 5: Constraints to cassava production identified by respondents (%).

Constraint	Contact farmers (N = 140)	Non contact farmers (N = 140)	All farmers (N = 280)
Finance	82.1	90.0	86.1
Limited availability of improved planting materials	81.4	88.5	85.0
Labour shortage	87.9	81.4	84.6
Land accessibility	18.6	12.1	15.4
Food shortage	69.3	72.1	70.7
Unavailability of fertilizer	67.9	67.9	67.9
Unavailability of tools	79.3	79.3	79.6

Figures do not add up to 100 because some respondents gave multiple responses.

contact farmers and 15.4% of non contact farmers) felt that land accessibility was a problem.

Conclusion

This paper examined the determinants of farmers' adoption of IAR improved varieties of cassava and sweetpotato. From the results of the study, it is apparent that the IAR improved cassava and sweetpotato technology that was readily adopted by farmers was the improved varieties, with more of the contact farmers adopting the improved varieties than non contact farmers. However, Wortmann *et al.* (1997) warned against the pitfalls of making wider inferences from the adoption behaviour of trial farmers, since the experimental process itself may influence the adoption process. Differences also exist in the adoption rates according to the crop and zone. Sweetpotato had a higher adoption rate as compared to cassava and Njala zone (IAR headquarters) had the highest adoption rate followed by Bo. Kenema, Rokupr and Kabala. The results however indicate that among other constraints, the adoption of the improved varieties is inhibited considerably by limited finance and lack of high yielding and disease-free planting materials acceptable by both the producers and consumers.

The findings further suggest that the sex of the farmer, religion, marital status, income sources outside agriculture and being a contact farmer are very important in explaining the adoption or non-adoption of IAR improved varieties of cassava and sweetpotato by farmers. Labour availability is also significant but the age of the farmer, literacy level, household size, household head, access to land and years of extension contact were found not to be significant in explaining the adoption behaviour of the respondents.

Implications. The findings discussed above should have important implications for tropical root and tuber crop production. The fact that root and tuber crops contribute greatly to food and nutrition security, suggests that research and development agencies concerned with the promotion of tropical root crops production should consider farmer' specific situations, constraints and socio economic characteristics in planning and developing programmes for intervention.

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