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CONSUMER PREFERENCE FOR CASSAVA PRODUCTS VERSUS DIFFERENT PROCESSING TECHNOLOGIES

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ABSTRACT: This study was proposed to explore the determinants of consumer preferences for cassava mechanically processed products. It was conducted in Pwani and Tanga regions in Tanzania. Primary data were generated from 120 consumers who were randomly selected with the use of questionnaire. The probit regression analysis was applied to determine the variables which influenced the consumers' preference for mechanically cassava processed products versus other processing technologies. The analysis suggests that quality of mechanically processed products, household size and quantity consumed per year were important factors that increase the probability of consumers' preference for mechanically processed cassava products versus different processing technologies in the study areas at $\alpha = 0.05$ significance level. On the other hand, price of the product was significant factor that reduce the probability of consumers' preference for mechanically processed cassava products versus different processing technologies in the study areas at the same significance level. Thus the study recommended that Processors and other stakeholders of the cassava sub sectors (SUA, Ministry of Agriculture, Food Security and cooperatives, NGOs and owners of the businesses) should focus on designing marketing strategy that integrates all the above attributes so that their products and services can satisfy customers' needs and wants.

KEYWORDS: cassava, consumer preference, mechanically processed cassava, probit regression analysis.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is the starchy root crop that is grown almost entirely within the tropics. Although it is one of the most important crops in the tropical countries, it is little known elsewhere in some parts within the tropics, and considered to be a low grade substance crop (Cock, 2001).

Cassava ranks second in the list of staple food crops in developing countries after maize (Nweke, 2003). In sub-Saharan Africa, cassava is grown chiefly as human food, but it is also an important animal feed and has several industrial uses. Being one of cheapest source of food energy, cassava gives a carbohydrate production per hectare which is about 40% higher than rice and 25% more than maize. Thus cassava plays a major role in meeting developing countries' rising demand for consumption of both food and animal feed (Tonukari, 2004).

The total area harvested in the world in 2005 was about 16 million hectares, with 57% in Africa, 25% in Asia and 18% in Latin America. About 15% of the world's population of cassava is exported to Europe and Japan as chips, pellets and/or starch. The starch is used in food industries, textiles, paper industries and in beer brewing. The remaining 85% of the world production is used within the producing countries for food (58%), animal feed (28%) and industrial uses (3%) where the wastage is about 11% (CIAT, 1993).

The area of land planted with cassava is greatest in Africa, but yields are lower than other continents, where in 2005 Africa, Asia and Latin America had 12 354 000, 3 429 000 and 2 649 000 hectares of land planted with cassava whereas productions were 109 755, 56 082 and 34 094 (000 metric tonnes) respectively (Prakash, 2008). Africa is the only part of the world where per capital food production has been declining in the last two decades, although cassava production has nearly double during the same period (De Bruijin and Fresco, 1999). Most cassava in Africa is produced by female farmers for food and is consumed near to where it is grown. There is a growing commercial market for cassava in Africa and men are gradually being involved in the production of cassava in Nigeria, Ghana and Democratic Republic of Congo (DRC) (FAO, 1995).

Cassava for human consumption is greatest in Africa, averaging to 409.5 g of fresh and dried cassava per capita per day. The highest consumption is found in Angola with 787 g per capita per day (Nhassico *et al*., 2008). The starch roots are the most commonly consumed part, but the leaves are also consumed as preferred green vegetable in many cassava-growing communities, especially in Central Africa (Hahn, 1998).

Both the tuber and leaves of cassava contain Cyanogenic glucosides, which may lead to toxicity if cassava is not properly processed. Safe consumption of cassava thus depends on successful removal of cyanogens. Depending on the processing methods used, the percentage of cyanide reduction varies from 70 to 100% (Nwapa, 1986). In order to minimize the cyanogens content, cassava is processed by different traditional methods, which includes fermentation (wet and solid-state) and drying. However, in solid state fermentation and drying, there is proliferation of spoilage and pathogenic micro-organisms on cassava, some of which may produce mycotoxins (Nwapa, 1986). The resulting flour is coloured thus not appealing to the consumer. This dissertation sought to evaluate the introduced cassava processing technologies on production and consumption using goal programming approach.

In Tanzania, cassava is grown in most parts of the country. However, chief growing areas are Tanga, Mwanza, Pwani and Lindi regions. In recent years, cassava is also grown in other parts of the country as a result of Government efforts to stimulate local self-sufficiency in food supply (Nang'ayo *et al*., 2007); as such, making cassava the most important root crop in the country. Despite its importance, Tanzania is estimated to produce 6.3 million tons of cassava per year.

Cassava is very high in starch and can grow even in areas with marginal rainfall, with possibility of contributing greatly to livelihood support. This led to insistence from policy makers and other bodies in the past to grow cassava as a food security crop. The main inherent problems with cassava include high perishability of the edible roots within 2-3 days after harvesting, high level cyanogenic glucosides in some variation (Mlingi and Ndunguru, 2003) and low nutritional value as it is mainly composed of starch. These have led to marginalization of the crop in terms of production and consumption, which have made it more of a subsistence crop. In addition, there exists stigma in some transects of Tanzanians to regard cassava as a poor man's food, therefore reduced production and consumption of cassava and increased vulnerability of cassava farmers to poverty (Mlingi and Ndunguru, 2003).

One solution to the perishability problem has been to leave the crop in the field and harvest in piecemeal only where there is need but this is uneconomical because it ties up the land unnecessarily. Another one has been to transfer the risk by selling the crop to businessman while still in the field at price set arbitrary and often very low, which gives very little income to farmers and thus a disincentive to increased cassava production. A noble solution has been to process the roots into shelf-stable product, for example flour but the methods used are still inadequate as in most area they are tedious, rudimentary and unhygienic, often leading to insufficient processing and poor quality products (Silayo *at al*., 2004).

However, mechanical chipping of cassava roots instead of manual chipping has been introduced, but the technology has not yet been reached by majority of cassava growers in terms of knowledge and physical ownership. The cyanide problem has been successfully dealt with through proper processing, e.g. dry and wet fermentation (Silayo *at al*., 2004). In recent years, the Programme for Agricultural and Natural Resources Transformation for Improved Livelihood (PANTIL) introduced the solutions of selection of low cyanide varieties and the processing machines which grant cassava prior to subsequent processing.

Grating and chipping machines have been introduced in few villages in Pwani, Dar-es-salaam and Tanga regions as a detoxification-method whereby High Quality Cassava Floor (HQCF) has been produced. However, the determinants for consumer preference on HQCF are not yet clearly established. Therefore, this paper was proposed to establish the factors which determine the consumer preference on the introduced cassava processing technologies' products.

The present paper focuses on the determinants of consumer preferences for cassava mechanically processed products. The principal research question is: How income, price, quantity of the product consumed and service quality, education level, household's size, age and sex do, clearly established determinants of cassava processed products choice.

LITERATURE ON CASSAVA PROCESSING TECHNOLOGIES

Three cassava processing technologies have been reviewed in this study, which includes traditional processing technology, wet and solid-state fermentation and mechanical processing technologies which have been recently introduced in Tanzania.

Traditional cassava processing technologies used in Africa probably originated from tropical America, particularly north-eastern Brazil and may have been adapted from indigenous techniques for processing yams (Jones, 2003). The processing methods include peeling, boiling, steaming, slicing, soaking or seeping, pounding, roasting and drying. These traditional methods give low product yields, which are also of low quality (Montagnac *et al.,* 2009).

Wet and solid-state fermentation cassava processing technology is a combination of two processing technologies that means wet fermentation and solid-state fermentation, reported to be very efficient in cyanide removal (Montagnac *et al.,* 2009) but resulted in high losses in nutrients of high value, such as proteins, carbohydrates, minerals, and vitamins (Hotz and Gibson, 2007).

Mechanical processing technology for cassava involves using chipping and grating machines, pressing devices, mills, gari fryers, and sifters (IITA, 1996). The technology involves chipping, grating and crushing which are usually very efficient in cyanide removal because they completely rupture plant cells of cassava and allow direct contact between linamarase and linamarin (Cardoso *et al.,* 2005).

CONSUMER'S PREFERENCE FOR CASSAVA PROCESSING TECHNOLOGIES PRODUCTS

The preference of any product is basically determined by a number of products. However the cassava processing technologies products can be influenced by the following factors:-

i) Quality of cassava products: In Ghana and Nigeria there is high quality traditionally processed cassava products such as *agbelima, fufu, gari and kokonte* which are mostly preferred by the people (Jumah *et al.,* 2008) have shown that traditional *fufu* accounts for the largest share 40% of the Ghanaian household budget for cassava food products.

Contrary, in Tanzania two governmental institutions that is Sokoine University of Agriculture (SUA) and the Ministry of Agriculture and Food Security (MAFS) under a joint project Tanzania Agricultural Research Project Phase II (TARPII-SUA) had implemented two cassava post-harvest researches. One of these was on processing of cassava for human consumption (Project 029) implemented in Magindu village (Kibaha district) and Songabatini village (Muheza district). The few successes realized included introduction, testing and adoption of chipping and grating machines by two farmers groups in these villages, invention of Kebab-looking food product (*kibabu*), and formulation of wheat-cassava flour buns, *chapatti* and *futari* (Laswai, *et al*., 2005; Silayo *et al.,* 2004).

ii) Consumer's income: In Africa, cassava is a marginalized crop in food policy debates because it is burdened with the stigma of being an inferior, a low protein food that is uncompetitive with glamour crops such a imported rice and wheat. Many food policy analysts consider cassava an inferior food because it is assumed its per capita consumption will decline with increase of per capita income (Nweke, 2003).

iii) Education of the consumers: The consumers' education level also affected their preference for certain food products. Generally, people tend to process cassava roots mainly into traditional foods as *fufu* (Nigeria) or *bada/Makopa* (Tanzania). Widowati and Hartojo (2000) in their study on production and use of cassava flour in Indonesia revealed that more than 70% of those with formal education processed cassava into traditional foods while those with higher education level seemed to use cassava flour for preparing more alternative cassava products as buns, chapatti and chips.

iv) Household's size: Household's size played a very important role in explaining preference in cassava processed products. Jumah *et al.* (2008) found that the mean household size to be four and the number of persons consuming certain cassava products per household was found to be three. This implies that over 70% of the persons in households were consuming cassava products. Other factors which have been seen to influence the preference for cassava processed products were age, sex and how frequently cassava products were eaten or quantity consumed (Tomlins *et al*., 2007).

METHODOLOGY

Description of the Study Area

Location of the study area

This research was conducted in two regions which are Tanga and Pwani regions. The regions are situated on the Eastern part of Tanzania mainland along the Indian Ocean coastal belt. Economically, the coastal regions have a typical agricultural economy with more than 90% of its population depending on agriculture. The research was conducted at Tongwe village in Muheza District (Tanga region) and at Mikongeni village in Kibaha district (Pwani region). These have been chosen because cassava is widely cultivated by many farmers and cassava processing technologies (both traditional and mechanical) are used. Moreover, the study areas are in close proximity to urban markets such as Tanga and Dar es Salaam where there is potential growing demand for cassava and its respective products.

Economic activity

Economically, Pwani and Tanga regions have a typical agriculture economy with more than 90% of its population depending on agriculture. In the year 1996 Gross regional income of Pwani and Tanga regions were estimated as TZS 20.8 billion and TZS 92.8 billion respectively. Pwani region has lowest GDP per capita (TZS 28 149) while Tanga region has a GDP per capita of TZS 60 021. In 1994, Pwani and Tanga regions ranked last and 9^{th} in the contribution to the National GDP, in which their contributions were 1% and 5.5% respectively according to NBS (1997). In 2002/03, Pwani and Tanga regions were among the most prominent cassava producing regions, contributing to about 17% of the total cassava produced in the country.

Cassava ranks the second after maize in terms of household producing it, area planted, and production volume in the country (MOA, 2003). In 2001/02 the crop contributed about 29% of food produced in the country preceded by maize which contributed about 49% of total volume of food (NBS, 2007).

Research Design

The research design for this study was a cross –sectional, where data were collected at a single point in time. The reason for choosing this design is simply because it is flexible, economical and easy to manipulate data and information (Bailey, 1994).

Sampling procedure and sample size

Purposeful sampling was used to select two villages where there is an on-going PANTIL cassava project. In this respect the village close to Kibaha town (Pwani region) and the other village more than 10 km off Muheza town (Tanga region), which situated along Arusha – Tanga main road were chosen, the villages were Mikongeni and Tongwe respectively. Then proportionate stratified sampling based on their income (i.e. those with low income versus those with high income) was employed.

Thereafter, random sampling was employed to get a sample of 30 respondents from each stratum. Ultimately sample of 120 respondents were used for this study. A sample size of 30 respondents is deemed large enough (Wooldridge, 2008). The Central Limit Theorem (CLT) states that the average from a random sample for any population, with finite variance, has an asymptotic standard normal distribution. Most estimators encountered in statistics and econometrics can be written as functions of sample averages (Wooldridge, 2002). Therefore, the t-statistic was used as inference test of the model, based on the law of large numbers and the Central Limit theorem (CLT).

DATA COLLECTION

Structured questionnaires with both closed and open-ended questions, group discussions and observation were used as methods for collecting primary data. Data were collected through interview of the sampled households and key informants who were the village chairmen and agricultural field officers to each village. The key variables asked were the farmers (household) characteristics, household sources of income, cassava production, processing (traditional, wet and dry and mechanical) and consumption.

The experimentations were used to collect information on efficiency (in terms of operational, time, fuel consumption) of the mechanical processing technology from the study area. The experiments were conducted by taking 5 kg of chunks/pieces of pealed cassava into each machine (manual cassava chipper, engine powered cassava chipper and cassava grater). The time used to process the cassava by each machine was recorded by using stopwatch as a pilot, and then the experiments were repeated four times, whereas deep stick was used to measure the fuel level. Secondary data were collected by reviewing document from the respective District Agriculture Departments, Ministry of Agriculture, Food Security and Cooperatives, International Institute for Tropical Agriculture (IITA) reports, Sokoine National Agricultural Library (SNAL) and Internet.

DATA ANALYSIS

The study employed the probit regression analysis to determine the significance of the number of factors which contribute to the consumer's preference (Eastwood *et al*., 1987) for cassava processed products to the household. Variables included in the model were income of the household, family size, number of years in schooling, gender of the household head, quality of the processed products, age of the household head and price of the processed products. In estimating probit regression model, the maximum likelihood estimation techniques were commonly used (Hennessy and Rehman, 2008). The consumer's preference for mechanically processed products by the household was estimated by maximum likelihood methods as shown in equation (6) as follows;

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_7 X_7 + \varepsilon \quad ....(6)$$

Where;

Y= Preference for mechanical processed products (1= technology preference; 0 otherwise),

α = Constant,

X_1 = Income of the household (low, high),

X_2 = Quantity consumed by the household in bags,

X_3 = Household's size,

X_4 = Price of processed cassava products,

X_5= Quality of the processed products (1= Mechanical processing technology; 0 otherwise),

X_6 = Number of years in schooling,

X_7 = Sex of the household head (1= male; 0 = otherwise),

X_8 = Age of the household head,

ε = The error term.

RESULTS AND DISCUSSIONS

Social-economic Characteristics of the Respondents

Characteristics of respondents interviewed have important social and economic implications towards factors influencing cassava production and consumption. For example, family characteristics such as age usually influence the quantity of the agricultural output. Therefore, this section describes the characteristics of sampled respondents, focusing on age, gender, household size and education level.

Age of the respondents

The distribution of farmers according to age is presented in Table 1. Results show that majority of the respondents (67.5%) were above 36 years of age and people with active age (17 to 55 years) constituted 80.8% of total respondents. Meanwhile, respondents aged above 55 years were 19.2%. Basing on the information above, it is clear that in the study area the working force is available and able to work in agriculture as their main economic activity but large percentage (48.3%) of the sampled cassava farmers are falling in the age of 35 to 55 years (Table 1).

Sex of the respondents

Result in Table 1, shows that, about 63% of the respondents were male and the remaining 37% were female. Skewed results were expected since men are the household heads to whom the interview was directed. As far as cassava production is concern as observed by TADENA (2004), access and use of land for cassava production is not gender biased. Either of the sexes can get involved in cassava production. There is no bias when it comes to providing access to farmland for women. Likewise, there are no important cultural beliefs and practices that are likely to affect the development of cassava. The results also show that 32% and 38% of the men and women respectively within sampled households were using mechanized cassava processing technology.

Household's size of the respondents

Results in Table 1 shows that about 23.3% of the sizes of the household range from 1 to 3 members and 59% of the household sizes have members ranging between 4 and 6 and only 17.5% of the sampled households were above 6 household's members. Therefore, majority of the households (76.7%) have 4 members and above, which signifies that there is enough work force due to the fact that majority of population in the study area fall in the age of 17-55 years.

Table 1: Social-economic characteristics (n=120)

Variable	Categories	Frequency	Percentage
Age	17-35	39	32.5
	36-55	58	48.3
	>55	23	19.2
Gender	Male	75	62.5
	Female	45	37.5
Household size	1-3	28	23.3
	4-6	71	59.2
	>6	21	17.5
Education level	No formal education	22	18.3
	Standard four (iv)	3	2.5
	Primary education	74	61.7
	Secondary education	21	17.5

Education of the respondents

Education is one of the factors that influence cassava production. A farmer with formal education is likely to be innovative or adoptive to new technologies than a farmer with no formal education whereas other factors remain constant. The study revealed a moderate rate of literacy in the study area. Results on level of education showed that respondents in the study area have attained formal education. The majority of sampled household heads in the study area (61.7%) and (17.5%) had attained primary education and secondary education respectively. These findings support the observation by the assessment of agricultural marketing information needs study (URT, 2004), which found that there is a large number of farmers with primary education and above. This shows that, the introduced cassava processing technology could be easily adopted in the study area because most of the farmers have formal education although the adoption depends with the efficiency of the technology and its profitability to the farmers.

CASSAVA PROCESSING TECHNOLOGIES USED IN STUDY AREA

In Tanzania there are main three technologies that are commonly used for processing cassava; these are traditional sun drying of plain chunks (Makopa), traditional wet and solid-state fermentation and mechanical processing technology.

Traditional (drying) cassava processing technology is consummated by peeling and cutting the fresh cassava into large pieces before being left for drying process. Traditional wet and solid-state fermentation cassava processing technology is accomplished by peeling and cutting the fresh cassava into large pieces like in the production of unfermented chunks/pieces traditional (drying), then the chunks/pieces are soaked into water for 5-6 days, before being dried.

Mechanical processing technology is sub divided into two processes, which are grating and chipping processes. The grating is a technology which processes peeled cassava to produce very tiny (grated) cassava particles. The grated cassava therefore, is pressed in a pressing machine for dewatering process in order to reduce water content. Hence, it becomes easy to reduce the remained moisture content through sun-drying. The process is especially applied to varieties with high cyanide content.

The chipping process is a technology that produces small chips as compared to traditional (drying) and traditional (wet and solid-state fermentation). This is applied to varieties with low cyanide content. The type of equipment used are mostly made up of stainless still which are user friendly since it has harmless (poison free) effect to the products as well as consumers, for instance, rusting.

ANALYSIS OF CONSUMER'S PREFERENCE OF CASSAVA FLOUR BY METHOD OF PREPARATION

As noted in the methodology, the analysis was done to examine the consumer's preference for cassava mechanically processing products. The study revealed that, there were consumers of the mechanical processed products versus non users. Consequently, the analysis was centred on variation of variables in relation to cassava consumption versus different technologies.

The results from the consumer's preference for mechanically processed cassava products in Table 2, show the likelihood ratio statistic of the suggested model was significant ($P < 0.05$), correctly predicting participation in 74.2% of the cases. Therefore the most significant influencing consumer's preferences factors for mechanically processed products of cassava were quality of the product, quantity consumed, household size and price of the processed products.

The quality of the products was one of the most influencing factors for consumer's preference for mechanically processed products; it is positively related to the consumer's preference and statistically significant ($p < 0.01$). Being of high quality products increased the probability by 0.497 (marginal effect) to opt for mechanically processed products. This result was confirmed by Laswai *et al*. (2005) and Silayo *et al*. (2004) who found that the high quality processed products were mostly preferred by people.

The quantity consumed by the household was statistically significant ($p < 0.05$) and positively related to the consumer's preference for cassava mechanically processed products (Table 2). This implies that a unit increase in quantity consumed increases the probability to prefer mechanically processed products by 0.166 (marginal effect).

Table 2 also indicates that household size was statistically significant ($p < 0.05$) and positively correlated to preference of the mechanically processed cassava products. This suggests that an increase in household size by one unit (person) increases the probability of preference to mechanically processed products by 0.223 (marginal effect).

Table 2: Probit regression analysis results for consumer's preference

Variable	Coefficients	Std. Error	Probability	Marginal effects
Age	0.016	0.216	0.464	0.003
Sex	- 0.399	0.492	0.418	-0.074
Education	0.052	0.076	0.499	0.009
Household's size	1.199	0.355	0.001*	0.223
Income level	0.396	0.451	0.379	0.074
Quality of products	2.312	0.591	0.000**	0.497
Quantity consumed	0.893	0261	0.001*	0.166
Price	-1.099	0.523	0.036*	-0.291
Constant	-3.630	1.375	0.008	

Log likelihood value = -26.24, Likelihood ratio statistics χ^2_8 = 94.11, Pseudo R^2 = 64.19%, % of correct prediction = 74.2%, Number of observation (N) = 120, **statistically significant at $P < 0.01$, *statistically significant at $P < 0.05$.

The price of the product was statistically significant ($p < 0.05$) but negatively related to cassava mechanically processed products. This means that an increase in one unit for price caused a decrease in probability option to cassava mechanically processed products by 0.219 (marginal effect). This conforms with the Law of Supply and Demand which states that the high the price the low the quantity demanded and vice versa, at a given point in time *ceteris paribus.* Also there are other factors which contributed slightly with positive relationship but not significant like age and education whereas gender had a negative relationship.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

This study was meant to explore the determinants of consumer preferences in mechanically processed cassava products in Pwani and Tanga region in Tanzania. Using consumer behavior literatures and theories it was hypothesized that disposable income, price, quality and quantity of the processed product consumed, as important determinants of consumer choice for the products. The hypotheses were tested with the data gathered from 120 respondents applying the probit regression analysis, and the following conclusions were generated.

The analysis of the data result reveals that quality of mechanically processed products; household size and quantity consumed per year were important factors that increase the probability of consumers' preference for mechanically processed cassava products versus different processing technologies in the study areas. On the other hand, price of the product was significant factor that reduce the probability of consumers' preference for mechanically processed cassava products versus different processing technologies in the study areas. Other factors such as age of household head, gender of the household head, education level and income level were not significant.

Recommendations:

These results suggest that processors of cassava should not only compete on the basis of quality, but also on other attributes identified by the study as important determinants of consumer preferential choices. Processors and other stakeholders of the cassava sub sectors (SUA, Ministry of Agriculture, Food Security and cooperatives, NGOs and owners of the businesses) should focus on designing marketing strategy that integrates all the above attributes so that their products and services can satisfy customers' needs and wants.

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