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Impact of Cassava Brown Streak Disease on Household Income and Demand for Virus Free Cassava Planting Materials among Farmers in Tanzania

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Abstract: In Tanzania, cassava is one of the key food security crop and an emerging cash crop. However, the crop has been experiencing declining productivity that is attributable to use of genetically low yielding local cassava varieties and existence of both abiotic and biotic stress factors. To address this challenges, the use of Virus Free planting materials was introduced in the Muleba and Kisarawe Districts, however, it was not accepted by the majority at its initial implementation. The overall objective of the study was to assess the demand for Virus Free Planting Materials (VFPM) as well as effect of Cassava Brown Streak Disease (CBSD) on household income generated from cassava production. A stratified random sampling technique was used to draw a sample size of 157 respondents. Out of this, 87 and 70 cassava farmers were drawn from Muleba and Kisarawe Districts, respectively. Descriptive statistics, budgetary analyses and multinomial linear regression were conducted. Willingness to Pay (WTP) method was also used to determine demand of farmers for the VFPMs. Findings revealed a high demand of clean cassava planting materials in the study area. Also, the findings revealed 50.06% and 36.78% income loss per hectare in Kisarawe and Muleba Districts, respectively. Though the Community phytosanitation approach was abandoned in the study area, currently it is gaining popularity; thus there is a need for up-scaling the intervention with more emphasis on awareness creation and on-farm demonstrations to ensure effective community adoption of the techniques.

Key words: *Virus Free planting material, phytosanitation, demand, willingness to pay*

1.0 Introduction

In Tanzania and other African countries, cassava is recognized as a key food security crop and an emerging cash crop from sale of fresh roots and leaves, processed products and planting materials. However, the crop has been experiencing declining productivity since 1980s (Mkamilo and Jeremiah, 2005). The declining yield is attributable to several factors such as use of genetically low yielding local cassava varieties, existence of both abiotic (soil infertility and drought s) and biotic stress factors (weed infestation, insects pests and disease). Cassava Mosaic Disease (CMD), Cassava Brown Streak Disease (CBSD), Cassava Bacterial Blight (CBB), Cassava Green Mite (CGM), Cassava Mealy Bug (CMB) and Nematodes are the most common biotic factors affecting cassava productivity. Mtunda *et al*. (2000) reported 55% loss in cassava yield in Tanzania due to CBSD. Similarly, Muhanna and Mtunda (2002) reported loss of about

74% in local cassava varieties due to CBSD. Thus, CBSD is among the principal biotic stress that threatens cassava production and productivity in the country. Apart from decreasing production of cassava, the rapidly spread of CBSD affects the value addition of cassava and increases labour for family members who have to remove necrotic tissues from affected roots. Epidemiological studies on CBSD have revealed amenability of the disease to careful management of the health of cassava plants or phytosanitation. The approach was introduced in four districts of Tanzania namely; Mkuranga, Chato, Muleba and Kisarawe. However, in Muleba and Kisarawe the intervention was not accepted.

Implementation of the phytosanitation approach to control CBSD involves two stages: extensive community sensitization for awareness raising and training of farmers and agricultural extension staff; and uprooting local cassava varieties and replanting clean cassava planting materials in place of local cassava varieties. Preliminary assessment of adoption of clean cassava planting materials revealed that after one year of sensitization majority of farmers did not uproot their fields; and a few of them mixed clean cassava planting materials with their local varieties in the same plots. Following such response it is assumed that cassava farmers would realize a yield loss as their crop would have suffered from CBSD. Thus, this study was carried out to assess the economic losses due to Cassava Brown Streak Disease (CBSD) and the demand for using clean cassava planting materials in the study area.

1.1 Theoretical Framework of the Study

Worldwide several studies have established the link between product attributes and consumers' preference (Hu *et al.,* 2012; Adams and Salois, 2010; McCann-Hiltz *et al.,* 2004). Lancaster (1966) also argues that consumers derive utility from a product's attributes as opposed to directly from the product itself. Following Lancaster's insights, cassava farmers as consumers for various cassava planting materials are expected to use planting materials with good attributes embodied in cassava production. These attributes include high yielding, resistant to diseases such CBSD and CMD, early maturity, longevity in ground, etc. Therefore, the expected utility from the product is the total utility derived from each attribute. Most of studies (Forbes-Brown *et al.,* 2016; Volinskiy *et al.,* 2009; Loureiro and Umberger, 2005) have used Willingness to Pay (WTP) or stated preference survey methods to elicit consumers' preference estimates. The particular strength of stated preference methods is the ability to derive an implicit value for specific product attributes, as well as to explore the influence of both socio demographic factors and consumer knowledge, awareness, and attitudes (e.g. toward risk, health, foods safety, etc.) on consumers' WTP for product attributes. In this regard, the present study used a WTP to examine farmers' demand for virus free cassava planting materials in their cassava farming.

In market analysis demand for homogenous goods is determined by a set of relevant prices as well as demographic characteristics. However, demand for quality traits need not only determined by similar set of variables. According to Senauer (2001) demographic characteristics may have limited explanatory power. Even if there is an objective measure of particular quality, it does not follow that all consumers perceive quality in the same manner. It is not often surprising that one consumer's utility increases with a particular quality, whereas another consumer's utility decreases. Therefore, in such cases, demand for quality depends on an individual's knowledge and perception of that quality. The effects of these factors on consumers' acceptance of a particular quality of good has been reported in several studies in developed

countries and developing countries especially on acceptance of genetically modified products. Given this fact, this study also explored whether the same cognitive factors influence WTP for clean cassava planting materials in Muleba and Kisarawe Districts in addition to price and socioeconomic factors.

2.0 Methodology

This study was carried out at Bisheke village in Muleba District and Mhaga village in Kisarawe District. The two districts were chosen as case study following their high level of incidence and prevalence of CBSD.

A cross-sectional survey research design was adopted whereby data was collected at a single time. A stratified random sampling technique was used to draw a sample size of eighty seven (87) and seventy (70) cassava farmers from Muleba and Kisarawe Districts, respectively. The total sample size of the study was one hundred and fifty seven (157) respondents. Hamlets formed strata of this study; in each study village three hamlets were sampled. Out of the three hamlets in each village, farmers in one hamlet received training as well as sensitization on the use of clean cassava planting materials to control CBSD. A list of households across respective hamlets within the two villages formed the sample frames of the study. Table 1 shows distribution of respondents from each hamlet across the study area.

Table 1: Distribution of sample size of the study

District name	Village name	Hamlet name	Number of respondents
Muleba	Bisheke	Kagondo	36
		Bisheke	32
		Mulambi	19
		Total	**87**
Kisarawe	Mhaga	Mhaga shule	22
		Kitondwe A	25
		Kitondwe B	23
		Total	*70*
Total Sample size of the study			**157**

Both qualitative and quantitative data were collected using a household questionnaire, and focus group discussion. To establish cost and benefit analysis, information such as costs of production (these included land preparation, planting, weeding, purchase of food crop seeds, harvesting and processing of food crops and cost for uprooting of cassava field as well as replanting costs) were collected using household questionnaire. Moreover, information such as types of intercrops mixed with cassava, crop area cultivated, quantity/or outputs of various crops produced and their output prices were collected.

Yield assessment was done in 100 square metre quadrants. The number of quadrants varied depending on the size and uniformity of the field. Quadrants were established mainly at the four angles and center of the field. In small fields and fields lacking uniformity data collection was done from a single quadrant. Cassava plants in a quadrant were counted and their number recorded. Ten plants selected randomly along two diagonals (i.e. 5 along each diagonal) were

then uprooted from the quadrant and the number of roots from each plant was recorded. Total yield was determined by first calculating the number of plants per hectare based on the number in a 100 square metre quadrant. Total weight of the roots was then obtained through multiplying the weight of roots per plant by the number of plants per hectare (i.e. in 10,000 square metres). Marketable yield was obtained by selecting fresh roots whose size is large enough to be accepted by buyers/consumers. According to middlemen, consumers have preference for specific root size. Hence, they prefer to buy roots of a minimum threshold, below which the roots are normally rejected as being non-marketable. During the study farmers were asked to grade roots into marketable and non marketable grades. Yield and its parameters such as number of plants per quadrant, number of roots per plant, total fresh weight of roots per plant and weight of marketable against non-marketable roots per plant were recorded.

In order to assess the demand for the clean cassava planting materials among cassava farmers; a household survey was used to collect data for the analysis. The survey had questions about farmers' use habits of different planting materials, attitudes toward different cassava planting materials including the clean cassava planting materials, and other psychographic factors such as risk preferences, benefits and knowledge of the community phytosanitation approach. Prior conducting the household survey farmers were provided with a full attribute description of the virus free clean cassava planting materials.

Uprooted cassava roots were measured and grouped into two main groups namely consumable and non-consumable. Dry weight for each category was derived by converting wet weight of the uprooted cassava roots using the conversion rate of 65% water. The derived dry weight was then multiplied by an average market price of TZS 1,000/= per 1 kilogram of dry weight of cassava.

Willingness to Pay (WTP) method was used to determine demand of farmers for the clean cassava planting materials; also to explore the effects of different factors on their influence on WTP, the following multinomial linear regression was used. The model was expressed as follows;

$$Y_i = \alpha + \beta_i X_i + \sum_{j=1}^{5} \beta_{ij} W_{ij} + \sum_{k=1}^{3} \beta_{ik} Z_{ik} + \varepsilon_i \quad \text{..... (1)}$$

Where; Y_i =WTP, X_i = treatment effect of training program of the project, W_{ij} = socioeconomic characteristics of the respondent [these included age (yrs), sex, total household farm land size (acres), annual income (TZS) and family size], Z_{ik} = cognitive factors such as benefit perception of using clean cassava planting material measured by the benefit perception index, community phytosanitation approach benefit perception index and risk attitude of farmers toward CBSD measured by risk attitude index.

Data were coded, entered and processed using three computer programs namely Microsoft Excel and STATA. Descriptive statistics such as means, percentages, frequency and cross tabulation were generated. Also budgetary analyses as well as multinomial linear regression were conducted.

3.0 Results and Discussion

3.1 Farmers' Characteristics and Awareness to Cassava Brown Streak Disease (CBSD)

Overall, in both districts there were slightly more males (58.6% and 67.1%) than females in the sample. Most of the respondents had attended school, and majority had primary education (85.7% in Muleba and 64.7% in Kisarawe). However, Kisarawe had a large proportion of respondents who had no formal education (25%) compared to Muleba which had 13.1%. Farming was the main source of income reported by most of the respondents in Muleba and Kisarawe. This accounted for 93.1% and 91.4% in Muleba and Kisarawe Districts, respectively. Causal labour and fishing as other sources of income were reported in Muleba whereas in Kisarawe petty trade/business was the only other source of income reported. This finding suggests that apart from farming farmers in Muleba had more sources of income than their counterpart farmers in Kisarawe. Also in both districts a large proportion of the respondents were married (Table 2).

Table 2: Socioeconomic characteristics of the respondents in the study area (n=157)

Variables	Variable categories	Muleba (% of respondents)	Kisarawe (% of respondents)
Sex of the respondent	Female	41.4	32.9
	Male	58.6	67.1
Marital status of the respondent	Single	3.4	1.5
	Married	96.6	82.4
	Separated/Divorced	-	10.3
	Widow/widowed	-	5.9
Education level	No formal education	13.1	25.0
	Primary education	85.7	64.7
	Secondary education	1.2	7.4
	College education	-	2.9
Main source of income	Farming	93.1	91.4
	Causal labour	3.4	-
	Fishing	3.4	-
	Petty trade/business	-	8.6

Average age of the respondents was within the productive working group category; with Kisarawe having order people (average age of 50 years) than Muleba (average age of 40 years). Muleba had family size with higher number (6) compared to Kisarawe (4). Results also revealed that in Kisarawe household possessed bigger land size for farming compared to their counterparts in Muleba District. A household in Muleba possessed a mean of 3.35 acres for farming land while in Kisarawe the average farming land size was approximately 8 acres (Table 3).

Regardless of farmers' hamlets of their residence, majority of them in both districts were aware of cassava brown streak disease and its devastating effects on cassava productivity. The Pearson Chi-square test conducted revealed that there was no significant association between hamlets of residence of farmers and their awareness on CBSD control χ^2 (1)=2.65, p>0.05. This might imply a spillover effects; farmers from hamlets which had received training shared knowledge with their non-project counterparts in other hamlets which had not yet received training.

Table 3: Farmers' demographic characteristics

District name	Variable	n	Minimum	Maximum	Mean	Std. Deviation
Muleba	Age (yrs)	87	20.00	65.00	39.97	10.49
	Family size	87	2.00	14.00	6.36	2.24
	Annual household income (TZS)	84	100,000.00	6,000,000.00	821,457.14	941,181.82
	Total household land size for agriculture (acres)	84	.50	40.00	3.35	5.29
Kisarawe	Age (yrs)	70	20.00	90.00	50.84	16.99
	Family size	70	1.00	9.00	4.41	2.07
	Annual household income (TZS)	64	40,000.00	5,000,000.00	696,250.00	909,836.02
	Total household land size for agriculture (acres)	67	.50	37.00	7.09	7.88

3.2 Cassava Yield in the Study Area

Three different cassava cropping options were identified in Kisarawe District. These included planting of cassava using only clean cassava planting materials; a mixture of clean cassava planting material with local cassava varieties; and a mixture of different local cassava varieties in a single plot. In Muleba District, only two options were observed. These include cultivation of cassava using only clean cassava planting materials and the second option involved a mixture of clean cassava planting materials with local cassava varieties in a single plot.

Figure 1 shows estimated cassava yield across different cassava cropping options by district. Results showed that in Kisarawe District farmers who opted to produce cassava using a pure stand of clean cassava planting materials realized higher yield (13,892.07 kg/ha) compared to the rest two options in which the use of mixture of local cassava varieties scored the lowest cassava yield (5,523 kg/ha) (Figure 1).

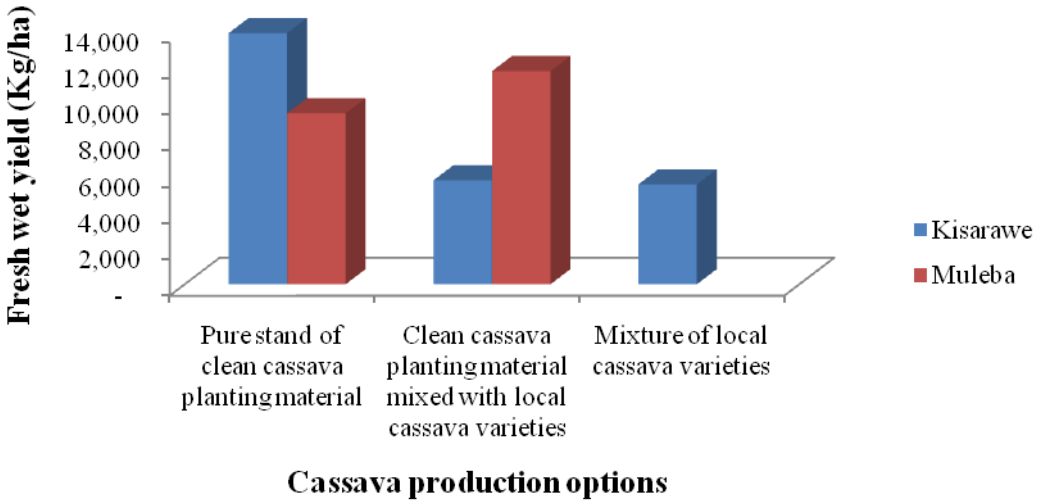


Figure 1: Estimated cassava yield (fresh weight Kg/ha) across different cassava production options in Kisarawe and Muleba Districts

In Muleba District, a plot of cassava with a mixture of clean cassava planting material mixed with local cassava varieties yielded higher (11,791.06 kg/ha) compared to a plot with only clean cassava planting materials (9,459.05 kg/ha). In spite of the negative effect of the CBSD the unexpected result in terms of yield in Muleba district might be due to genetically yielding potential differences among cassava varieties. This suggested further research to assess yield potential of different cassava varieties as well as resistance to CBSD that is genetically controlled.

Table 4 shows yield of different sampled cassava varieties in Kisarawe and Muleba Districts. In Kisarawe District, one local variety and two improved cassava varieties were sampled. These included Rasta, a local cassava variety; Mkuranga 1 and Kiroba which are improved varieties. Of the three varieties, Mkuranga 1 recorded the highest yield (13,212.43 kg/ha) whereas Rasta had the least yield of 4,624.67 kg/ha. In Muleba District, Katuku and KAEMP both being local varieties were the leading cassava varieties in terms of yield. These were followed in ascending order with Mkombozi (which was the only improved cassava variety sampled), Mabunu and Mfundo (Table 4).

Table 4: Estimated yield of different sampled cassava in Kisarawe and Muleba districts (fresh weight Kg/ha)

District name	Sampled cassava variety	n	Minimum	Maximum	Mean	Std. Deviation
	RASTA	6	1,728.00	9,555.00	4,624.67	2,800.54
Kisarawe	KIROBA	10	5,750.00	19,530.00	12,463.60	4,309.91
	MKURANGA 1	7	2,592.00	30,360.00	13,212.43	10,707.01
	KAEMP	13	2,736.00	17,640.00	12,805.92	4,231.07
	MKOMBOZI	22	1,591.00	22,300.00	9,459.05	5,952.75
Muleba	KATUKU	11	4,680.00	25,669.00	13,024.27	6,983.18
	MFUNDO	3	4,704.00	13,144.00	7,816.00	4,635.88
	MABUNU	2	7,770.00	9,976.00	8,873.00	1,559.88

3.3 Economic Losses due to CBSD Infestation in the Study Area

To assess economic loss due to CBSD infestation in the study area a number of assumptions were made. These include; i) an average of 65% of fresh cassava being water) was used as a conversion rate for all cassava varieties in the study area; ii) agro ecological and environmental factors was assumed to affect the moisture content of cassava equally and iii) an average of 1,000/=TZS per 1kg of dry weight of cassava was used across the study area as market price. Table 5 shows the overall income gain and loss per hectare in Muleba and Kisarawe Districts among farmers using local cassava varieties. Results show that CBSD caused an overall economic loss of 1,865,309/= TZS and 1,429,817/= TZS per hectare in Kisarawe and Muleba Districts, respectively. This is equivalent to 50.06% and 36.78% income loss per hectare, respectively.

Table 5: Overall income gain and loss per hectare in Muleba and Kisarawe district among farmers using local cassava varieties

District name	Mean income gained from marketable cassava roots (TZS/ha)	Mean income lost from non-marketable cassava roots (TZS/ha)	Mean total income from marketable and non-marketable cassava roots (TZS/ha)	% loss of income due to CBSD
Kisarawe	3,726,298.00	1,865,309.00	3,726,298.00	50.06
Muleba	3,887,134.00	1,429,817.00	3,887,134.00	36.78

Further analysis was conducted to compare economic losses between farmers in hamlets received training[1] and those from hamlets without training[2] across the two Districts. Findings show a similar percentage of economic loss due to CBSD between farmers in hamlets received training and those from hamlets without training in Muleba District. However, surprising finding was noted in Kisarawe District where farmers from hamlets with training had recorded a higher economic loss (71.7%) compared to 22.08% loss which was recorded among farmers from hamlets without training (Table 6).

Table 6: Overall income gain and loss between farmers from hamlets received and those which didn't receive training on CBSD control

Incomes	Kisarawe		Muleba	
	Hamlets with training	Hamlets without training	Hamlets with training	Hamlets without training
Mean income gained from marketable cassava roots (TZS/ha)	2,869,109.00	4,512,054.00	3,803,789.00	4,020,485.00
Mean income lost from non-marketable cassava roots (TZS/ha)	2,058,389.00	996,450	1,405,825.00	1,477,800.00
Mean total income from marketable and non-marketable cassava roots (TZS/ha)	2,869,109.00	4,512,054.00	3,803,789.00	4,020,485.00
% loss of income due to CBSD	71.7	22.08	36.95	36.75

The prevailing situation in Kisarawe District might be associated with the fact that in hamlets without training a large proportion of farmers had shifted from using their local cassava varieties to Kiroba and Mkuranga 1 cassava varieties; on account of this they had low rate of cassava infestation with CBSD. For instance, within hamlets which farmers had no training; both Mkuranga 1 and Kiroba cassava varieties each was reported to be planted by 40% of the responses of the respondents. Only 20% of the responses of the respondents declared to have planted Rasta a local cassava variety that is highly susceptible to CBSD. As opposed to what happened in hamlets without training, a high proportion of responses of the respondents (61.5%) used Rasta in their farming in hamlets which received training; whereas Kiroba and Mkuranga 1 were reported by only 30.8% and 7.7% of the responses of the respondents, respectively (Table 7).

[1] Include farmers in village hamlet that received sensitization and training on community phytosanitation approach; however, they didn't uproot their local cassava to replace with clean cassava planting materials. Also this hamlet was categorized in phase I for project implementation

[2] Include farmers in village hamlets those didn't received sensitization and any training on community phytosanitation approach. These hamlets were categorized in phase II and III for project implementation

Table 7: Proportion of respondents with their corresponding usage of various cassava varieties

		Kisarawe		Muleba	
Project intervention status	**Types of cassava planted**	**Count**	**Percent**	**Count**	**Percent**
Hamlets which had no training	Rasta	3	20.0	-	-
	Kiroba	6	40.0	-	-
	Mkuranga 1	6	40.0	-	-
	Katuku	-	-	9	45
	Kaemp	-	-	8	40
	Mfundo	-	-	3	15
Hamlets which had training	Rasta	8	61.5	-	-
	Kiroba	4	30.8	-	-
	Mkuranga 1	1	7.7	-	-
	Kaemp	-	-	5	50
	Katuku	-	-	2	20
	Mabunu	-	-	2	20
	Kajaga	-	-	1	10

3.4 Demand for Clean Cassava Planting Materials among Cassava Farmers in Kisarawe and Muleba Districts

Overall demand for clean cassava planting materials revealed that 82.8% and 100% of the respondents were ready to substitute their local cassava varieties with the clean cassava planting materials in Muleba and Kisarawe Districts, respectively. When they were asked if they had been ready to pay some money for acquiring the clean cassava planting materials similar trend was also evidently among the respondents. This was admitted by 79.3% and 91.4% of the respondents in Muleba and Kisarawe Districts, respectively. This result implies that there is a high demand of clean cassava planting materials in both Districts. However, demand for clean cassava planting material in Kisarawe surpasses that of Muleba.

A cross tabulation analysis was conducted to see if there was a significant difference in terms of demand of the clean cassava planting materials between hamlets received training and those ones which did not receive training. For the case of Kisarawe District, in both hamlet categories 100% of the respondents were demanding clean cassava planting materials; whereas in Muleba District there was a higher proportion of a response of the respondents (88.9%) among farmers' residing in hamlet that received training demanding clean cassava materials than in hamlets which did not receive training (78.4%) (Table 8). However, the observed difference between in Muleba was not statistically different. The high demand of clean cassava planting materials observed in Kisarawe district might be due to the fact that in Kisarawe cassava production is more valued as they consider it as their main source of income as opposed to Muleba where farmers have a wide range of sources of income. Also, according to findings of this study the level of CBSD infestation in Kisarawe District was higher than in Muleba District; and this has been revealed through the large proportion of economic loss in Kisarawe.

Table 8: Demand of using clean cassava planting material between hamlets received training and those which didn't receive training on CBSD control

Readiness of using clean cassava planting materials	Muleba District		Kisarawe District	
	% of respondents in Intervention area	% of respondents in non-intervention area	% of respondents in Intervention area	% of respondents in non-intervention area
Yes	88.9	78.4	100.0	100.0
No	11.1	21.6	0	0
Total	100.0	100.0	100.0	100.0

WTP for clean cassava planting materials was also assessed in the two districts. Figure 2 show demand curves for the clean cassava planting materials in Kisarawe and Muleba Districts.

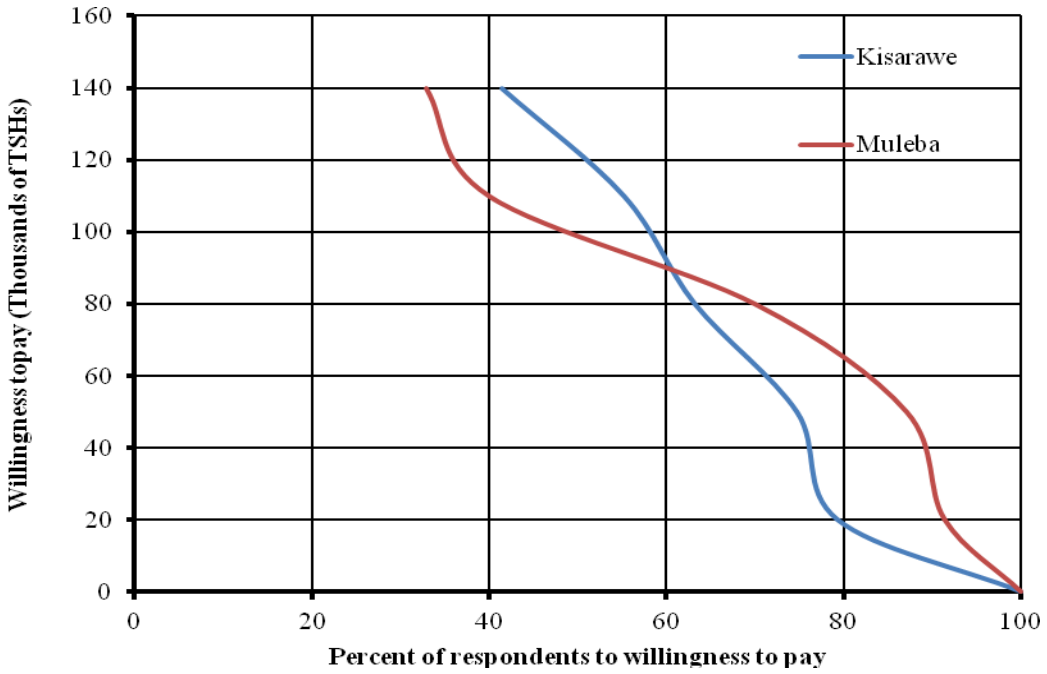


Figure 2: Demand curves for the clean cassava planting materials in Kisarawe and Muleba districts

Generally, findings in Figure 2 show that in both District farmers were willing to pay even more than the estimated market price for clean cassava planting materials. Findings, also revealed that a large percentage of respondents in Kisarawe District were willing to pay above the market price as compared to Muleba District. The differences in term of demand for the clean cassava planting materials between farmers in Kisarawe and Muleba Districts might be explained by the fact that in Kisarawe District cassava is currently the main source of income whereas in Muleba District farmers have more diverse in terms of source of household income. For instance, in Muleba District farmers coffee production and fishing were reported to be dominant sources of their income. However, these were mainly for male whereas female depends on beans. The willingness to pay was also assessed in the two districts between intervention and

non-intervention areas. In intervention areas from both districts majority of the respondents were willing to pay at the estimated market price and above the market price. This accounted 75% and 90.5% in Muleba and Kisarawe Districts, respectively. This result suggests that trainings and sensitization effort made by the project at its initial stage had an effect in terms of demand for clean cassava planting materials.

3.5 Factors affecting WTP for clean cassava planting materials

Table 9 shows parameter estimates for WTP model with training as only explanatory variable. Result show that farmers who had training and sensitization on community phytosanitation approach using clean cassava planting materials were willing to pay 28,473.36TZS for clean cassava planting materials enough for planting one acre more than their counterpart farmers. The difference was statistically significant at p>0.001. This suggests that training had an effect on adoption of the approach as well as use of clean cassava planting materials.

Table 9: Parameter estimates for WTP model with training only as treatment factor

Variable	Coefficient	Std.Err	*t*	p>/t/
Training	28473.36	8203.126	3.47	0.001
Constant	75625	5113.22	14.79	0.000

To analyse the effect of different factors on WTP the parameter of the expanded model (Equation 4) were estimated. Among factors tested age, sex, family size, annual household income and community phytosanitation approach benefit perception index were clearly not significant. On the other hand, training, total household land size, negative risk attitude index toward CBSD and benefit perception index on use of clean cassava planting materials were very important as they were statistically significant at p>0.05 (Table 10). Similar finding on farmers' positive benefit perception toward influencing adoption of improved dual purpose cowpea was also reported by Kristjanson *et al.* (2005) in Nigeria. In Kenya Achieng (2014) revealed that farmers' attitude influenced adoption of improved maize storage system.

Table 10: Parameter estimates for WTP model with farmers' characteristics and cognitive factors

Variable	Coefficient	Std.Err	t	p>/t/
Training , sensitization and awareness creation	17506.64	7545.825	2.32	0.022
Age (year)	247.3814	271.0388	0.91	0.363
Sex	6702.806	8210.269	0.82	0.416
Total land size (acres)	1183.375	601.352	1.97	0.051
District	43792.92	11023.11	3.97	0.000
Total annual income (TZS)	.0071971	.0042051	1.71	0.089
Negative risk attitude toward CBSD index	-61135	13393.73	-4.56	0.000
Perception index on benefit of CPA	15059.49	8060.313	1.87	0.064
Perception index on benefit of CCPM	28200.48	8247.467	3.42	0.001
Family size	-3135.021	1779.719	-1.76	0.080
Constant	9983.807	21102.87	0.47	0.637

The size of the effect of training on WTP was still very important; as it increased WTP by offering 17,506.64TZS more than non trained farmers. Result also revealed that a unit increase of agricultural land increased the WTP by 1,183TZS. An increase in benefit perception of use of clean cassava planting materials index by 1 increased the WTP by 28,200TZS. Also a one unit increase of positive risk attitude of CBSD on cassava productivity index increased WTP by

61,135TZS. These finding implies that for successful community phytosanitation approach using clean cassava planting materials training, sensitization as well as awareness creation should be part and parcel as these will help to change perception of communities in question. These findings agree with other adoption studies on improved cassava varieties in Tanzania (Wambugu *et al.,* 2011) and elsewhere (Achieng, 2014: Bertin *et al.,* 2012)

4.0 Conclusion and Recommendations

4.1 Conclusion

Basing on the findings of this study, it is very clear that there is a high demand of clean cassava planting materials in the study area. A sound economic loss due to CBSD noted in both districts implies that the infestation level of CBSD is still high in the study area. Community phytosanitation approach using clean cassava planting material is currently gaining its popularity even in the area where initially it was not accepted; thus there is a need for up-scaling the intervention with more emphasis on awareness creation and on-farm demonstrations to ensure effective community adoption of the techniques.

4.2 Recommendations

In order to combat the economic losses due to CBSD as well as addressing the high demand of clean cassava planting materials the study recommends the following;

Up-scalling of the project activities in all villages in the study area since majority of farmers acknowledged the role of community phytosanitation approach on increasing cassava productivity. District councils, researchers and other key stakeholders in the cassava industry should include this approach as one of key tools for combating the biotic stress and hence increasing cassava productivity.

Future interventions to promote phytosanitation approach for control of cassava diseases should ensure that community sensitization is given an ample time; at least one year period starting from off-season and ending closer to on-season. This will facilitate/ensure readiness of farmers to uproot their crops as they will be matured enough for harvesting; and thus leaving fields to be replanted with clean cassava planting materials

References

Achieng, F. O. (2014). Socio-Economic Factors Influencing Adoption of Improved Maize Storage Systems in Bungoma District, Kenya.*Unpublished Master of Arts Thesis. University of Nairobi, Nairobi, Kenya.*

Adams, D. C. and Salois, M. J. (2010). Local versus organic: A turn in consumer preferences and willingness-to-pay. *Renewable Agriculture and Food Systems* 25(4): 331-341.

Bertin, T., Ann, D., Zacharie, T., Ebenezar, A. and Alain, T. (2012). Enhancing farmers access to quality planting materials through community-based seed and seedling systems: experiences from the western highlands of Cameroon. *Middle-East Journal of Scientific Research* 12(4): 455-463.

Forbes-Brown, S., Micheels, E. T., and Hobbs, J. E. (2016). Consumer Willingness to Pay for Dairy Products with the 100% Canadian Milk Label: A Discrete Choice Experiment. *Journal of International Food and Agribusiness Marketing* 28(3): 203-224.

Hensher, D. A., Rose, J. M., and Greene, W. H. (2005). *Applied choice analysis:* A primer
Hu, W., Batte, M. T., Woods, T., and Ernst, S. (2012). Consumer preferences for local production and other value-added label claims for a processed food product. *European Review of Agricultural Economics* 39(3): 489–510.

Kristjanson, P., Okike, I., Tarawali, S., Singh, B. B. and Manyong, V. M. (2005). Farmers' perceptions of benefits and factors affecting the adoption of improved dual-purpose cowpea in the dry savannas of Nigeria. *Agricultural Economics* 32(2): 195-210.

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of political economy* 74(2): 132-157.

Loureiro, M. L., and Umberger, W. J. (2005). Assessing consumer preferences for country-of-origin labeling. *Journal of Agricultural and Applied Economics* 37(01): 49-63.

McCann-Hiltz, D., Veeman, M., Adamowicz, W., and Hu, W. (2004). Agricultural biotechnology: A comparison of consumers' preferences for selected policy options. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie* 52(3): 333-350.

Mkamillo, G. S. and Jeremiah, S. C. (2005). Current status of cassava improvement programme in Tanzania. In *African Crop Science Conference Proceedings* 7(7): 1311-1314.

Mtunda, K. J., Muhanna, M., Raya, M. D. and Kanju, E. E. (2000). Current status of Cassava brown streak virus disease in Tanzania. Cassava Brown Streak Virus Disease: Past, Present, and Future.

Muhanna, M. and Mtunda, K. J. (2002). Report on the study of cassava root rot problem in Muheza District, Tanga Region, Tanzania.

Volinskiy, D., Adamowicz, W. L., Veeman, M., and Srivastava, L., 2009. Does Choice Context Affect the Results from Incentive-Compatible Experiments? The Case of Non-GM and Country-of-Origin Premia in Canola Oil. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie* 57(2): 205-221.

Wambugu, C., Place, F. and Franzel, S. (2011). Research, development and scaling-up the adoption of fodder shrub innovations in East Africa. *International journal of agricultural sustainability* 9(1): 100-109.