Improvement of Cassava Production, Processing, Marketing and Utilization Through Introduction of Disease-Tolerant Cassava Varieties

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Abstract

A baseline survey was conducted in Tongwe, Kabuku, Chanika and Mikongeni villages, located in the Districts of Muheza, Handeni, Ilala and Kibaha, respectively, in the cassava growing ecosystem of Tanga, Coast and Dar es Salaam regions. The objective was to establish baseline data as entry point for improving production, utilization, processing and marketing of cassava in these areas. The survey involved 104 households, represented by 62.5% male and 37.5% female farmers, using a structured questionnaire. The results were coded and analysed using the SPSS statistical package. It was observed that majority of households farmed on land size of less than 2 ha, with about 80.2% farming on their own land and 91.8% farming on rented land. Most farmers (54.7%) produced less than 1.25 MT of fresh cassava roots per hectare, with a few producing as far as 10 times more. The crop was slightly more of a cash crop than a food crop, with yearly mean production of 2.18 MT compared with 1.44 MT (53%) sold. Production faced limitations, especially lack of market (37.6%) and low disease tolerance (19.8%). The varieties grown were mainly Kiroba, Cheupe, Cheusi Mwangia and Mkunungu in Tongwe, Chanika, Mikongeni and Kabuku villages, respectively. Introducing new varieties as a solution to the reported problems is required but the essential attributes should be: high disease tolerance (28.5%); high yield (25.9%); sweetness when chewed (13.8%) and early maturity (10.5%), which are potential factors towards solving marketing problems. In a follow-up program, Kiroba variety, which is a relatively high disease tolerant variety, was introduced in Kabuku, Mikongeni in Chanika villages to farmer groups and individual farmers. While results in Mikongeni and Chanika did not show remarkable changes Kabuku village registered very positive impacts, just after two years. These include the increase of the numbers of farmers groups from 1 to 3, individual farmers from 20 to 37, overall area planted from 2 to 4.6 hectares, yield from average of 1.25 to 18 MT per hectare and cash earned per hectare from almost zero to 800,000 shillings and average price of about 4,500 shillings per 100 kg of fresh cassava. Introducing disease-tolerant cassava varieties could change the status of this crop and contribute to improved livelihood. For sustainability of the processing industry, pricing of raw materials should not exceed that for the fresh market during high price seasons.

Key words: Basiline data, production limitations, attributes, impact and livelihood

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Tanzania J.Agric.Sc. (2008) Vol. 9 No.1, 69 - 78

Accepted September, 2008

Introduction

Cassava is Africa's second most important food staple after maize, in terms of calories consumed (Nweke, 2003). The main inherent problems with cassava are perishability of the edible roots within 2-3 days after harvesting, high levels of cyanogenic glucosides in some varieties (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, processing, utilization and marketing, which have made it more of a subsistence crop. Therefore, if research on this crop is made more effective, perhaps it could be used to close the African food gap (Nweke *et al.*, 2000). In Tanzania, where majority of people still live below the poverty line (ASDS, 2001) cassava could be used to bridge the poverty gap. The main growing regions include Tanga, Coast, Lindi, Mtwara, Ruvuma, Tabora, Kigoma and the Lake regions (Msabaha and Rwenyangira, 1990). However, past research in Tanzania on cassava concentrated mainly on pre-harvest activities though not in a complete sense, and accorded low priority to post-harvest research, yet this is the phase where all the production efforts can be wasted. In recent years, research done by Sokoine University of Agriculture (SUA) and the Ministry of Agriculture, Food Security and Cooperatives has led to the invention of kebab-looking food product (*kibabu*), and formulation of wheat-cassava composite flour buns and chapatti (Laswai, *et al.*, 2005; Silayo *et al.*, 2004a). Economic analysis of cassava chipping for flour business also revealed positive signs (Silayo, *et al.*, 2004b) but more work needs to be done. These interventions have proved to cause dramatic change in the society, as depicted by the increase of acreage and income by more than 100% and 50%, respectively by some participating farmers (TARPII-SUA, 2004). New research areas need to come up in order to have all the benefits of cassava taped for the well being of the society but scaling up of already known technologies should come first. Processing is an intermediary intervention for increased cassava production on one side and increased utilization and marketing on the other, in a complex value chain and marketing. However, this intervention may not affect production, utilization and marketing promptly without also intervening on them for sustainability.

The Tanzania Development Vision (TDV) 2025 and the accompanied "Poverty Reduction and Income Growth Strategy" both aim at modernizing agriculture for increased contribution to the national GDP (Mbogoro, 2005). Applied to cassava growing areas and the crop's inherent problems intervention is required to boost its production and improve its image through value adding and improved marketing. Since adoption of proper processing and other technologies for value adding in the value-chain may trigger demand of more fresh produce, efforts to have sufficient supplies to the processors are required. These call for balanced expansion and involvement in production, processing, utilization and marketing for the benefit of

stakeholders, with increased production as the entry point. However, such interventions would be rightly done if the current situation on the ground is known, against which successes of interventions can be assessed.

Therefore, the main objective of this study was to assess the entry situation and receptiveness of introducing disease-tolerant cassava variety to sustain supply of raw materials in the planned farmers' group processing plants. Specifically, the study aimed at conducting a baseline survey on selected villages to establish entry point for improvement of cassava production, marketing and utilization and introduce cassava varieties which are disease tolerant and high yielding.

Materials and Methods

The baseline survey was conducted using structured questionnaire. The questionnaire was designed to obtain information regarding cassava production, processing, storage and marketing. The interviewees were farming households sampled randomly from existing farmers groups where they existed and randomly from those who grow cassava where there were no existing farmers groups. The numbers of households interviewed were limited to 25 in each of Chanika (Ilala District) and Kabuku villages (Handeni District), 28 in Mikongeni village (Kibaha District) and 26 in Tongwe village (Muheza District). These made a total of 104 households, from which each household was represented by one person, 62.5% male and 37.5% female farmers.

The survey data was compiled using SPSS statistical package and the results were summarised into frequency tables. Information in the frequency tables was interpreted to reflect the real situation on the ground as bases for future interventions.

New cassava varieties which were relatively more disease-tolerant were introduced to Kabuku, Chanika and Mikongeni and planted in farmers groups' farms of approximately 0.8 ha. The varieties involved were *Kiroba* and *Kikombe* for Chanika and Kabuku, and *Kiroba* for Mikongeni. No cassava was introduced to Tongwe because *Kiroba* variety was earlier on introduced in another intervention, which made this village a source of *Kiroba* planting materials for Kabuku. The source of planting materials for Mikongeni and Chanika villages was Agricultural Research Institute-Kibaha and farmers in Rufiji District, respectively. The planting materials were planted in a spacing of 1m x 1m, followed by weeding as soon as weeds infestation began. A year later receptiveness and field performance was assessed, based on aggregate numbers.

Results and Discussion

Pre-intervention phase

Cassava production

The pattern of land for farming in all the villages is shown in Table 1. The figures given provide an average situation in all the four locations surveyed.

Table 1: Farming acreage

Land size (ha)	Owned land (%)	Rented land (%)
<2	80.2	91.9
2-4	10.9	5.4
>4	8.9	2.7

Cassava was grown by all of the respondents (100%), while maize grain was grown by about 80% only. In terms of priority crops the variation between the four locations is shown in Table 2.

Table 2: Percentage of farmers in production of various crops

Crop type	Name of village			
	Chanika	Kabuku	Mikongeni	Tongwe
Cassava	92	96.2	100	100
Maize	44	92.3	78.6	96
Sweet potatoes	92	0	17.9	0
Cowpeas	40	61.5	60.7	4
Rice	32	3.9	14.3	40
Pepper	4	7.7	10.7	77
Cashew nut	8	7.7	25	0
Oranges	8	34.6	21.4	44
Bananas	4	7.7	0	48
Groundnuts	8	0	25	0
Coconut	8	7.7	10.7	16

The leading priority crop in all the four locations was cassava while the second priority crop was maize except in Chanika village where sweet potato was second and maize the third. The trend shown implies that cassava competed favourably with maize in Mikongeni, Kabuku and Tongwe, while sweet potato was an equal competitor in Chanika. The other crops grown were less significant.

The area under cassava cultivation was about 99% in farm holdings of less than 2 ha and 1% in more than 2 hectares holdings. However, this distribution may not give a very clear picture as the crop can be grown alone, intercropped or both but intercropping was the main practice as responded to by 64%, 71.4% and 68% of farmers in Chanika, Mikongeni and Tongwe, respectively. In Kabuku it was either grown alone (54.2%) or intercropped (45.8%) but it was relatively more grown alone. No explanation was given for these observations but pressure of land or cultural practices might have been the contributing factors.

Production yield varied across the locations and across individuals but was less than 12.5 MT per hectare. In a clustered mode, yield was less than 1.25 MT, 1.25-2.5 MT and 2.5-12.5 MT per hectare in 54.7%, 30.2% and 15.1% of the respondents, respectively. The reasons for such high discrepancies in production could not be substantiated but low yielding varieties, prevalence of diseases and pests, poor agronomic practices and poor weather might have contributed. The mean production was estimated at 2.18 MT per hectare whereas the mean

sales were 1.44 MT, implying that more than 50% of produced cassava was sold. This corresponded to the higher rate (67.1%) accorded to it as a cash crop.

Cassava production was faced with a lot of constraints. The major four factors as reported by the respondents were lack of market (37.6%); low disease tolerance (18.9%); lack of agricultural implements (7.6%); and lack of improved varieties (7.1%). Other problems, though of less importance were drought/bad weather (6.6%), lack of good planting material (4.6%), and lack of capital (4.1%). These results imply that marketing was a leading problem that hindered the usefulness of cassava as a crop that could reduce poverty among its growers.

Cassava varieties

Generally, the main cassava varieties grown by the respondents in order of importance are shown in Table 3.

Table 3: Cassava varieties

Variety grown	Name of village				% of total
	Chanika	Kabuku	Mikongeni	Tongwe	
Kiroba	0	1	1	23	24.8
Kibanda meno	0	8	0	2	9.9
Cheusi Mwangia	0	0	19	0	18.8
Kalolo	0	0	7	0	6.9
Cheupe	20	0	1	0	20.8
Kikombe	3	0	0	0	3
Mkunungu	0	9	0	0	8.9
Mahiza	0	5	0	0	5

The varieties in Table 3 are all sweet varieties except *Kalolo*, which is bitter. Although in each location two or more varieties were grown, only one was most popular. These were *Kiroba*, *Cheupe*, *Cheusi Mwangia*, and *Mkunungu* varieties in Tongwe, Chanika, Mikongeni and Kabuku, respectively. However, the next popular variety in Kabuku was *Kibandameno* while in Mikongeni village was *Kalolo* (bitter variety), which was used as severe drought relief variety. The rest of the varieties were only lightly grown. It was interesting to note that production of *Kalolo* (bitter variety) was in the farms of old people who used it as a livelihood strategy during off season when the rest of the cassava often consumed in the fresh form did not exist. It was during this time that the crop was processed for sale in order to obtain money to pay for the farming labour and fetching water for their household uses.

Where they were considered as priority one variety, the mean area of production was 0.33, 0.47, 0.83 and 0.55 hectares for *Kiroba*, *Cheupe*, *Cheusi Mwangia* and *Mkunungu*, respectively. For other varieties, the mean area of production was 0.24, 0.38, 0.63 and 0.68 hectares for *Kibandameno*, *Kalolo*, *Kikombe* and *Mahiza*, respectively. These show that although *Kiroba* was grown by many people (24.8%), the mean area (0.33 ha) was smaller than for other varieties except *Kibandameno*,

which implies that as a newly introduced variety it was yet to be adopted fully or there was pressure of land where it was mostly grown (for example Tongwe village). It could also be that it was grown in smallholdings due to lack of enough planting materials since the variety was relatively new. For unknown reasons yet, the least popular varieties seemed to be grown in larger mean areas. Perhaps, their inherent problems made them repelled by the very small-scale farmers with small farm holdings in order to make maximum use and profit per unit of land.

One of the important observations in this study was that there was need to evaluate and introduce new varieties which could be more suitable to different forms of utilization and processing. The qualities envisaged in new cassava varieties to be brought to the villages were ranked as good yield/harvest (25.9%), high tolerance to pests and diseases (28.53%), sweet for chewing (13.77%), early maturity (10.49%), drought resistant (5.57%), good cooking quality (4.92%), good taste (4.26%), good market (3.28%), and good leaf for *Kisamvu* (1.31%). They should also be good for boiling (0.99%), soft (0.66%) and good for dry chips for flour making (0.33%). Although good marketing was not ranked high the parameters that were ranked high could have direct implication to improved market. Simultaneously, each cassava variety in the study area was found to have its own limitations.

Factors that prompted some varieties to be more preferred are the inherent quality characteristics and the accompanied limitations. The main limitations are low disease-tolerance, bitterness when used in the fresh form, poor yield and late maturity. For the main cassava varieties these limitations were revealed as presented in Table 4.

Table 4: Limitations of the main cassava varieties in percentage of respondents

Limitations	Varieties					
	Kiroba	*Cheupe*	*Cheusi Mwangia*	*Kibandameno*	*Mkunungu*	*Kikombe*
Bitterness	75	-	-	-	52.9	-
Low tolerance to diseases	15	90	93.1	60.9	41.1	28.6
Poor yield	5	4.8	-	28.6	-	14.3
Late maturity	-	-	3.4	-	5.9	14.3
Poor cooking quality	-	-		7.1	-	-

[1]*Kisamvu* is a vegetable relish prepared from tender cassava leaves

The limitations that were reported for the sweet cassava varieties are attributes of agronomic and consumption factors. While *Kiroba* variety was reported to be relatively bitter than the rest it was the most disease tolerant with low incidences of poor yield. These make this variety most favourable where the intention is to grow it for uses other than fresh form. However, from this survey results, farmers in Tongwe village

where this variety was introduced before have indicated that this variety matures within 8-10 months during which the bitter test is yet to set in. The *Kalolo* variety which was identified as bitter variety which is edible only after detoxification processes was reported to have low tolerance to diseases (33.3%) and slightly poor yield (8.3%).

It was also observed that in the surveyed locations cassava processing was little practiced and when this happened traditional methods were used. These methods are rudimentary and very inefficient which warranted need for introducing improved methods that will be used to produce good quality cassava flour and other products for local and distant markets. Sustaining these markets will require increased cassava production. From the inherent limitations and the envisaged attributes reported by farmers in the surveyed areas, *Kiroba* variety was ranked as the most suitable one and was worth introducing and propagating to boost production and sustain the cassava processing industry.

Intervention

Prior to the intervention past experiences in dissemination of new varieties were explored. This was according to the survey results as reported by respondents that agents for supplying new varieties were fellow farmers (72.7%), researchers (12.5%), extension officers (8%) and NGOs (6.8%). By considering disease tolerance and yield as important attributes for selecting a variety worth introducing then *Kiroba* takes the lead followed by *Kikombe* by far. These were reasons for extending *Kiroba* to Kabuku, Mikongeni and Chanika villages. In addition, farmers in Chanika expanded production of *Kikombe* variety which was also introduced to Kabuku village although it was not among the popular varieties. These varieties were obtained through order-purchase arrangement assisted by researchers and extension officers. This was done to impart sense of ownership of the materials by the participating farmers.

Post-intervention phase

Introducing disease-tolerant cassava varieties to the villages of Kabuku, Chanika and Mikongeni villages as proposed was accepted by the farmers but field performance measured two years after the intervention varied greatly. In Mikongeni the crop was stunted due to bad weather, hence it could not be multiplied as it was postponed to grow much taller. In Chanika village, the plan was for every group member to plant the two varieties (*Kiroba and Kikombe*) but was late due to insufficient rainfall. However, they managed to earn TAS 350,000 and 100,000 per hectare of *Kikombe* and *Kiroba* variety, respectively. The low yield was probably aggravated to by lack of planting in ridges.

In Kabuku village the intervention was well received as shown by production and sales data (Table 5). The results show that there was a tremendous response to change as shown by the increase in number of farmers groups who were constituted without the efforts of the project from

Table 5: Dissemination *Kiroba* variety in Kabuku

Attributes/Factors	Entry point		Two years after intervention	
	Group	Individual farmers	Group	Individual farmers
Number of participants	1	20	3	37
Land area (ha)	0.8	1.2	2.4	2.2
Yield (tons/ha)	-	2.178	18.0	-
On-farm earnings (TAS/ha)	-	-	800,000	-

1 to 3. Concurrently, this led to the increase in acreage planted with *Kiroba* variety by farmers groups from 0.8 to 2.4 ha. High responses were also shown by individual farmers as depicted in change in their numbers (85%) and acreage (83%) after the intervention. The high yield (18 tons/ha) registered in the farmer's group farm was due to the potential of the introduced variety and was eight times higher than the average found earlier in this study and within the range of 15-25 MT/ha for high yielding varieties reported in Hahn (1986). It was difficult to asses increase in yield in the individual farms because harvesting was done arbitrarily and mostly consumed at home. However, potential harvest from individual farms could be estimated from the average computed from the group farm. The earnings from the field farm can be calculated to give TAS 44,440 per MT (equivalent of about TAS 4,500 per 100 kg bag). This price was obtained when fresh cassava was commanding high price in the market. This price could be the supply price to the envisaged processing plant to avoid competing with the fresh cassava market from raw cassava consumers. Going by the estimate of about 20% conversion from fresh form to flour, the cost of raw materials can be estimated at TAS 225 per kg of flour produced. This figure will be added to investment costs, other variable costs and profit in order to get the selling price.

Conclusions

Baseline survey in the cassava growing villages of Tongwe, Kabuku, Mikongeni and Chanika was successfully done and the two years impact of introducing disease-tolerant cassava varieties successfully measured. The data obtained revealed weaknesses and limitations in the whole of the cassava sub-sector. The level of these weaknesses plus the positive attributes from this study form a basis for the way forward of the study. The weakness on production can be minimized through introduction and dissemination of disease-tolerant cassava varieties.

Recommendations

It is recommended to proceed with original study ideas which were aimed at improving production, utilization, processing and marketing for sustainable livelihood. Although parallel efforts are required in this mission, entry point should be to disseminate disease-tolerant cassava varieties for sustainable availability for marketing in the fresh form and availability for processing into value added products. Pricing of raw materials for processing should not exceed that for the fresh market during high price seasons.

Acknowledgement

The authors would like to appreciate the funding from the Royal Norwegian Government and the Government of the United Republic of Tanzania through the PANTIL programme of the Sokoine University of Agriculture. We would also like to acknowledge assistance from District Agricultural Offices for their facilitation. Enumerators who participated in administering questionnaires are also acknowledged.

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