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Adoption of Cashew Production Technologies by Farmers in the Southeastern Tanzania

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Abstract. The level of adoption of improved cashew (*Anacardium occidentale L.)* production technologies by farmers was assessed in the Southeastern Tanzania. The study was conducted in three selected districts namely Tandahimba (Makonde plateau), Mtwara rural (Coastal area) and Nachingwea (Nachingwea-Masasi plain). The findings have revealed that most of the respondents were experienced cashew farmers being aware of improved cashew technologies. On the other hand study has confirmed that only a proportion of respondents have adopted improved technologies at different levels. Several factors were responsible for constraining farmers from adopting the package of cashew technologies some of them include inadequate and untimely supply of inputs particularly those with subsides and also delay of payment after farmers sold their raw nuts. Further results of logistic regression summarize the factors that influenced adoption of technologies. It was found that number of years spent in school, number of active labour in the household and access to extension services were the most important factors that influenced technologies adoption. In last section of this paper recommendations were made, some of them include; district councils should supervise and ensure adequate and timely supply of inputs and also building capacity of extension officers on recommended cashew management practices.

Keywords: Cashew, adoption, production technologies, farmers, Southeastern Tanzania

1. Background Information

Cashew (*Anacardium occidentale L.)* is the major cash crop produced by smallholders of Southeastern Tanzania with an average of 7 ha of cashew trees per farmer. In addition cashew fields are intercropped with food crops such as maize, cassava, pigeon peas, cowpeas and groundnuts [1]. Cashew yields vary between trees, areas and age depending on management practices, environment and incidence of insect pests and diseases. Various efforts have been made by the government through Naliendele Agricultural Research Institute (NARI) and other stakeholders to improve cashew yield through developing and distributing improved technologies to cashew farmers. NARI developed various technologies such as improved cashew planting materials, insect pests and diseases control strategies as well as agronomic packages and distributed to farmers in collaboration with other stakeholders like district councils and Non-Governmental Organizations. Further, delivery of improved planting materials to farmers involved establishment of cashew development centers (CDC's) and village based nurseries. Additionally, integrated cashew management program (ICM) was established to provide farmers with a basket of technology options. ICM was the multidisciplinary approach developed to provide cashew farmers with a range of options for increasing cashew productivity. With this respect, in 1990s NARI selected, multiplied and distributed improved cashew materials (Series I & Series II) to rural farmers in Southeastern Tanzania. The major objective was to assess the performance of such materials and create awareness to farmers in order to influence adoption. Despite all the efforts made by NARI and other stakeholders, adoption rate of improved technologies is still low. Therefore, this study was carried out to investigate the factors influencing adoption of cashew technologies in Southeastern Tanzania.

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2. Objectives of the Study

The main objective of the study was to assess the current level of adoption of improved cashew nut production technologies by farmers in the Southeastern Tanzania. The specific objectives were; to determine the extent and intensity of adoption of cashew production technologies by farmers, to investigate the factors influencing adoption of cashew production technologies by farmers, to assess farmers' perceptions on improved cashew materials and also to document farmers' constraints or limitations for adoption of cashew production technologies.

3. Methodology of the Study

The Southeastern Tanzania comprises of Mtwara and Lindi regions, and Tunduru district in Ruvuma region. The zone covers 103,478 km^2 where by 17,750 km^2 is in Mtwara, 66,950 km^2 in Lindi and the rest (18,778 km^2) in Tunduru district. The total area under cashew cultivation is 185,179 ha (35%), 123,015 ha (23%) and 74,368 ha (14%) in Mtwara, Lindi and Ruvuma regions respectively. The area is occupied by 2.4 million people out of whom about 1.3 million are in Mtwara region. The population in Lindi region and Tunduru district is 864 652 and 298 279 respectively [2]. Southeastern Tanzania has two main seasons: a humid and hotter wet season (November to May) and a cool, less humid dry season (June to October). Mean annual rainfall ranges from about 800 mm in inland and central areas to 1200 mm in the hills and plateau near the coast [3]. The most important annual crops are sorghum, maize, cassava, rice, vegetable, groundnut, sesame, sweet potato, pigeon peas, cowpeas, green grams and bambaranuts. Tree crops are mainly cashews, coconuts, citrus and banana [4].

This study used cross sectional research design in which cross sectional data were collected and used for analysis. Purposive sampling was used to select district and villages for the survey while random sampling technique was used to draw respondents for the interview. Selected villages were those which had at least one cashew demonstration plots planted in the past ten to twelve years. Three districts (Tandahimba, Mtwara rural and Nachingwea) were selected for the survey. Selected villages include Dihimba, Nanyamba, Mwang'anga and Namgogoli for Mtwara rural; Nanyanga, Kitama, Miuta, Mdimba and Makukwe in Tandahimba; and Ntira, Namanga, Chiumbati miembeni and Ndomoni for Nachingwea. In each village at least 15 cashew farmers were drawn for interview and made a sample size of 75 respondents in each district and hence a total sample size of 225 respondents. A structured questionnaire was used for collecting information from sampled farmers. Descriptive statistics such as means, standard deviation, graphs, frequency distributions and cross tabulations were used to describe the data. The information obtained from these statistics provided information to support the results from Binary logistic regression. Statistical Package for Social Science (SPSS) was used for analysis.

Since the dependent variable has only two outcomes; "Adoption and non-adoption of improved cashew materials", a Binary Logistic Regression Model (BLGM) was used [5]-[8]. In this study, it was conceptualized that, a farmer who had planted more than 5 improved cashew trees qualified to be an adopter and hence ranked 1 while ranked 0 if not adopted. The logit (Y) was given by the natural log of odd i.e. Y=P(Y=1) / 1-P(Y=1) which was expanded using the following equation:

$$\text{Log}\,(P/1\text{-}n) = \beta_0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \ldots\ldots\ldots\ldots\ldots\ldots \beta_n X_n + \varepsilon_i. \quad (1)$$

where Log (P/1-n) = the logit, which is the positive logarithm of the odd ratio of a farmer adopting a technology against non adopter (dependent variable indicated by Y= 1 and Y=0).
B_0 = Y – intercept, $\beta_1 \ldots \beta_n$ = (Coefficients of independent variables). $X_1 - X_n$ = (Independent variable under observation.
X_1 = Age of respondent (years), X_2 = Number of years in school (years), X_3 = Cashew farming experience (years), X_4 = Number of active labour in the household, X_5 = Total farm land owned (number of acres owned), X_6 = Access to extension services.

4. Results and Discussion

4.1. Socio-Economic Characteristics of Respondents

In this study findings have revealed that the average age of respondents was 48 years the minimum being 20 and maximum 86 years. About 82% of the respondents had primary education. Long experience of 30 years in cashew farming was scored in 23% of respondents while 30% was for farmers with 10 to 20 years in cashew production and another proportion 12% was for those with experience of less than 5 years. The average number of household people was 6 out of which 50% were dependants. This implies that available labour force for cashew nut production is meager particularly during labour dependant operations. About 89% of respondents reported experiencing shortage of labour for farm activities particularly in cashew.

Important cash crops grown in the study area include sesame, cashew, maize, rice and cassava. It is seen that, cashew was the first important cash crop in terms of income contribution to the household followed by sesame and rice. Among these major cash crops, cashew contributed 49% of the total income earned by the household from these crops, sesame contributed 19% and rice 15% while maize and cassava contributed 8% and 9% respectively.

4.2. Adoption of Improved Cashew Technologies

Generally, about 91% of respondents were aware about the presence of improved cashew materials. However, in overall, only 57% planted these materials in their fields. In Tandahimba district 64% of the respondents planted improved cashew materials while in Mtwara and Nachingwea districts the statistics were 61% and 47% respectively. High score for Tandahimba corresponds with its leading across cashew growing areas in Southeastern Tanzania. Sources of planting materials varied among respondents. Farmers reported that 44% of improved planting materials were bought from the research stations and 25% reported to have obtained from their own field and others (31%) were given free by local governments and Non Governmental Organizations (NGO's). The findings revealed that the average number of cashew trees owned per household was 200. Among the total cashew trees planted by respondents only 25% were improved materials. In Nachingwea district only 6% were improved materials while in Tandahimba and Mtwara was 25% and 24% respectively.

4.3. Logistic Regression Results on Adoption of Improved Cashew Materials

Binary logistic regression model was used to investigate important factors influencing adoption of improved cashew materials (Table 1). The factors predicted in the model were age of respondents, education level, number of active labour in household, total farm land owned and access to extension services. The -2 log likelihood was 278.272. The Chi-square was 31.681 and significant at 1% level. The findings revealed that every one unit increase in education level leads to a 1.265 (26%) increase in the log-odds of adoption of improved cashew materials holding other factors constant (*ceteris paribus*). This implied that the probability of adoption of improved cashew materials increases with increased level of education. Also for every one unit increase in number of active labour in the households led to a 1.312 (31%) increase in the log-odds of adoption of improved cashew materials. This implied that the probability of adoption is higher to those households with large number of active labour compared to smaller numbers. Likewise it was found that access to extension services lead to a 1.989 (99%) increase in the log-odds of adoption of improved materials. This implies that the probability of adoption for the farmers with access to extension services is higher than that of farmers without extension services. Therefore education level of the respondents, number of active labour in the households and also access to extension services were the important factors influenced adoption of improved cashew materials in the study area.

Table 1: Logistic Regression Results for Adoption of Improved Cashew Materials

Variable	β	SE β	Exp (β)	df	Sig.
Constant	-3.458	1.006	0.031	1	0.001
Age (yrs)	0.024	0.013	1.024	1	0.066
Years of schooling (yrs)	0.235	0.075	1.265	1	0.002**
Total farm land owned (acres)	0.008	0.009	1.008	1	0.378
Number of active labour in the household	0.272	0.107	1.312	1	0.011**
Access to extension services (1,0)	0.687	0.331	1.985	1	0.038**

-2log likelihood = 278.272; ** significant at 0.05; 67% of cases predicted the model; Chi – square = 31.681 significant at 0.001. Dependent variable = (Adoption of improved cashew materials (1 was if adopted and 0 was if not adopted).

4.4. Cashew Diseases and Insect Pests

Generally, majority of respondents (89%) reported using fungicides on cashew for disease control and among those 90% had some knowledge about powdery mildew disease (PMD), unlike other diseases like Blight (15%), Anthracnose (3%) and Dieback (5%). This implies that majority of respondents had inadequate knowledge on the causes and symptoms of the diseases. The most common fungicides used by farmers for control of cashew diseases include Sulphur dust, Bayfidan and Mupavil as reported by 80%, 5% and 5% of respondents respectively. Number of rounds for fungicides application varied from one to five rounds depending on the income level of respondent. About 32% and 31% of respondents were spraying three and four rounds per season respectively. Others (20%) sprayed five rounds, two rounds (10%), 1 round (3%) and more than 5 rounds (3%). The average rate of fungicide (Sulphur dust) application was 200 gm per tree per round the minimum being 60 gm and the maximum 735 gm. The findings revealed that majority of respondents (70%) had inadequate knowledge on diseases control. However, majority of respondents had knowledge on fungicides spraying intervals.

Likewise, the findings revealed that 75% of respondents were using insecticides for pests control on cashew. About 70% of cashew trees planted by respondents were sprayed with insecticides. However, the findings revealed that more than 70% of the respondents had little knowledge on insect pests attacking cashew trees. About 60% of respondents were aware of *Hellopeltis spp*, while 43%, 9% and 2% were aware of *Mecocorynus loripes*, Mealy bug and Coconut bug respectively. Number of rounds for insecticides application also varied from one respondent to another depending on incidence of insect pests and income levels. Other respondents reported mixing insecticides and fungicides for one spraying round and others are alternating. The common insecticides used by respondents were karate (82%), Ninja (11%) and Duduall (5%). (1%) (Fig. 1). Further results revealed that the average rate of insecticide application was 4 mls per tree per round while the recommended rate is 5 mls particularly for karate. Nachingwea district recorded lower application rate (3.1 mls) compared to other districts like Tandahimba and Mtwara. These findings implied that many farmers were not able to achieve the recommended application rates for pesticides. The major challenges faced by respondents were on how to identify destructive insect pests and also application rates to be used for different insecticides, thus most of spraying activities were done by hired motorized blowers' operators.

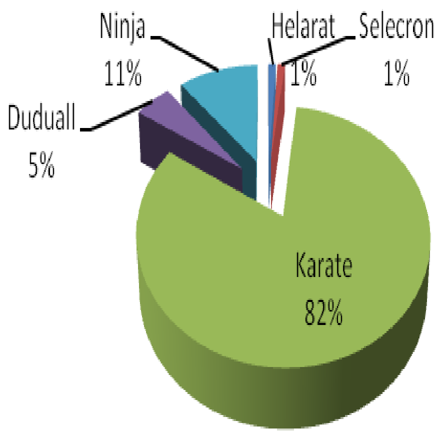

Fig. 1: Different insecticides as used by respondents

Generally, only 26% of the respondents owned motorized blower, and the rest hired the service. At district level, in Mtwara district 29% of the respondents owned motorized blower while in Nachingwea and Tandahimba districts was 20% and 28% respectively. High prices of motorized blowers were the major limiting factor to the majority of respondents. About 56% of the respondents were not satisfied with the hired services provided by the blower operators. The major challenges reported were inadequate knowledge (39%) of the operator on the application rates, inefficient operation (29%) particularly on canopy coverage and also untimely application (37%) due to long queue of farmers waiting for the same service. This resulted to reduction in number of cashew trees for insect pests and diseases control.

4.5. Perception of Farmers on Improved Cashew Materials

The findings revealed that 56% of the respondents preferred improved to local materials. The study identified different characteristics of improved materials as perceived by the respondents. The first important characteristic was high yielding followed by early bearing and clean, big and well filled nuts as reported by 54%, 51%, and 51% respondents respectively. Other characteristics include tolerance to insect pests and diseases, easy pesticides application due to their size, fruit taste and also short harvesting period as reported by 47%, 20% and 12% of respondents respectively. Clean, big and well-filled nuts are qualities acceptable at domestic and international markets unlike local materials that require more sorting and grading. With improved cashew materials farmers increases their chances of selling their raw nuts.

4.6. Constraints Faced by Farmers in Adopting Improved Cashew Technologies

About 72% of the respondents reported that, inadequate and untimely supply of inputs particularly for subsidized insecticides and fungicides was the first important limitation for adoption of recommended practices. This was due to the reason that, it leads to untimely and insufficient application of pesticides. While inadequate extension services (63%) and unavailability of improved planting materials (63%) at village level were the second important constraints for adopting cashew technologies followed by delay of payment (60%) after farmers' sold their raw cashew nuts to primary society as it was reported by 63%, 63% and 60% of respondents respectively. This situation discouraged farmers to invest on cashew farming and also adoption of improved technologies. Other constraints for adoption of cashew technologies by farmers include inadequate capital (58%) to invest on improved cashew nut production, poor price incentives (53%) which also discouraged farmers to adopt improved technologies, high prices of inputs (52%) particularly pesticides and motorized blowers, uncertainty of the performance of improved materials particularly on tolerance to insect pests and diseases and also yield and lastly shortage of land (45%) for planting new cashew trees and also at a recommended spacing.

5. Conclusion and Recommendations

Substantial efforts have been made by NARI to develop improved cashew technologies in the Southeastern Tanzania, but also dissemination of these technologies in collaboration with other stakeholders in the cashew industry including local government authorities and non-government organizations (NGOs). Despite all these efforts, the study established that the level of adoption of cashew technologies is relatively low. Several factors are mentioned as being responsible for this setback. These include unavailability of improved planting materials at village level, inadequate and untimely supply of inputs (particularly subsidized insecticides and fungicides), inadequate extension services as well as inefficient marketing system. Basing on these findings, the following recommendations were made:

- Accessibility of improved cashew planting materials should be improved by establishing nurseries at ward or village level. This could minimize transport cost incurred by farmers in accessing planting materials out of their localities.
- Inputs should be supplied to farmers timely and at affordable prices since improved cashew materials can double their yields if inputs are used.
- Extension services should be improved in order to build the capacity of cashew farmers on cashew production in general and management of improved cashew materials in particular. Mass media should also be involved in promoting the technologies
- Since price incentives play a significant role in farm resource allocation decisions, stakeholders in cashew sub-sector should improve marketing efficiency so that farmers feel secure to invest in the crop.

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