The use of needs assessment methodologies to focus technical interventions in root and tuber crop post-harvest systems: A case study to improve incomes and reduce losses associated with marketing of fresh cassava from rural areas to Dar es Salaam.

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LIST OF ACRONYMS

CDTF	-	Community Development Trust Fund
CIAT	-	Centro Internacional de Agricultura Tropical
DFID	-	Department For International Development
DTV	-	Dar es Salaam Television (Tanzania)
FEU	-	Farmers Education Unit (MoA)
ITV	-	Independent Television (Tanzania)
MATI	-	Ministry of Agriculture Training Institute
MDB	-	Marketing Development Bureau
MoA	-	Ministry of Agriculture (Tanzania)
MoFA	-	Ministry of Food and Agriculture (Ghana)
NGO	-	Non-Government Organisation
NGSS	-	Non-Grain Starch Staple
NRI	-	Natural Resources Institute
RNRRS	-	Renewable Natural Resources Research Strategy
SUA	-	Sokoine University of Agriculture
TAHEA	-	Tanzania Home Economics Association
T&V	-	Training and Visits (MoA Extension Programme)
TFNC	-	Tanzania Food and Nutrition Centre
TSH	-	Tanzanian Shilling (unit of currency)
UK	-	United Kingdom

SUMMARY

The Transfer of Needs Assessment Methodologies and Post-Harvest Technologies for Non-Grain Starch Staple Food Crops (NGSS) in sub-Saharan Africa project was initiated in Tanzania in July 1993 as a collaborative venture between the Natural Resources Institute (NRI) and the Tanzania Food and Nutrition Centre (TFNC). The project was funded by the UK Department For International Development (DFID). The main project involved activities in Ghana and Tanzania but this report deals exclusively with activities in Tanzania focusing on the transfer of needs assessment methodologies, the application of needs assessment in identifying post-harvest problems and technical interventions for NGSS and the identification, validation and dissemination of a technology to improve incomes and reduce post-harvest losses associated with marketing of fresh cassava roots from rural production areas to urban markets in Dar es Salaam.

In the first stage of the project a range of needs assessment methodologies were successfully validated under field conditions through the mechanism of three case studies, which were carried out in Lake Zone, Tanga Region and Dar es Salaam of Tanzania. Following the case studies, two training in needs assessment workshops were conducted in Tanzania to disseminate needs assessment technologies to key personnel from research organisations and institutes in Tanzania, Mozambique, Uganda, Kenya, Ghana, Rwanda and Ethiopia.

The needs assessment case study in Tanga Region highlighted post-harvest problems as a major constraint facing farmers and traders involved in the marketing of fresh cassava to urban areas, and formed the basis for a more detailed study of the marketing system for fresh cassava from rural production areas to urban markets in Dar es Salaam. Semi structured interviews with key stakeholders in the marketing system demonstrated that reductions in quality resulting from poor handling and delays in marketing lead to serious reductions in income throughout the market chain. Farmers and market personnel identified the criteria for a technical intervention to reduce income losses incurred when marketing fresh cassava.

After considering various options a simple low cost storage technique for fresh cassava originally developed by the Centro Internacional de Agricultura Tropical (CIAT) and NRI and later modified with DFID RNRRS funds by the NRI and the Ministry of Food and Agriculture (MoFA) in Ghana was selected for validation in Tanzania. Validation exercises in Tanzania demonstrated that low cost fresh cassava root storage technology had the technical and economic potential to alleviate post-harvest problems associated with marketing of fresh cassava and improve the incomes of those involved in the cassava market system.

In the final stage of the project a flexible dissemination strategy was developed and used to carry out a limited technical dissemination campaign in the major cassava markets in Dar es Salaam and selected villages of Kisarawe and Rufiji Districts in Pwani (Coast) Region, and to promote wider awareness of the technology throughout Tanzania. Needs assessment techniques were used to develop practical approaches for dissemination and two impact assessments (November 1996 and December1997)

were carried out to assess effectiveness of dissemination activities and allow for optimisation of the strategy.

The first impact assessment (November 1996) was used to highlight the strengths and limitations of the initial dissemination strategy, so that a more effective strategy could be developed in collaboration with representatives of the Agricultural Extension Services and key stakeholders in the market system. In December 1997 a second impact assessment was made to assess the effectiveness of the revised dissemination strategy and to highlight any problems. The wider awareness campaign was found to have been effective and a number of expressions of interest had been received from organisations and individuals interested in fresh cassava within Tanzania.

A high level of interest and awareness was found in markets and villages where training activities had taken place, but a number of problems were identified which were hampering uptake of the technology. The two main problems were: (a). to be effective the technology needs to be implemented at all points in the market system but individuals were unwilling to take the risk of being the first to use the technology without proof of the economic benefits of the technology; (b). the market system is dominated by a large open type of package called a lumbesa which is not suitable for application of the technology or for transport of cassava but is used for other reasons related to transport charges.

To overcome the first difficulty the project team developed a marketing demonstration to provide a practical demonstration of the financial benefits of low cost fresh cassava root storage technology to potential beneficiaries within the marketing system. The second difficulty was addressed by representatives of various village governments and market co-operatives in collaboration with the TFNC/NRI project team. In November of 1997 the village governments of Jaribu and Bungu villages in Rufiji District enacted bylaws to encourage adoption of close packaging for cassava and adoption of the new storage technology. To support this initiative the Agricultural Extension Service in Rufiji District have agreed to integrate the technology into their extension programmes, and in addition the village government in Jaribu has initiated its own training programme in the sub-villages around Jaribu. In December 1997 the village governments of Masaki, Sungwi and Gumba villages in Kisarawe District villages decided to follow the lead taken by villages in Rufiji District and develop bylaws and training programmes to promote uptake of the new technology. The Agricultural Extension Service for Kisarawe District have acknowledged the importance of cassava as a source of income generation in the District, and have agreed to integrate the technology into their extension programmes. If co-operation between the various stakeholders is maintained it seems likely that the technology will start to be adopted during 1998.

This case study within the main regional Africa project has demonstrated not only that low cost fresh cassava root storage technology has the technical and economic potential to reduce post-harvest losses and improve incomes, but has also shown that key stakeholders are genuinely interested in adoption of the technology and are willing to co-operate and spend their own funds to promote uptake of the technology.

However, for successful uptake of the technology a wider dissemination at both local and national level is required. It is also clear that lack of funds in rural areas could constrain producers and country buyers from adopting this technology. To meet the needs of those involved in marketing of fresh cassava throughout Tanzania a sustained campaign of dissemination is required, involving close collaboration between the Agricultural Extension Services, selected NGOs and key stakeholders involved in marketing of fresh cassava from rural areas to various urban centres in Tanzania. A concept note for wider dissemination of low cost fresh cassava root storage technology in Tanzania is included in this report (Appendix 5).

The findings of this case study have shown that successful adoption of this technology would improve the quality of cassava reaching urban consumers, and contribute to poverty alleviation by improving the income generating potential of marketing of fresh cassava.

RECOMMENDATIONS

A new project should be initiated in Tanzania to build on the achievements of the existing project by extending the low cost fresh cassava root storage technology more widely within Tanzania. The new project should include the following:

- To use needs assessment techniques to clearly identify the areas of Tanzania (not covered in the current project) where fresh cassava is most important as an income generating crop, and to identify the main urban markets for cassava (other than Dar es Salaam).

- To use needs assessment techniques to investigate the importance of the cassava export market in Zanzibar, and assess the potential for dissemination of the technology in Zanzibar. If appropriate to disseminate the technology in Zanzibar via the Agricultural Extension Services.

- To extend the technology to all areas of Tanzania (where fresh cassava is important) by providing training to agricultural extension officers at district and village level, and incorporating the new storage technology into the existing T&V (Training and Visits) programme of the Agricultural Extension Service.

- To identify and involve appropriate non government organisations in dissemination of the technology, and post training support for users via the mechanisms of user groups and microfinance schemes.

- To continue to actively involve key players from the market system in dissemination activities as community trainers, and to continue to make use of the media to increase awareness of the technology.

- To incorporate the new storage technology into the curricula of the Ministry of Agriculture Training Institutes (MATI) to ensure that newly trained extension officers are familiar with the technology, its importance and methods for dissemination.

- To ensure that the wider issues that affect uptake of the new technology into a market chain are incorporated into training materials.

BACKGROUND

1. Cassava (*Manihot esculenta* Crantz) together with potato, sweet potato, cooking banana and plantain are the main non-grain starch staples in Tanzania. The production of cassava has tended to fluctuate over the last 8 years for which data is available (1985/86 to 1992/93), but overall production increased by 17.5% over the period (Ministry of Agriculture, 1994). For many people, cassava represents food security and an inexpensive source of daily calories particularly for those in low income groups. For people living in production areas close to major roads within approximately 150km of major urban centres such as Dar es Salaam cassava represents an important opportunity for income generation through its marketing to urban consumers.

2. Cassava is widely consumed in Tanzania. Fresh cassava is especially important in Tanga, Pwani (Coast), Dar es Salaam, Morogoro and Mwanza Regions. Traditionally, cassava is grown as a domestic, subsistence crop for home consumption. Trends in urbanisation, however, have opened up a new and growing demand for fresh cassava in towns and cities. With high urbanisation rates, for example the population of Dar es Salaam was considered in 1992 to be expanding at 4.5% per annum (Government of Tanzania), the demand for cheap staple produce such as cassava is expected to rise considerably in the years ahead. This will place even greater strains on current marketing systems; a problem exacerbated by the perishable nature of fresh cassava itself.

INTRODUCTION

3. For centuries in sub-Saharan Africa, a spectrum of root crops have supported and contributed to the nutritional requirements of both rural and urban communities. With increasing populations, the role of root crops is destined to become even more critical, not only to provide sustenance, but also as a vehicle by which those involved in the production and trading of these commodities can generate income. The present and future challenge is to link possible improvements in the productivity of root crops on the farm with more efficient post-harvest handling systems that will minimise wastage in terms of physical loss, quality depreciation and monetary value. Success in this area will improve the quality of food reaching the consumer and improve the income of rural producers.

4. This report presents the findings of a United Kingdom Department for International Development (DFID) funded Regional Africa project entitled "Transfer of Needs Assessment Methodologies and Post-Harvest Technologies for Non-Grain Starch Staple Food Crops in Sub-Saharan Africa". The project is managed by the Natural Resources Institute (NRI). The Tanzania Food and Nutrition Centre (TFNC) is the counterpart organisation for East Africa and responsible for field management in Tanzania. One aspect of the project involved validating needs assessment methodologies through case studies and the follow though of these studies with appropriate technology transfer activities. The results presented here demonstrate this approach and its benefits. In this case study, work commenced in 1993 to address the following issues:

(a) to examine typical marketing systems for cassava which link areas of production with urban markets;

(b) to assess the major needs and opportunities for greater efficiency within these post-harvest systems;

(c) to assess the level of losses and quantify the depreciation of fresh cassava entering urban markets;

(d) to validate and assess the feasibility of using modified handling techniques to ameliorate losses within the system; and

(e) to adapt and disseminate appropriate post-harvest handling methods to key individuals and organisations.

5. Needs and loss assessment studies carried out in 1993-1994 identified reductions in income resulting from post-harvest losses as a major problem facing stakeholders involved in production and marketing of fresh cassava roots from rural production areas to markets in Dar es Salaam for sale to urban consumers. The most likely technical intervention for alleviating this problem appeared to be a modified version of a fresh cassava root storage technology originally developed by Centro Internacional de Agricultura Tropical (CIAT) and NRI in Latin America and later modified for Africa by NRI and the Ministry of Food and Agriculture in Ghana as part of DFID funded research project (R5448cb). In the period between October 1994 and December 1995 adaptive research was carried out in Tanzania by the TFNC and NRI to enable the transfer of a technology for low cost ambient storage of fresh cassava from Ghana to Tanzania. During this period the technology was tested and validated at TFNC (Mikocheni), two markets in Dar es Salaam (Tandale and Tandika) and one village (Masaki) in Kisarawe District, Pwani Region. The results of this work clearly indicated that the technology was feasible and appropriate for local conditions pertaining around dar es Salaam. A flexible dissemination strategy was developed and applied from January 1996 until the conclusion of the case study in February 1998. Assessments of the dissemination strategy were made in November 1996 and December 1997 to evaluate performace of the strategy and to allow improvements to be made.

6. For convenience, the project activities reported here have been divided into three phases. These phases represent the chronological order of activities during the life of the case study and so follow a logical sequence.

PHASE 1: TRANSFER OF NEEDS ASSESSMENT METHODOLOGIES, AND USE OF NEEDS ASSESSMENT TO IDENTIFY AND PRIORITISE POST-HARVEST PROBLEMS FOR NGSS

TRANSFER OF NEEDS ASSESSMENT METHODOLOGIES

7. Two case studies were made in Lake Zone and Tanga Region to validate a range of needs assessment techniques under field conditions (Reports NGSS 93/94 V5 & NGSS 93/94 V6). These studies proved useful not only for assessing methodologies and approaches but also proved invaluable for identifying problems and opportunities in the post-harvest area from a farmers perspective. Following on from the case studies, two training workshops were organised in Morogoro to provide training in needs assessment techniques for potential users at both regional and national level (Report NGSS 93/94 V7). Participants were drawn from research institutes and organisations whose work is focused on non-grain starch staple food crops. The regional workshop was attended by personnel from Tanzania, Mozambique, Uganda, Kenya, Ghana, Rwanda and Ethiopia. Training materials from the two case studies and the workshops were compiled into a needs assessment manual for wider circulation (Kleih *et al.* 1997).

USE OF NEEDS ASSESSMENT TO IDENTIFY AND PRIORITISE POST-HARVEST PROBLEMS FOR NGSS

Needs assessment study

8. The first stage of the study was the identification and characterisation of marketing channels. Urban markets were selected on the basis of their role and function in the marketing system, with a cross section of major wholesale/retail markets (such as Kariakoo, Tandale, Tandika and Buguruni) and smaller retail markets (such as Urafriki and Ubungo). The major supply areas were identified on the basis of information provided by market traders. The study focused on the marketing chain between Kisarawe District in Coast Region and Dar es Salaam, which is an approximate distance of 65 kilometres.

9. Secondary information, collected to supplement and support the primary data, included that concerning market prices, production and household expenditure. The sources of this information included the Marketing Development Bureau, the Bank of Tanzania and the City Council.

10. Primary data collection was largely based upon individual and group interviews (methods described in IIED 1995) with purposively sampled representatives at key stages of the marketing chain. Key informants included: consumers, market masters, retailers, wholesalers, cooking vendors, country buyers, village traders and farmers. The number of informants with which discussions were held was judged on the basis of ensuring the information collected was deemed consistent and valid. The survey team consisted of two food scientists, one marketing economist and one socio-economist.

11. Check lists of key issues were prepared for each of the informants identified. Observation was used as a key tool to cross check information elicited during the interviews and as a means of facilitating discussion with interviewees.

12. A schematic representation of the marketing chain from the producer to the consumer is shown in Figure 1.1 (Appendix 1). Representatives of each of the participants in this chain were interviewed and the system thereby characterised. This information is detailed in Ndunguru *et al.* (1994).

13. The needs assessment study confirmed that the cassava was mainly consumed in Dar es Salaam without processing. Fresh cassava is consumed in one of three forms: steamed/boiled, deep fried or roasted, with boiling the most common. The most important quality criteria as defined consumers are summarised in Table 1.1 (Appendix 1).

14. The performance of the marketing system was assessed into two ways. The first examined marketing margins, which when combined with the information gained from each of the various marketing agents, offered an indication of economic performance. The second assessed post-harvest losses throughout the marketing chain. Marketing margins are detailed and discussed in Ndunguru *et al.* (1994) and are not further discussed here.

15. An indication of the potential post-harvest losses is indicated by consumer's quality criteria described in Table 1.1 (Appendix 1). Time is a key factor in all the quality changes. This can be translated in actual market terms by the price /grading criteria identified. The level of price discounting associated with age is presented in Table 1.2 (Appendix 1) for each stage in the marketing chain. The quality changes associated with time include discoloration, mould growth and withering.

16. At the farm level, delays were associated with unreliable transport and were reported as a problem by farmers and village traders. Country buyers, who are often urban based, hire their own transport and largely circumvent the problem of relying on truck operators or buses. At the urban market, delays in selling produce were found to affect country buyers, village traders and farmers. The absence of an end user with predictable and regular requirements appears to contribute to the uncertainty of predicting market demand on a daily basis.

17. One of the conclusions from the needs assessment study was that there is significant price discounting for old cassava. Delays were possible at various stages in the marketing system. It was recognised that the needs assessment study only provided an indication that losses were an issue and a more detailed assessment of loss was recommended. If this study confirmed the losses then the possibilities for extending the shelf life of cassava should be examined.

Assessment of post-harvest losses for cassava in Dar es Salaam

18. In order to measure and confirm the extent of post-harvest losses of cassava in the market environment, data were gathered from consignments of cassava delivered

to an urban market situated to the north of central Dar es Salaam. Where possible, the number size, source, age and varietal content of cassava consignments were determined on a daily basis. Records of unit (sack) weight, pricing profile of units over time (0-48 hours), size distribution of roots recovered from sample sacks, and an assessment of external damage and internal quality of the roots were also monitored. Natural splits, insect bore holes, bruised skin (not broken), gashes, sharp cuts and ragged tears were the categories of wounds observed most often. Note was made of their frequency and location relative to the stem and distal end of the root and finally the incidences of superficial rots were also recorded.

19. The internal condition of roots was assessed by scoring their cortical tissues for five different characteristics: physiological deterioration, physiological browning, evidence of internal microbial rots, extent of dry corky tissue and potential sale category as defined by market traders. Scores taken from sections along the root were used to determine which part was more prone to damage.

20. Baseline data on quality and losses was collected over a 3 week period. Routinely sample sacks were chosen randomly, weighed and their contents examined in detail. Both the external and the internal condition of the roots were assessed at this time (1-2 days after harvest). For comparison purposes, additional sacks were purchased and held back for a number of days prior to inspection. In this way, it was possible to determine the likely rate of quality depreciation over time (from 2-8 days).

21. The principal results of the case study indicated that the perishability of fresh cassava was a major factor dictating both production and marketing strategies. In the absence of other storage methods, for the producer there is the option of retaining roots in the ground for a period following their optimal maturity. This may be a useful and sometimes necessary alternative to marketing, however, ultimately the central cortex of the cassava will become fibrous, corky and prone to rotting so diminishing the quality of the roots when ultimately offered for sale. Once harvested, neither transporters, traders, wholesalers nor retailers generally practice options that would help conserve the quality of the roots and those handling fresh cassava usually rely on a rapid turnover of produce before physiological deterioration degrades the quality of their produce. In most instances the greater proportion of roots delivered to the market are damaged to some degree that accelerates the rate of root deterioration. Much of this damage results from poor harvesting and handling practices and could be either avoided or diminished.

22. In most instances deterioration becomes increasingly evident after 3 days and with the passage of time market traders could recognise some five categories of root quality:

- those with a premium price;
- those saleable at a discounted price;
- roots sold for makopa (dried cassava pieces) production;
- roots used for animal feed; and finally
- roots with extensive rots that retained no value.

23. In the markets trading cassava in Dar es Salaam, prices are extremely volatile with dramatic changes reflecting the balance of supply and demand over time. When cassava supplies are abundant, unit prices fall and customers demand cassava of the highest quality. Conversely when cassava is in short supply, prices rise and wholesalers and retailers are still able to sell their produce despite the fact that the produce may show signs of advancing physiological deterioration.

24. The outcome of the needs assessment study (Ndunguru *et al.* 1994) was presented at a national project co-ordination workshop. As a result, potential post-harvest interventions were identified and a number of case studies initiated. One of these was to reduce the losses of fresh cassava which occurred during marketing. This could be best achieved through a technical intervention to improve both harvesting and post-harvest handling techniques. Discussions with respondents in the major cassava markets in Dar es Salaam (Tandale, Tandika & Buguruni) and at Masaki and Sungwi villages in Kisarawe District indicated that their would be strong interest in uptake of new handling methods if the technology was simple to apply, involved limited outlay and improved income for users.

PHASE 2: TECHNICAL INTERVENTION TO ALLEVIATE PROBLEMS FACED IN MARKETING OF FRESH CASSAVA

IDENTIFICATION OF A SUITABLE TECHNICAL INTERVENTION

25. To meet the needs of people involved in production and marketing of fresh cassava in Tanzania, suitable technical interventions would need to fulfill the following criteria:

- Maintain quality of fresh cassava roots for 7-10 days.
- Simple to apply, using readily available materials.
- Very low capital outlay and operational costs.
- Improve nett income (inclusive of cost of application) of user.
- Be adapted for transporting cassava by road (or sea).
- Suitable for both rural and urban use (for use by producers, traders and consumers).

26. Traditional Tanzanian solutions to the problems of fresh cassava spoilage include burying cassava roots in pits or sun drying pieces of root to make *makopa*. Pit storage meets most of these criteria but is not suitable for transport purposes or for use in urban markets where the cassava must be readily accessible. *Makopa* production is not a method for keeping cassava fresh and does not provide good economic returns. *Makopa* is normally seen a last resort which can be used to prevent a total loss of income if cassava has deteriorated to a point where it cannot be sold as fresh roots. In Latin America fresh cassava for export is preserved by freezing (-20°C) or by dipping

the roots in a suspension of hot wax and fungicide. Neither of these methods is appropriate for farmers and traders in Tanzania because of high capital and operational costs and requirement for specialised facilities and technical personnel.

27. In the 1980s, as an alternative to traditional techniques, a project undertaken by the Centro Internacional de Agricultura Tropical (CIAT) and the NRI developed a simple conservation strategy based on cassava root storage in polyethylene bags combined with a chemical treatment to control secondary microbial (fungal) rotting. Storage times of upto one month were achieved. This was sufficient to permit the provision of fresh, high quality product to consumers and for at least one week at home storage. This system proved suitable for the marketing of cassava in Latin America. In recent years, NRI in collaboration with the Ministry of Food and Agriculture has worked to adapt the technology to conditions in Ghana.

28. The original CIAT/NRI technology consists of harvesting and selecting high quality, relatively undamaged roots from low cyanide cassava varieties. The roots are washed or cleaned and then dipped or sprayed with a fungicide, thiabendazole, which is widely used as a post-harvest treatment for banana and potato. The drained roots are then placed in polyethylene bags that are sealed. The respiration of the roots within the bag causes the relative humidity (RH) of the enclosed atmosphere to rise. The high RH in combination with a temporary holding of the bagged roots at high temperature causes root curing which promotes an extension of shelf life (CIAT, 1989).

29. Experience gained in Ghana suggests that, for most practical purposes, simply dipping sound roots in water and maintaining them at high humidity for several days in the shade will extend the useful self-life of fresh cassava for periods of 7 to 10 days without the necessity to use fungicide. Given the limited level of funds available to potential users of the modified storage technology it seemed likely that the Ghanaian option would be most appropriate for Tanzania.

Low cost fresh cassava root storage technology.

30. This technology involves a series of steps which link together to create optimal conditions for storage of cassava roots under field conditions. The steps are as follows:

(a). Harvest roots carefully with roots intact on stem.

(b). Remove roots from stem taking care to avoid wounding the roots.

(c). Separate damaged and undamaged roots into two heaps.

(d). Use a sharp knife to cut away damaged pieces from damaged roots by making clean smooth cuts. Allow cut surfaces to dry before dipping roots in water.

(e). Pour water into a large container and dip roots in the water.

(f). Put dipped (wet) roots into sacks.

(g). Tie sacks with string.

(h). Place sacks on a platform of logs in the shade.

(i). Wrap sacks with plastic sheets or sheets made from old sacks sewn together.

VALIDATION OF MODIFIED HANDLING METHODS

31. Three storage trials were conducted during the period of November and December 1994 to demonstrate the feasibility and potential of different elements of the cassava storage technology. The first was conducted on two day old cassava to illustrate the ability of high humidity and fungicide (thiabendazole - Reg. Product STORITE) treatments to prolong the storage of fresh material for periods of one to two weeks respectively. With the help of local wholesale agents, two further market based demonstrations were carried out to show the effectiveness of different elements of the storage technology. A five day investigation highlighted the contribution of shade to diminishing the rate of cassava deterioration and finally cassava traders were introduced to the concept of creating a cassava clamp using polyethylene sheets to conserve sacks of cassava in the open market. The internal conditions of sample roots derived from a range of different storage treatments were assessed at the end of each trial and categorised using several measurements, including their likely market value. Table 1.3 (Appendix 1) illustrates the experimental approach adopted throughout the trials.

32. In general, observation of the external condition and the incidence of superficial damage to cassava roots fails to provide a reliable impression of the physiological quality of the internal tissue of cassava roots. Only by dissection can the quality of the roots be determined. An assessment of material recovered from the storage trials suggests that uncleaned/undressed roots have a much less wholesome appearance when recovered from store. Treatment with STORITE is able to ameliorate this to a certain extent but such a process represents an expensive option in comparison to storage in ordinary sacks alone. Table 1.4 (Appendix 1) provides an indication of the variable scores recovered from roots stored under different conditions.

33. The mean score values show quite clearly the benefit of shade and fungicide treatment on the physiological condition of roots stored for 8 days. In comparison to roots maintained in the open market under sun, cassava treated with STORITE and held in a clamp showed no microbial deterioration. Scores given by market traders indicated that cassava retained in the market outside the storage clamp was unlikely to be used for anything other than animal feed whereas materiel recovered from the clamp was considered to be of almost the same grade as fresh roots. The present results indicate that post-harvest treatments had no great impact on either the level of secondary browning or incidence of dry desiccated areas within the cortical tissue of stored cassava. Provided cassava consignments are relatively free from serious physical damage or have had such damage components cut away, storage in sacks

under plastic or canvas tarpaulin will extend the storage life of the produce by 4 to 5 days at least. Under normal circumstances, the use of the fungicide STORITE can be circumvented unless cassava consignments need to be stored for periods in excess of 10 days. This is not a normal requirement at the present time.

34. Cognisant of the limited financial resources available to the cassava producers, traders and retailers, a judgment of the feasibility of the cassava storage technology focused on the likely provision of water, man-made fibre sacks and polyethylene sheeting (the use of the fungicide, thiabendazole, was not considered to be a viable option because of very high cost of this chemical). All these materials are essentially available to all potential beneficiaries in the market chain at affordable prices and hence, from a purely technical point of view, the methodologies have the potential to make a considerable impact on the storability of fresh cassava. However, for successful uptake the improved handling method has to lead to a significant increase in nett income as this was considered by potential users in both rural and urban areas to be the most important criterion for adoption ranking well above quality improvements and prolonged shelf life.

ECONOMIC ASPECTS OF IMPROVED LOW COST FRESH CASSAVA ROOT STORAGE TECHNOLOGY

35. To assess the economic potential of low cost fresh cassava root storage technology a micro-survey of the marketing chain for fresh cassava from villages in Pwani Region to markets in Dar es Salaam was made in collaboration with the Marketing Development Bureau (MDB). This survey highlighted the major post-harvest problems faced by key players in the marketing system and the financial implications of these problems in terms of reduction in income. The major problem faced by farmers was damage to roots during harvest which often lead to a 5 to 10% loss of marketable cassava. Country buyers were affected by delays during transportation and in the market, and by damage caused to cassava roots during transportation. Root breakages during transportation could lead to losses of between 6 and 10% of value of the consignment. Losses due to delays varied according to the severity of the delay. Market personnel were affected by losses due to delays in marketing and transportation problems (Appendix 2).

36. It also became clear that post-harvest problems and income levels from fresh cassava marketing are closely correlated with the time of harvest. Although cassava is available in the markets throughout the year three distinct cassava seasons were distinguished. These were; January - May, June - August and September - December. The factors of volume, price and quality were all subject to seasonal variations (Table 2.1, Appendix 2).

37. A comparative economic analysis indicated that low cost fresh cassava root storage technology has potential to improve nett income levels for all of the key players in the marketing system. Incomes for farmers could be improved by 5 to 10% dependent on season. In the case of country buyers, in the January to May season application of the technology could improve profits from 6.9% to 8.7% (expressed as a percentage of the total cost), in June to August profits can be increased from 1.2% to

5.8% and from 2.4% to 4.4% in the September to December season. For retailers in the January to May season application of the technology could improve profits from 14.3% to 16% (expressed as a percentage of the total cost), in June to August profits can be increased from 8.5% to 13% and from 10.5% to 12.5% in the September to December season (Table 2.4, Appendix 2).

38. Overall it was clear from the work carried out during phase 2 that low cost fresh cassava root storage technology has both the technical and economic potential to improve incomes for potential beneficiaries at all points in the marketing system as well as improving the quality of cassava reaching urban consumers. However, it was also clear that this could only be achieved if the technology is applied consistently from the point of harvest through to the final consumer. To achieve this an effective dissemination campaign was required to sensitise all potential users to the benefits of uptake of the technology and the need for co-operation between farmers, country buyers and market personnel.

PHASE 3: DISSEMINATION OF LOW COST FRESH CASSAVA ROOT STORAGE TECHNOLOGY

39. To assist in the development and implementation of an effective strategy for dissemination of low cost fresh cassava root storage technology a number of subsidiary objectives were defined, these were:

(i). To develop methods for dissemination of the technology.

(ii). To carry out a limited dissemination campaign to selected groups of potential beneficiaries in two districts of Pwani Region, and to promote awareness of the technology throughout Tanzania.

(iii). To maintain flexibility by ongoing evaluation of the dissemination campaign so as to determine the overall effectiveness of the dissemination strategy.

(iv). In the light of the ongoing evaluation, to modify and improve the dissemination strategy with a view to establishing a protocol for widespread dissemination of the storage technology to potential beneficiaries throughout Tanzania.

INITIAL STRATEGY FOR DISSEMINATION OF IMPROVED STORAGE TECHNIQUES FOR FRESH CASSAVA

40. As a starting point an initial strategy was developed for limited dissemination of improved storage and handling methodologies to a several groups of potential beneficiaries, so that the effectiveness of dissemination techniques could be evaluated. The initial strategy involved three main areas of interaction. The first involved teaching representatives of organisations that already have a remit to transfer knowledge and technical expertise to personnel working in the agricultural sector. The second area focused on direct interaction with individuals and communities involved in the production, trading and sale of fresh cassava. The third area of

activity sought to publicise dissemination activities through various forms of mass media.

41. Procedures for monitoring the effectiveness of the dissemination initiatives were incorporated in the work programme. By continually assessing the level of success and recognising difficulties, the project team sought to refine its dissemination activities and retain flexibility. Activities monitored included: the number of active trainers; the number of demonstrations organised by each trainer over a given period; the number of individuals within the community or market adopting and practicing the storage methdologies over an extended period of time, and periodic monitoring of key informants to assess their experience of the technology over time and under different marketing conditions.

42. The initial dissemination strategy was implemented between December 1995 and October 1996 with the intention of disseminating the technology in two of the main markets in Dar es Salaam and in selected villages which supply those markets with fresh cassava. The approach taken was to identify key personnel (cassava traders/commission agents, retailers, market administrators, members of women's groups, village agricultural extension officers, school teachers and community development officers in Tandale and Tandika markets and Masaki village (Kisarawe District, Pwani Region) and train them in the theory and application of the storage technology so that they could train others in their respective communities with some support from TFNC during the initial stages of the dissemination programme. It was hoped that the community based trainers would train others who in turn would train further groups of people thus leading to inductive spread of the technology with only nominal support from TFNC and NRI. During this period, TFNC made a number of follow up visits to the markets and village involved in the exercise to assess progress with dissemination, uptake of the technology, and to provide additional support as required.

43. In November 1996 the project team carried out an impact assessment at the markets in Dar es Salaam (Tandika and Tandale) and villages (Masaki, Sungwi and Gumba) in Kisarawe District to assess the effectiveness of the initial strategy, identify problems facing users of the technique and limitations associated with the design or practical application of the dissemination strategy. The impact assessment highlighted the strengths and limitations of the initial strategy and enabled the project team to develop an improved approach for the second stage of dissemination activities.

44. The main strengths and limitations of the initial strategy were as follows:

Strengths

- Participation and ownership of dissemination strategy and technology was encouraged at community level via the active involvement of potential users as community trainers and disseminators of the technology.

- The involvement of women (farmers and farmer/traders) in Masaki village as community trainers and disseminators proved particularly effective. These women not only trained people in the area around Masaki but also sensitised farmers and farmer traders in the nearby villages of Sungwi and Gumba.

- In areas where TFNC trained community trainers inductive spread of awareness of technology occurred without further support which indicates a high level of interest among farmers and considerable potential for effective dissemination and uptake of the technology in rural areas.

- Excellent relationships were established with representatives of the market co-operative organisations in Tandale and Tandika markets. Representatives of Tandika market demonstrated that the market co-operatives could take the lead in promoting the technology to farmers and traders in the markets supply areas, and reported requests for training received from representatives of Jaribu and Bungu villages in Rufiji District.

Limitations

- The linkages between supply areas and specific markets were not adequately described thus limiting opportunities for spread of awareness of the technology within the market chain.

- The initial strategy concentrated on dissemination in markets rather than at farm level. The impact assessment indicated that this was not the correct approach because cassava root quality was perceived by market traders to be an issue for farmers and country buyers and not market traders or retailers.

- Although dissemination in areas targeted by the project team was good, inductive spread did not continue into new areas. Effective dissemination of the technology in rural areas would be greatly facilitated by forming closer links with the agricultural extension service, village organisations, market co-operatives and co-operative development officers, and by integrating the dissemination strategy for low cost cassava fresh root storage into existing national extension programmes.

- Potential end users and community trainers often failed to appreciate that cassava storage is their problem and did not see themselves as owners of the technology. It was apparent that this problem could be overcome if partnerships could be developed between the project team and key players in the market chain.

- The project team had not developed a complete understanding of end users thoughts on the new technology and its applicability and relevance for them as people involved in marketing of fresh cassava. Market traders did not fully appreciate the reason, for applying the technology in the markets. Farmers and farmer/traders demonstrated a theoretical knowledge of how to apply the technology but did not understand why the technology should be used, and did not see the economic benefits. The project team perceived benefits in terms of improvements in product quality and shelf life but these were seen as being

irrelevant by the majority of potential beneficiaries whose thoughts focused on the need for economic benefits versus cost of adoption of the technology.

- The community trainers concept of training was different from that of TFNC/NRI team which expected the community trainers to organise practical demonstrations of the technology. In reality community trainers carried out verbal sensitisation but expected TFNC to return and provide practical training to sensitised communities. Furthermore community trainers lacked the resources for running a demonstration and did not appreciate the importance of practical demonstrations in the dissemination process.

- Community trainers demonstrated a good understanding of how to apply the low cost storage technology, but could not explain why each step is carried out. It was evident that the education of community trainers needs to be strengthened to enable them to answer queries raised by end users. It was also clear that the revised strategy should include increased support for the community trainers by the TFNC/NRI project team in the short to medium term.

- All community trainers and potential users of the technology commented on the importance of appropriate supporting literature, and many commented on the lack of newspaper and radio coverage of project activities.

45. This review exercise proved invaluable for identifying problems with the initial strategy which had limited the uptake of the technology by potential beneficiaries. To overcome the limitations stated above a series of meetings were held with representatives of the agricultural extension service, market co-operative orgnisations and potential users in 5 villages (Jaribu, Bungu, Masaki, Sungwi and Gumba) in Pwani Region, and the three major cassava markets in Dar es Salaam (Tandale, Tandika and Buguruni). Participatory appraisal techniques were used to identify the key issues for successful dissemination and to develop ideas for a revised dissemination strategy. Further discussions were held with the various participants during implementation of the revised strategy so that modifications could be made in the light of field experience.

REVISED STRATEGY FOR DISSEMINATION OF IMPROVED STORAGE TECHNIQUES FOR FRESH CASSAVA

46. The objectives of the revised strategy were: (i). to disseminate the improved storage technology effectively to selected villages in two districts within Pwani Region that supply cassava to markets in Dar es Salaam and to potential users in the three major cassava markets within the city and (ii). to promote wider awareness of the technology amongst policy makers, potential disseminators and users throughout Tanzania. It was very important to distinguish between dissemination and promotion of awareness. In the context of this project dissemination involved direct transfer of technology to potential users and provision of training for potential disseminators. Dissemination can be considered to be effective if it leads to uptake of the technology by users and further dissemination activities by disseminators outside of the project. Promotion of awareness involved sensitising target groups and the population as a

whole to the existence and importance of improved handling practices for fresh cassava. An effective promotional campaign should generate strong interest in the technology among target groups and pave the way for technology transfer activities at a later date.

Dissemination of improved storage technology to potential beneficiaries in selected areas

47. The main objectives of this component of the work programme were to develop and validate effective techniques for dissemination of the new storage technology to potential beneficiaries, and to apply these techniques on a limited basis in selected areas. It was anticipated that successful dissemination would not only lead to uptake within the target areas but encourage potential disseminators to transfer the technology to areas not covered by the project team.

48. As a starting point discussions were held with representatives of co-operative organisations in the three major fresh cassava markets in Dar es Salaam and a small workshop was held to promote the technology to the market co-operatives and discuss issues relevant to uptake of the technology. These discussions enabled the project team to identify the key issues and develop approaches for dissemination in collaboration with the market commission agents.

49. Representatives of the market co-operatives expressed a high level of interest in the new storage technology but made it clear that the technology would need to be applied at all points in the marketing chain for it to be effective. After further discussions it was agreed that a link should be made between markets and supply areas for dissemination purposes, and that market personnel should take an active part in transfer of technology to villages that supply cassava to their respective markets. Given that fresh cassava trading is a business activity it was agreed by all parties that farmers and country buyers would be more likely to co-operate with representatives of the market co-operatives who are themselves involved in marketing of fresh cassava rather than relying on project personnel who have no obvious connection with the cassava marketing. To further strengthen the link between the co-operatives and the dissemination activities the logos of the market co-operatives were placed on the front cover of the leaflet designed for distribution to potential users of the technology.

50. To establish links between markets and their supply areas for dissemination purposes the relationships between the markets in Dar es Salaam and the production areas were determined. The relationship of the cassava supply areas to their respective markets is illustrated in Table 1.5 (Appendix 1). It is immediately apparent that supplies of cassava for Dar es Salaam are derived from villages with access to major roads within 150km of the city. For this reason production areas are confined mainly to three districts of Pwani Region and two districts of Tanga Region, although small amounts of cassava are received from Morogoro by Tandale market at the peak of the season in February. It is also evident that villages only supply cassava to one or at most two markets. This is due to the location of the markets in relation to the major roads out of the city. Tandika market is in the south of the city and thus receives all of its cassava from villages in Rufiji and Mkuranga Districts which lie to the south.

Tandale market is in the north of the city but close to a major bypass road and thus receives the majority of its cassava from villages in Tanga Region which lies to north but also has access to cassava from Rufiji in the south and Morogoro in the west. Buguruni lies in the south west of the city close to the Kisarawe Road and is thus confined to receiving its supplies exclusively from villages in Kisarawe District.

51. To make the best use of available funds it was decided that dissemination activities should concentrate on the three main cassava markets in Dar es Salaam and selected villages in two districts of Pwani Region. The markets were considered to be important in part because they are the end point for all cassava marketed from production areas into Dar es Salaam, but also because training in the markets would not only raise awareness but provide a supply of trained market personnel for use in the demonstrations at village level. The selection of villages could be considered as demand lead because the selections resulted directly from requests received from villages in the production areas. Requests for training were received from Masaki, Sungwi and Gumba villages (Kisarawe District) as a result of villagers involvement in validation exercises in Masaki in 1995. Requests for training were received from Jaribu village (Rufiji District) after a farmer trader from Jaribu saw part of a practical demonstration carried out by the project team in Tandika market. Following a visit to Jaribu in November 1996 by the TFNC/NRI project team and representatives of Tandika market co-operative it was agreed that Jaribu and its surrounding villages (Bungu and Mjawa) would be included in the limited dissemination programme.

52. Initial training sessions were carried out by the TFNC/NRI project team in Tandale and Tandika markets. Training was provided for representatives of the market co-operatives, commission agents, retailers and the local Community Development Officer. Following these demonstrations volunteers were selected from Tandale and Tandika markets who were willing to carry out training activities in Buguruni market and in selected villages. Demonstrations at Buguruni market and in village locations were organised and supported by TFNC but the actual training activities were carried out by commission agents who normally purchase cassava from the target village.

53. Two types of demonstration were developed. The first type was intended to provide a demonstration of the storage technology and practical training in the use of the technology for potential users and extension workers. The second type of demonstration was intended to show the low cost storage technology in use in the marketing system and provide a practical demonstration of the economic benefits of using the low cost storage technology at all points in the market chain.

Practical demonstration and training in application of low cost fresh cassava root storage technology for potential users and extension workers.

54. The arrangements for training sessions in villages and markets were essentially similar, except that good harvesting practices were not demonstrated in the markets. The description that follows is appropriate for any of the training sessions organised by the project team. As a prelude to the demonstrations a member of the project team or a commission agent would visit the target village to meet with representatives of

the village government and local Agricultural Extension and Community Development Officers to discuss issues of cassava marketing, arrange for training sessions to take place and distribute literature (extension workers manuals, user leaflets and posters). The village government would also be asked to publicise the event in the village, and ensure that key personnel would be available for training (representatives of village government, teachers and other prominent figures in the community who might take a part in further training activities).

55. The training and practical demonstration was divided into three one day sessions spread over an eight day period. The first day was devoted to classroom activities discussing the issues that relate to fresh cassava marketing, post harvest problems and the financial and technical implications of these problems and explaining each step of the technology in detail (Plates 1.1 & 1.2, Appendix 1) with a simplified explanation of the science behind the technology. After the theory an opportunity was provided for discussion. The discussion sessions were always of a lively nature. Most of the people attending these demonstrations derive 30 to 80% of their annual income from fresh cassava. For this reason it is hardly surprising that they should be very concerned by the prospect of reductions in income which could be avoided. However, it was also normal for potential users to be very sceptical about the practicality of the new technology. Most people felt that the technology must fail because it involved two steps that appeared to contradict the practical experience of the trainees. Potential users felt that making the cassava wet would cause it to rot more quickly, many also felt that placing cassava in a closed sack would lead to premature rotting because the cassava would be unable to breathe. These comments illustrate the importance of practical demonstrations in technology transfer. To assist extension workers in future training activities examples of questions and answers from training sessions were included in the final version of the manual for extension workers.

56. On the second day of training participants were taken into the field to participate in a practical demonstration of the application of the technology. The cost of the cassava used in practical demonstrations was covered by either the project team or by the village government. For the practical demonstration a very strong emphasise was placed on participation by the trainees as practical experience is vital for building confidence in the practicality of the technology. Each step of the technology was first demonstrated by a commission agent from the market and then carried out by all of the trainees. A sequence of photographs illustrating a typical practical demonstration is given in Appendix 1 (Plates 1.3 -1.8).

57. The low cost cassava storage technology involves a number of steps which have to used together to achieve the maximum improvement in shelf life of fresh cassava. The simplest form of practical demonstration would involve dividing freshly harvested cassava into two batches. The technology would be applied to one batch, the other batch being handled in the conventional manner would provide a control for comparative purposes. However, early trials of the demonstration technique indicated that potential users would be tempted to miss out some of the steps, hoping to achieve an improvement in shelf life at a lower cost. To demonstrate the importance of using

all of the steps in combination freshly harvested cassava was divided into six batches which were then handled as follows:

	Batch 1:	Batch 2:	Batch 3:	Batch 4:	Batch 5:	Batch 6:
Roots Sorted	-	+	+	+	+	+
Wound Dressing	-	-	+	+	+	+
Dipped in Water	-	-	-	+	-	+
Sacks Wrapped in Plastic Sheet	-	-	-	-	+	+

The second day of the demonstration was completed when the various batches of cassava had been labeled and placed in a shady spot to be stored for 7 days.

58 The third and final day of the practical demonstration took place seven days after day 2. Participants were given an opportunity to compare external appearance and internal condition (by simple dissection) of cassava from each of the batches (Plates 1.9 & 1.10, Appendix 1), and also to taste raw roots to evaluate freshness. In a typical demonstration trainees can clearly see that if all of the steps of the storage technology are correctly applied cassava roots will still be fresh after seven days. If the technology is not used cassava roots will be in very poor condition after 7 days. The demonstration will also show that the technology will not work effectively if some of the steps are missed out.

59. As a follow-up to the practical demonstration the project team made at least one further visit to answer queries raised by potential users and provide support to those wishing to extend the technology within the local community.

Practical demonstration of the financial implications of using low cost fresh cassava root storage technology within the market chain.

60. Practical demonstrations of low cost fresh cassava root storage technology, demonstrate to potential users that the modified storage technology has the technical potential to keep cassava fresh for at least 7 days after harvest. However, potential users remained sceptical about using the technology because of uncertainties about the economic benefits of the technology coupled to an awareness that the technology increases handling costs and requires more effort to apply. The majority of potential beneficiaries were unwilling or unable to take the risk of adopting the new technology on a trial basis.

61. To overcome this problem the TFNC/NRI project team decided to provide partial financial support for potential users to evaluate the technology from harvest to final consumer under real conditions, with the objective of demonstrating that application of the new technology at all points in the market chain can improve the incomes of all persons involved in marketing of fresh cassava. To encourage active participation and ownership amongst farmers, country buyers and market personnel a scheme was divised to defray some of the costs of trying out the technology, and

eliminate the element of financial risk for those wishing to try out the technology as part of a marketing demonstration.

62. Marketing demonstrations were organised from selected villages through to each of the major cassava markets in Dar es Salaam. The demonstrations followed a common format and made use of farmers, country buyers, transporters and market personnel selected by their respective village governments or market co-operatives. A member of project staff supervised the demonstration and kept a record of costs incurred and sale prices so as to calculate the financial benefit of using the technology at different points in the market chain. The format for marketing demonstrations was as follows:

- Purchase of two truck loads of cassava by country buyer. Project team covers cost of purchase and recovers funds at point of sale.

- One truck load treated with low cost storage technology, remaining load handled in conventional manner. Project team supplies plastic sheets and covers cost of sacks and 50% of transport costs and recovers funds at point of sale.

Non-TFNC/NRI project team dissemination activities

63. As part of the dissemination process it was hoped that some of people who had received training in low cost fresh cassava root storage technology from the TFNC/NRI project team would be interested in sensitising or training others within their communities. This can be a very effective method for promoting inductive spread of a new technology into areas not covered by the project team. However, it is vital to be aware of the capabilities and limitations of any individual or group who express willingness to participate in dissemination activities. The most common limitations faced by individuals and groups are:

- Lack of finance.

- Limited time.

- Narrow geographical focus.

- Lack of understanding.

In the present case study a group of twelve female farmers and farmer traders from Masaki village proved highly successful at sensitising farmers in villages and sub-villages close to Masaki and showed a good understanding of the elements of the technology but were unable to carry out practical training due to lack of funds and limited time. In Jaribu village the village government obtained the permission of the Jaribu villagers to spend village funds on carrying out practical demonstrations of fresh cassava technology in the sub-villages around Jaribu and proved highly effective in carrying out this job. However, the village government could not extend the technology any further because it does not have a remit to operate outside of the

Jaribu area. These two examples demonstrate the potential for inductive spread of the technology at local level, but also illustrate the importance of involving organisations with a wider remit and better access to external funding in the dissemination process. To disseminate low cost fresh cassava root storage technology more widely it would appear to be vital to integrate dissemination activities into the existing programmes of the Agricultural Extension Services and to involve relevant non government organisations (NGO) in the dissemination process.

Promotion of wider awareness of the improved storage technology within Tanzania

64. The main objective of this component of the dissemination strategy was to promote wider awareness of the improved storage methodologies for fresh cassava within Tanzania. The target groups were identified as policy makers, disseminators (Government and NGO) and potential users, and the routes for dispersion as being via promotional material (leaflets, posters and video presentations) and mass media. These routes will be discussed in turn.

Promotional materials

65. Promotional materials which can take many forms including brochures, posters and videos can used to promote wider awareness and can be used as an integral part of technology transfer activities. The major promotional materials for this project were descriptive leaflets, a promotional poster, a set of training posters and two videos.

66. Following discussions with community trainers and potential users leaflets were designed for potential users and extension workers. The leaflet for potential users took the form of an 12 page "A5" format booklet portraying each step of the technology in pictorial form with simple written captions in large clear print (Appendix 6). The booklet was designed so that it could be used to promote awareness, and also be used during and after training sessions as a memory aid for anyone using the technology. To help establish a clear link between the technology and the marketing of fresh cassava, and to encourage the involvement of market co-operatives in dissemination of the technology the logos of the co-operative organisations of the three main cassava markets in Dar es Salaam (Tandale, Tandika and Buguruni) were included on the front cover.

67. The manual for extension workers took the form of a 24 page "A5" format booklet (Appendix 6). This booklet was designed to provide an introduction to the technology, technical rationale, economic justification (in practical terms), a detailed illustrated description of each step of the procedure and a selection of questions and answers relating to application of the technology. The questions were derived from training sessions and discussions held in villages and markets. Economic data were derived from a survey carried by the Marketing Development Bureau (MDB) as part of the project. The objective of this brochure was to provide would-be disseminators with enough information and understanding of the elements of the technology to be

able not only to provide training in use of the new handling procedures but also to be able to offer support and answers to the many questions raised by users.

68. Both manuals were originally produced in Kiswahili for use in Tanzania and field tested before final printing. Field testing highlighted the need for larger print in the user leaflet and a small modification to one of the illustrations. Both manuals were designed for ease printing using simple equipment (either a photocopier or printing press). All of the illustrations took the form of simple line drawings because farmers had expressed difficulty in understanding some of the photographs contained in existing extension brochures. Once the Kiswahili versions of the brochures had been finalised English versions were prepared for use by non-Kiswahili speaking persons interested in the low cost storage technology. During the second stage of the dissemination, requests for information were received from Zanzibar, Kenya, Zambia, Malawi and Sri Lanka. Appropriate materials were sent to interested parties in these countries. Copies of both manuals were distributed to extension and education offices in all parts of Tanzania that produce fresh cassava, government offices responsible for agricultural policy development and implementation, NGOs, village governments and market co-operatives. In addition brochures were made available at the World Food Day and the National Farmers Day meeting held in Arusha and attended by representatives of farming communities from all parts of Tanzania. A detailed distribution list is given in Table 1.6 (Appendix 1).

69. As part of the awareness campaign for rural areas, a simple "A3" format poster describing the elements of the technology (in pictures with short captions) and potential benefits of adoption was prepared (Appendix 6). The poster was originally intended for display in rural extension and village government offices and in the offices of the market co-operatives in Dar es Salaam. For this reason presentation followed the same principles as for the user leaflet with large bold print, simple text and clear illustrations to stimulate the interest of anyone reading the poster. To prevent deterioration under field conditions posters were laminated using a lightweight (150μm) laminate. Copies of the poster were sent to extension offices in areas of the country which cultivate cassava, and also to the offices of various NGOs and other organisations having possible interest in dissemination of fresh cassava storage technology (Table 1.6 Appendix 1).

70. In addition to the promotional poster described above a set of nine "A2" format posters showing each element of the technology in pictorial form without captions was prepared as an educational aid for use in training sessions. The durability of the posters was enhanced by laminating with a heavy duty (250μm) laminate. Sets of posters were distributed to each of teams involved in training sessions in markets and villages.

71. Video presentations can be a very effective way of sensitising an audience to a new idea because the message is communicated in an easily assimilated and attractive form. The present project built on material from a research project (R5448cb) carried out in Ghana. As part of the Ghanaian project a quantity of raw video footage had been prepared showing the various elements of the technology. This footage was assembled into a 15 minute training video titled "Always Fresh Cassava" showing

ordinary people applying the technology and highlighting the potential benefits of using the technology. The original video was prepared in English and then dubbed into Kiswahili for use in Tanzania, and French for possible use in Francophone countries in sub-Saharan Africa. The Kiswahili version of the training video was evaluated at TFNC and then released for use in promoting the low cost storage technology. The training video proved useful for promoting the technology at small workshops held in Dar es Salaam for representatives of the market co-operatives and media organisations and at presentations conducted in rural areas (Jaribu, Bungu and Masaki) to promote the technology to village governments, representatives of the local extension services and potential users of the technology. Presentations at village level were conducted with the help of the Agricultural Extension Services who supplied a mobile theatre vehicle equipped with generators and video projection equipment.

72. Reaction to the video from Ghana was generally of a highly favourable nature. In villages people were interested to see the technology being applied in another African nation and readily absorbed the underlying message of the video. It was apparent however that many people did not feel confident enough to apply the technology on the basis of having seen the video. These people felt that although the technology might work in Ghana it would not work in Tanzania because certain elements of the technology appeared illogical in the context of their own experiences with cassava. This point underlines the need to follow-up video sessions with training sessions that include a strong element of practical participation on the part of trainees.

73. The training sessions in Jaribu and Bungu villages were covered by a film crew from the ITV television company. Although only short sequences of film were required for transmission as part of news programmes the ITV crew agreed to record video footage of all stages of the training activities and practical demonstration of the technology. In all three hours of video film was compiled on a VHS format cassette. Although this footage was mainly recorded for possible future use in training films, some of raw footage proved useful for sensitisation purposes at village level. Parts of the Tanzanian footage were shown to villagers in Masaki village as an accompaniment to the training video "Always Fresh Cassava". Villagers were interested to see people from the same region of Tanzania participating in training activities and applying the technology. It was evident that this increases their confidence in the practicality of the technology for Tanzania.

Mass media

74. Within Tanzania mass media can be said to comprise of radio, newspapers/ magazines and television. Radio is probably the most effective medium for reaching both rural and urban communities as it has been estimated that >90% of the rural population have some access to a domestic receiver, in urban areas this figure is estimated to be closer to 100%. In rural areas the choice of programming is often limited to Radio Tanzania so it is relatively easy to reach the majority of the target audience. Newspapers and magazines are useful for accessing urban populations and reaching those who are involved in policy development and implementation.

Television is a relatively limited medium because access is limited mainly to high income urban populations.

75. As part of the initial strategy it had been hoped that media interest would be aroused in the projects activities but this passive approach was not successful. In the revised strategy a proactive approach was adopted. Representatives of media organisations including *Majira* newspaper, *Daily News*, Radio Tanzania, Radio One, ITV television network (both of Tanzania) and the Farmers Education Unit of the Ministry of Agriculture were invited to attend a media briefing at TFNC. At the briefing session participants were provided with an outline of the project and shown the Kiswahili version of the video "Always fresh cassava". The reaction to the video was favourable, but the representative from Radio Tanzania was sceptical about the technology as he felt that wet cassava would rot very quickly. All media organisations expressed interest in assisting with dissemination of the new technology, and it was agreed that a media team should be formed to provide coverage of key project activities. The media team comprising of representatives of Radio Tanzania, ITV, Radio One, *Majira* and the Farmers Education Unit (MoA) provided coverage of training sessions at Jaribu and Bungu villages and Buguruni market in Dar es Salaam. A journalist from *Majira* newspaper provided coverage of several other project activities.

Articles in newspapers and magazines

76. To maximise sensitisation newspapers and magazines were selected for their ability to raise awareness in selected target groups. To reach policy makers and potential disseminators feature articles highlighting project activities and the importance of the improved storage technology were published in the *Daily News* and *Pasua* magazine (Appendix 3). The *Daily News* is an English language daily which is circulated to all government offices in urban areas and is widely read by Tanzanians in senior positions. *Pasua* is a Kiswahili monthly review magazine which has a similar readership to *Daily News*. *Majira* is a popular Kiswahili newspaper with a daily circulation of >60,000 copies. *Majira* is widely read in urban areas of Tanzania and also reaches some of the more accessible rural areas. *Majira* also publishes a women's special interest section on a weekly basis. A number of reports of project activities were published in *Majira* over a period of months, and a special feature article was published in the women's section (Appendix 3). This article was specifically aimed at women in urban areas who are responsible for purchasing and preparation of fresh cassava at household level.

77. To reach rural populations (potential users and Agricultural Extension Service) with printed media articles describing the technology and project activities were published by the Farmers Education Unit of the Ministry of Agriculture in the newsletter of the Agricultural Extension Service and *Ukulima wa kisasa* (farmers magazine) which are distributed nationally via the extension services.

78. During 1997 the project team gave permission for a UK based freelance journalist to prepare articles on the technology for possible publication in international journals relevant to Africa. In August 1997 a small piece on the technology appeared

in Africa Analysis a business review magazine which circulates in a number of sub-Saharan countries (Appendix 3).

Radio features

79. Radio was selected as the best means for reaching all of the target groups (potential beneficiaries, policy makers and disseminators) in rural and urban locations because of the very high levels of access to radio receivers (>90% of population) in Tanzania. Two stations agreed to provide coverage of project activities (Radio Tanzania and Radio One). However, most programming was concentrated on Radio Tanzania because this station has a nationwide coverage and concentrates on news and feature programmes rather than popular music. Radio Tanzania featured the project on the national news on eight occasions during 1997. In addition the Farmers Education Unit (FEU) and the Tanzania Food and Nutrition Centre (TFNC) each produced four special feature programmes for transmission during 1997 in the regular timeslots allocated for agriculture and Food and Nutrition respectively. The FEU incorporated interviews with participants (farmers, farmer traders, market agents and village government officials) in project activities into its programmes. Coverage on Radio One was restricted to brief news items on project activities and announcements of forthcoming events as this station concentrates on popular music and is limited to areas close to the main centres of population.

Television presentations

80. Television is a relatively new form of media in Tanzania. At the present time (1998) their are only two television networks operating in Tanzania (ITV and DTV) and both are privately owned commercial operations. Coverage is limited to Dar es Salaam and the other major urban centres in the country. Due to the high cost of television receivers the target audience is limited to urban high income households, although ITV has established several large public screens in open spaces in central Dar es Salaam that provide coverage to a wider audience. However, inspite of the limited coverage television still offers a useful avenue for raising awareness because it has a high profile and its target audience includes those who are in a position to promote dissemination and uptake of the new technology.

81. To publicise the practical demonstrations and raise awareness of the technology, ITV television reported the projects activities in the national news programme at 20:00 and 22:00 on 28/06/97. The reports lasted for two minutes and included clips from the Kiswahili version of the video "Always fresh cassava". All the elements of the technology were shown and the activities of TFNC and NRI in Tanzania were summarised. During the training sessions at Jaribu village (Rufiji District) the project was featured on the ITV news on 4 evenings. ITV featured training sessions at Buguruni market and Bungu village (Rufiji District) as part of the news on two further occasions. A five minute feature on the technology and project activities was transmitted as part of the weekly news review programme in July 1997. In addition ITV provided the project team with three hours of unedited video footage showing all aspects of the training sessions filmed at Jaribu and Bungu.

ASSESSMENT OF THE IMPACT OF INTERVENTIONS IN MARKETING OF FRESH CASSAVA

82. To monitor the impact of interventions in the fresh cassava marketing system two assessments were made by the TFNC/NRI project team (Nov 96 and Dec 97). The primary objectives of the impact assessments were to assess progress made, identify problems with the dissemination process and suggest improvements to the dissemination strategy to increase potential for uptake of the storage technology within the marketing system.

83. The first impact assessment was made in November 1996 and covered dissemination activities for the period from December 1995 until October 1996 (initial dissemination strategy). Visits were made to two of the main cassava markets (Tandale and Tandika) in Dar es Salaam, three villages (Masaki, Sungwi and Gumba) in Kisarawe District and the District headquarters of the Agricultural Extension Service in Kisarawe to discuss dissemination and uptake of low cost fresh cassava root storage technology. Semi-structured interviewing techniques (with checklists) were used to obtain information on the following topics:

- Level of awareness and interest in using the new storage technology.
- Understanding of the new technology amongst potential users, extension staff and community trainers.
- Inductive spread of awareness of the new technology within rural communities and markets where training had occurred.
- Uptake of low cost fresh cassava root storage technology by potential users.
- Problems associated with the uptake of the technology.
- Strengths and limitations of the dissemination strategy
- Improved approaches for dissemination.

84. At all of the markets and villages visited the level of awareness of the technology was close to 100% and all respondents were able to describe each step of the technology accurately. In the villages the level of interest in adopting the technology was also close to 100%, but in the markets the level of interest amongst commission agents was around 80% and only about 50% of retailers expressed any interest in adopting the technology. Market personnel felt that the technology would have to be adopted at village level prior to adoption in the markets, and many felt that the technology was too time consuming to be useful in the retail section.

85. Extension workers in Kisarawe demonstrated a complete understanding of the principles of the technology and were able to answer questions relating to application of the technology. However potential users and community trainers were unable to go

beyond describing the steps of the technology and some of the community trainers had not understood the importance of using all of the steps in combination.

86. In Tandika market community trainers (originally trained by the project team) had sensitised market personnel in the wholesale and retail sections and organised one practical demonstration with the support of the TFNC/NRI project team. In addition the community trainers at Tandika had successfully sensitised several farmer/traders from Jaribu village (Rufiji District) and established links with the village government at Jaribu. In Masaki village (Kisarawe District) a group of 12 community trainers (all female farmers) had sensitised 65, 21 and 3 farmers and traders in Masaki, Sungwi and Gumba villages respectively. There was also evidence that these women had raised awareness of the technology in some of the small sub villages in the Masaki area. However, inspite of the successes of the community trainers in the villages there was no evidence of uptake of the technology in the villages in November 1996, and only a few commission agents and retailers in Tandika and Tandale markets were making use of some of the elements of technology.

87. A number of factors were identified as being responsible for the lack of evidence of uptake of the technology in November 1996. These were as follows:

- Potential users did not appreciate that the technology could provide improvements in income which would outweigh any increases in costs and effort required to apply the technology.

- Without proof of the economic benefits individuals were unwilling to take the risk of being the first to adopt the new technology.

- To be successful the technology must be adopted at all points in the market chain simultaneously, but in November 1996 it was clear that farmers, country buyers and market personnel were unwilling to co-operate with each other.

- Cassava arriving from Rufiji and Kisarawe Districts is packaged in large open packages known as *lumbesas* (Plate 1.11, Appendix 1). These packages are unsuitable for use with the new storage technology and do not represent a good system for packaging cassava. However, these packages are popular with country buyers and market personnel for differing reasons. Market personnel prefer the *lumbesa* because they feel that the quality of the roots can be quickly assessed without have to break open the package. Country buyers prefer the *lumbesa* because of the issue of transport costs. In Tanzania transporters charge on a per package basis, a single large lumbesa is equivalent to about 3 sacks of cassava thus reducing transport costs by >60%.

These factors were taken into account when developing improved approaches for dissemination of the new storage technology.

88. The strengths and limitations of the initial strategy for dissemination and development of improved approaches for dissemination are discussed in detail in the

section of the report dealing with dissemination and hence will not be discussed further here.

89. The second impact assessment was made in December 1997 and covered dissemination activities for the period from December 1996 until November 1997 and ongoing activities due for completion in March 1998. To assess the limited dissemination campaign visits were made to the three main cassava markets (Tandale, Buguruni and Tandika) in Dar es Salaam, three villages (Masaki, Sungwi and Gumba) in Kisarawe District, two villages in Rufiji District (Jaribu and Bungu) and the District headquarters of the Agricultural Extension Service in Kisarawe to discuss dissemination and uptake of low cost fresh cassava root storage technology. The project team were unable to visit the headquarters of the Agricultural Extension Service for Rufiji District in Utete during the assessment due to problems at the Rufiji river crossing. Semi structured interviewing techniques (with checklists) were used to cover the same range of topics as the first impact assessment.

90. To assess the wider awareness campaign a detailed questionnaire was sent out with a prepaid reply to all the organisations which had received literature and posters as part of the awareness campaign (Table 1.6, Appendix 1). The questionnaire was designed to assess the effectiveness of the dissemination materials and to gauge the respondents level of interest and suitability for involvement in future dissemination activities. In addition visits were made to key persons in the Ministry of Agriculture (Commissioner for Extension, Deputy Commissioner for Training and the head of the Farmers Education Unit), the Tanzania Home Economics Association (TAHEA) and the Community Development Trust Fund (CDTF) to discuss their reactions to the wider awareness campaign and their interest in possible future dissemination activities.

91. At all of the villages and markets visited the level of awareness of the technology remained at close to 100% of the community. However, the level of understanding of the technology had dramatically improved. In addition most respondents had realised the importance of the technology in terms of improved income and this had lead to a greater practical commitment to adopting the technology. Although the technology had not been adopted as of December 1997, key stakeholders were taking action to resolve the issues that hinder uptake of this technology. The village governments of Jaribu and Bungu had organised meetings with the market co-operatives in Tandale and Tandika and representatives of the project team to discuss practical co-operation to ensure adoption of the technology throughout the market chain.

92. During these discussions the issue of closer collaboration between producers and market personnel was resolved and the village governments passed a series of bylaws to encourage adoption of the technology and the resolution of the *lumbesa* issue. Initially the issue of *lumbesas* versus closed sacks appeared to be a sticking point with country buyers and transporters who felt that it would be difficult to calculate transport charges and purchase price at the market. This issued was resolved by the representatives of Tandale market who pointed out that they receive cassava in closed sacks as well as *lumbesas* from Tanga Region and hence have already

established scales that allow prices for consignments in different forms of packaging to be agreed without weighing. Traders in Tanga Region have avoided the issue of increased transport charges by sewing closed sacks together to form larger packages which command the same transport charge as a *lumbesa*. Most respondents expressed confidence that the technology will start to be adopted by mid-1998 if the project team provides practical proof of the economic benefits of the technology.

93. Discussions with respondents in the markets, villages and District offices of the Agricultural Extension Service revealed that most people are satisfied with the revised approach for dissemination. However, a number of useful improvements were suggested by representatives of villages governments and markets involved in the project for incorporation in future dissemination activities. These were:

- To include education on the wider issues of fresh cassava marketing as part of the dissemination campaign so as to encourage co-operation and early resolution of the key issues that could hamper adoption.

- To consider the possibility of forming a cassava traders association (open to anyone involved in production or marketing of cassava) to raise the profile of cassava as an income generating crop, and improve the level of organisation in the cassava marketing system.

- To organise a series of demonstrations of the technology in use in the market chain to provide proof of the financial benefit of adopting the technology.

- To provide ongoing support to users of the technology by integrating the technology into the national programmes of the Agricultural Extension Service.

- To provide short-term loans to groups of potential users to help with the initial cost of adoption of the technology (purchase of plastic sheets).

The suggestion for marketing demonstrations was adopted and included in the work programme for the final quarter of the current project. The other suggestions were discussed with relevant personnel in the Ministry of Agriculture and two NGOs who focus on providing technical and financial support for small groups in both rural and urban areas.

94. As part of the evaluation of campaign to promote wider awareness of the potential of low cost fresh cassava root storage technology visits were made to the Ministry of Agriculture (Commissioner for Extension, Deputy Commissioner for Research and Training and the head of the Farmers Education Unit), the Tanzania Home Economics Association (TAHEA) and the Community Development Trust Fund (CDTF). At all of organisations visited copies of the project poster were seen on display in prominent locations. Senior members of these organisations were familiar with the technology and expressed interest in discussing ways for promoting uptake of the technology.

95. The discussions, at TAHEA and CDTF focused on NGOs ability to interact closely with the community and the potential for assisting uptake through microfinance schemes. TAHEA and CDTF support a large number of small informal groups around Tanzania, and CDTF has established an extensive microfinance network which currently provides loans to group members mainly to finance pre-harvest activities. CDTF recognised the importance of supporting post-harvest initiatives to improve the income generating potential of crops such as cassava. They agreed that their microfinance network could provide a means for providing loans to assist potential beneficiaries to adopt the new technology. They also felt that their support groups could have an important role in disseminating the technology and providing post training support to users.

96. The discussions at the MoA focused on mechanisms for: integrating low cost cassava storage technology into existing extension programmes; integration of the new technology into the training syllabus of the Ministry of Agriculture Training Institutes (MATI); involvement of the Farmers Education Unit (FEU) in continuing and extending the wider awareness campaign. The representatives of the MoA fully appreciated the technical and economic importance of the new storage technology and felt strongly that the technology should be extended more widely in areas of Tanzania where fresh cassava is important either as a staple food crop or as a source of income generation.

CONCLUSION

97. In the current technology transfer case study fresh cassava marketing in Tanzania was used to demonstrate how needs assessment can be used to focus technical interventions. The results of the case study demonstrated the effectiveness of needs assessment as a rapid participatory method for identifying practical problems in both rural and urban communities. The case study on fresh cassava identified post-harvest losses as the major cause of reductions in income in the marketing system and enabled key players to identify criteria for a successful technical intervention. A modified version of the CIAT/NRI low cost fresh cassava root storage technology adapted for use in Ghana by NRI/MoFA (Ghana) was identified as being best able to meet the criteria identified by potential beneficiaries during the needs assessment case study in Tanzania.

98. Validation exercises carried out in villages in Pwani Region and markets in Dar es Salaam showed that low cost fresh cassava root storage technology could extend the shelf life of fresh cassava roots from 1-2 days to between 7 and 10 days, and fulfilled all of the user defined criteria. Economic studies demonstrated that low cost fresh cassava root storage technology has the potential to prevent post-harvest losses and improve income levels throughout the market chain.

99. In the final phase of the case study, participatory techniques were used to develop a flexible strategy for dissemination of fresh cassava root storage technology in Tanzania. The strategy focused on practical dissemination in two districts (Kisarawe and Rufiji) of Pwani Region, and a wider awareness campaign which aimed at sensitising key personnel in targeted organisations throughout Tanzania.

Two impact assessments were made to assess the effectiveness of the dissemination activities and gauge uptake potential and demand for wider dissemination of the technology.

100. In the villages and markets involved with the project, dissemination activities had been successful. Potential users had developed a clear understanding of the economic benefits of adopting the new storage the technology and were co-operating to overcome a number of problems that hinder adoption of the technology within the marketing system. Representatives of the market co-operatives in Dar es Salaam stressed the importance of extending the technology more widely to include Tanga Region, Morogoro Region and Mkuraranga District of Pwani Region as these areas also supply cassava to the markets in Dar es Salaam. They also felt that the dissemination campaign should be sustained within the Districts of Pwani region already covered by the project team as this would ensure successful completion of the uptake process.

101. The success of the wider awareness campaign can readily be gauged from written and verbal expressions of interest received by the TFNC/NRI project team and by the level of interest shown by organisations visited by the project team. During 1997 the project team received written expressions of interest from two commercial farming concerns in Tanga Region Tanzania, and District Directors for Tunduma and Mafia Island respectively. Verbal requests for information and training were received from the MoA authorities in Zanzibar, Lukange Parish (Morogoro) and from representatives of the Agricultural Extension Services of Malawi and Zambia. Discussions were held with representatives of the Commission for Agricultural Extension, Commission for Training, Farmers Education Unit, CDTF and TAHEA. Representatives of the extension service and NGOs agreed that it was important to complete extension of the technology to all areas that supply cassava to markets in Dar es Salaam, and also suggested that the technology should be extended to other areas of Tanzania where fresh cassava marketing is important. In addition they suggested that the new storage technology should be incorporated into the curriculum of the Ministry of Agriculture Training Institutes (MATI) as this will help to make uptake more sustainable by ensuring that newly trained extension officers are familiar with the technology and methods for effective dissemination.

PROPOSALS FOR WIDER DISSEMINATION OF FRESH CASSAVA STORAGE TECHNOLOGY

102. The current project has shown clearly that fresh cassava root storage technology has both the technical and economic potential to improve the income level of anyone involved in marketing of fresh cassava by ensuring that better quality cassava reaches the urban consumer. It has also demonstrated that there is a demand for wider extension of this technology in Tanzania both from potential users and from NGOs and representatives of the extension service. To meet these demands a new project is proposed which seeks to build on the achievements of the current project by extending the technology more widely in Tanzania, and ensuring sustainability of the dissemination process by incorporating low cost fresh cassava root storage technology into the Training and Visits programme, of the Agricultural Extension Services and

the training curriculum of the MATIs. The new project will involve the following aspects:

- Selection of partners and approaches for dissemination.
- Selection of geographical location and identification of beneficiaries.
- Development of a sustainable dissemination programme.

Selection of partners and approaches for dissemination activities.

103. In the new project it is envisaged that specific training activities will be carried out mainly by the Agricultural Extension Services and specific NGOs supported at local level by representatives of village governments and key players from the market system acting as community trainers. Non Government Organisations (NGO), will be selected for their ability to provide support to small groups in both rural and urban areas, and in particular for their skills in microfinance schemes. During the current project TAHEA and CDTF were identified as likely partners based on their proven experience in the desired areas. For promotion of wider awareness of the technology, the new project will continue to make use of media organisations within Tanzania and also make wider use of the Farmers Education Unit (FEU) of the MoA for radio programming, and the production and distribution of dissemination materials. To promote participation, ownership and sustainability, organisations and individuals will be actively encouraged to become partners in the dissemination process and not to consider themselves simply as "consultants" only concerned with a specific activity for a limited period of time. However, to ensure that the overall strategy remains coherent NRI and TFNC will continue to fulfill a role as managers/co-ordinators of the new project, and also provide technical support as required.

104. The current project has already developed proven methods and materials for dissemination of low cost fresh cassava root storage technology, and identified potential partners for wider dissemination. It would be the intention in the new project to make use of existing methods and materials with appropriate modifications to meet the need for a wider campaign.

105. In dealing with the Agricultural Extension Services it would be the intention to integrate the low cost fresh cassava root storage technology into the T&V (Training and Visits) programme as this would appear to be most appropriate of the current national extension programmes. Training in the technology and approaches for dissemination would be initiated at District level by providing training to key personnel (District Executive Director, District Agricultural Development Officer and District Extension Officer and subject specialist). To optimise use of resources training sessions would be organised at a MATI for personnel from several districts at the same time. Initial sessions would be conducted by experienced personnel from the TFNC/NRI project team, but later sessions would probably be run by MATI staff. Senior District staff would then be encouraged to train field officers within their District and ensure that dissemination takes place as part of the T&V programme.

The project team would monitor and support the training sessions for field officers and dissemination activities in the field.

106. In the case of the NGO's it would be the intention to follow a similar top downward approach for training relevant staff within the NGO in various aspects of the technology. The major roles of the NGO partners will be: (a). To disseminate low cost fresh cassava root storage technology to small groups (these may be youth, women's or other groups) of potential users within rural and urban communities, and to promote and support community trainers to continue training activities within the community; (b). To provide post training support for users of the low cost fresh cassava root storage technology at community level. The nature of this support will include provision of loans through existing microfinance schemes to assist users or groups of users to purchase materials required for implementation of the technology, and access to help and advice regarding any technical difficulties experienced by users.

107. At community level key players from the market chain (farmers, traders and market personnel) and representatives of village governments will continue to be involved in the dissemination process as community trainers, as this approach was found to be an effective way for encouraging ownership of the technology and dissemination process at local level. It would also be true to say that trainees were more ready to accept that the technology could be of real use when the message was delivered by a representative of the relevant market co-operative or village government.

Selection of geographical location and identification of beneficiaries

108. Cassava is grown to some extent in most regions of Tanzania and thus it might appear to be appropriate to spread the dissemination into all cassava growing regions. However, the major concentrations of cassava are restricted to Tanga, Pwani, Dar es Salaam, Mtwara, Morogoro and Mwanza Regions. In addition cassava is grown in Zanzibar for export by ship to the Yemen. The low cost fresh cassava root storage technology is most appropriate for use in areas where cassava roots are consumed in the fresh form, and where fresh cassava is marketed from rural to urban areas as a source of income generation. For this reason Mtwara Region can be discounted as in this Region most cassava is consumed in the dried form. In Mwanza Region cassava utilisation is divided between fresh consumption and fermentation into *Udaga* and thus there would appear to be potential for selective dissemination in the Mwanza Region. Fresh cassava is very important as a staple food and source of income in all of the other regions mentioned above. It therefore seems to be appropriate to target wider dissemination activities in Tanga, Pwani, Dar es Salaam, Morogoro and Mwanza Regions. To extend the project into Tanga, Morogoro and Mwanza Regions studies are required to identify the major production areas and the markets that they supply so that dissemination activities can be targeted effectively.

109. During the current project the TFNC was approached by representatives of the MoA in Zanzibar who felt that the technology should be extended to the islands because Zanzibar grows cassava for export by sea to Yemen. However, few details

were given of the extent of the export trade, its economic importance in terms of income generation, or the duration of the journey by sea from Zanzibar to Yemen. To assess the potential for extension of the technology to Zanzibar, studies would be required to determine the extent of production and export of fresh cassava from Zanzibar, and quantify losses in economic terms.

Development of a sustainable dissemination programme.

110. To make the dissemination programme sustainable it is desirable not only to incorporate low cost fresh cassava root storage technology into existing national and NGO programmes, but also to ensure that prospective Agricultural Extension Officers are given a thorough grounding in all aspects of the storage technology and its dissemination during their initial training. If this is achieved it would seem likely that awareness and promotion of the technology will be sustained beyond the life of the existing project. To achieve this the new project would aim to prepare and implement a revised curriculum for the Ministry of Agriculture Training Institutes (MATIs) which would include training in all aspects of low cost fresh cassava storage technology. The revised curriculum will provide training in application and the dissemination of the technology, identify likely beneficiaries, stress the importance of the technology in income generation, and deal with the wider issues of fresh cassava marketing which are likely to impinge on the activities of the extension worker in the field. The revised curriculum would be developed and implemented by the Training Commission (MoA) in close collaboration with the TFNC who have considerable experience in developing and revising syllabuses for the MATIs. It would also be the intention that initial training for staff at the MATIs would be provided by experienced staff drawn from the current TFNC/NRI project team.

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APPENDIX 1.

TABLES, FIGURES AND PLATES.

Table 1.1. Quality criteria recognised by consumers in Dar es Salaam.

Characteristic	Description
Freshness	1-2 days old
Colour	White, avoid browning or discoloration
Absence of Mould	Mould is a sign of deterioration
Damage	Absence of cuts
Size	Small-medium roots (dislike fibres in larger roots)
Variety	Look for sweet and not bitter varieties
Cooking quality	Cooks soft when boiled

Table 1.2. Time related value changes for fresh cassava at different stages in the marketing chain.

	Time	Price per unit (TShs)	Discount
Farmer	"fresh"	2000	
	2 day	1500	25%
	3 day	1000	50%
	>3 days	<500	>70%
Country buyer	"fresh"	4500-5000	
	2-3 days	500-1000	80%
	>3 days	<500	>90%
Wholesaler	"fresh"	6000-7000	
	2-3 days	1500-2000	75%
	>3 days	600-1000	90%
Retailer	"fresh"	3-5 pieces (30 TShs)	
	2-3 days	5-6 pieces	up to 50%
	> 3 days	negotiable	

Note: "fresh" refers to cassava roots which are uprooted and sold the same day or one day later.

Table 1.3. Summary of experimental design used to assess quality of cassava over a 7 day period at Tandale market, Dar es Salaam, Tanzania. The cassava was one day old after harvest. It was of variety Mkunungu from Tanga Region. Assessments were made after purchase (1 day old) and at 8 days old.

Factors				Treatment number	Assessment at day 1 - No of replications	Assessment at day 1 - No of replications	Roots per replicate	No of roots assessed per replicate
Root Condition	**Storage location**	**Wash treatments**	**Packaging**					
1. Undressed roots	1. Transported	1. Dry	1. Fresh roots	1	x1	x1	Full sack	14
	2. Open Air	1. Dry	2. Traditional	2		x1	Full sack	5
	3. Plastic covered	1. Dry	2. Traditional	3		x1	Full sack	5
	3. Plastic covered	2. Water drenched	2. Traditional	4		x1	Full sack	5
	3. Plastic covered	3. Water washed	3. Rice sacks	5		x2	Half sack	5
	3. Plastic covered	4. STORITE washed	3. Rice sacks	6		x2	Half sack	5
2. Dressed roots	3. Plastic covered	1. Dry	3. Rice sacks	7		x2	Half sack	5
	3. Plastic covered	2. Water drenched	3. Rice sacks	8		x2	Half sack	5
	3. Plastic covered	3. Water washed	3. Rice sacks	9		x2	Half sack	5
	3. Plastic covered	4. STORITE washed	3. Rice sacks	10		x2	Half sack	5
	3. Plastic covered	3. Water washed	4. Polyethylene sacks	11		x2	Half sack	5
	3. Plastic covered	4. STORITE washed	4. Polyethylene sacks	12		x2	Half sack	5

Table 1.4. A preliminary assessment of the internal condition of roots stored under various conditions 7 days after arrival (8 days post-harvest) at Tandale market, Dar es Salaam. Details of the trials are given in Table 1.3.

Storage treatment	Physiological	Microbiological	Browning	Desiccation	Traders category
In sun	4.3	2.7	2.0	1.2	3.6
In shade	2.9	1.2	1.9	1.6	2.1
Chemical treatment in polyethylene bags and in shade.	2.5	1.0	1.7	1.2	1.3

Scores shown are mean values of five determinations along length of single roots selected at random.

Scores: Physiological scores range from 1 to 6. Other scores range from 1 to 5. A score of 1 indicates no defect, higher scores denote poorer quality.

Table 1.5. Links between markets in Dar es Salaam and cassava supply areas in Pwani and Tanga Regions.

MARKET	REGION	DISTRICT	VILLAGE
Buguruni	Pwani Region	Kisarawe	Masaki, Sungwi & Gumba & surrounding sub-villages Kibuta & surrounding sub-villages
Tandale	Pwani Region Tanga Region	Rufiji Handeni Korogwe	Jaribu , Bungu & surrounding sub-villages Kabuku Kitumbi Kwamkonga Michungwani
Tandika	Pwani Region	Rufiji Mkuraranga	Jaribu, Bungu & Mjawa & surrounding sub-villages Kimanzichana & surrounding sub-villages

Table 1.6. Distribution of literature and posters on low cost fresh cassava root storage technology (upto 10/12/1997).

Identity and location	**Number of copies of extension manual**	**Number of copies of user manual**	**Number of copies of poster**
DFID (UK)	10	10	10
GOVERNMENT ORGANISATIONS:			
MoA Zanzibar	10	10	3
Planning Commission (DSM)	2	2	2
Commission for Agricultural Extension (DSM)	5	5	2
Commission for Research (MoA)	5	5	2
Commission for Science & Technology	5	5	2
Ministry of Science & Technology	5	5	2
District Executive Directors for: Kisarawe Rufiji Mkururanga	 5 5 2	 5 5 2	 2 2 2
National Co-Ordinator Roots & Tubers (Ukiruguru)	10	10	15
Research Steering Group	8	8	0
Market Development Bureau (DSM)	3	3	2
TFNC Management	15	15	6
TFNC Project Staff	11	11	0
Farmers Education Unit (MoA), DSM	20	20	5
Ministry of Agriculture Library DSM	10	10	5
University of Sokoine - Library	10	10	3
University of Sokoine - Dept. Food Sci & Tech	10	10	2
Divisional Secretary Tunduma (on request)	2	2	1
TFNC Library	20	20	10
MoA Training Institutes (MATI): Ukiruguru Naliendele Ilonga Uyole Tengeru Tumbi Mlingano Madaba	5 per MATI Total: 40	5 per MATI Total: 40	2 per MATI Total: 16

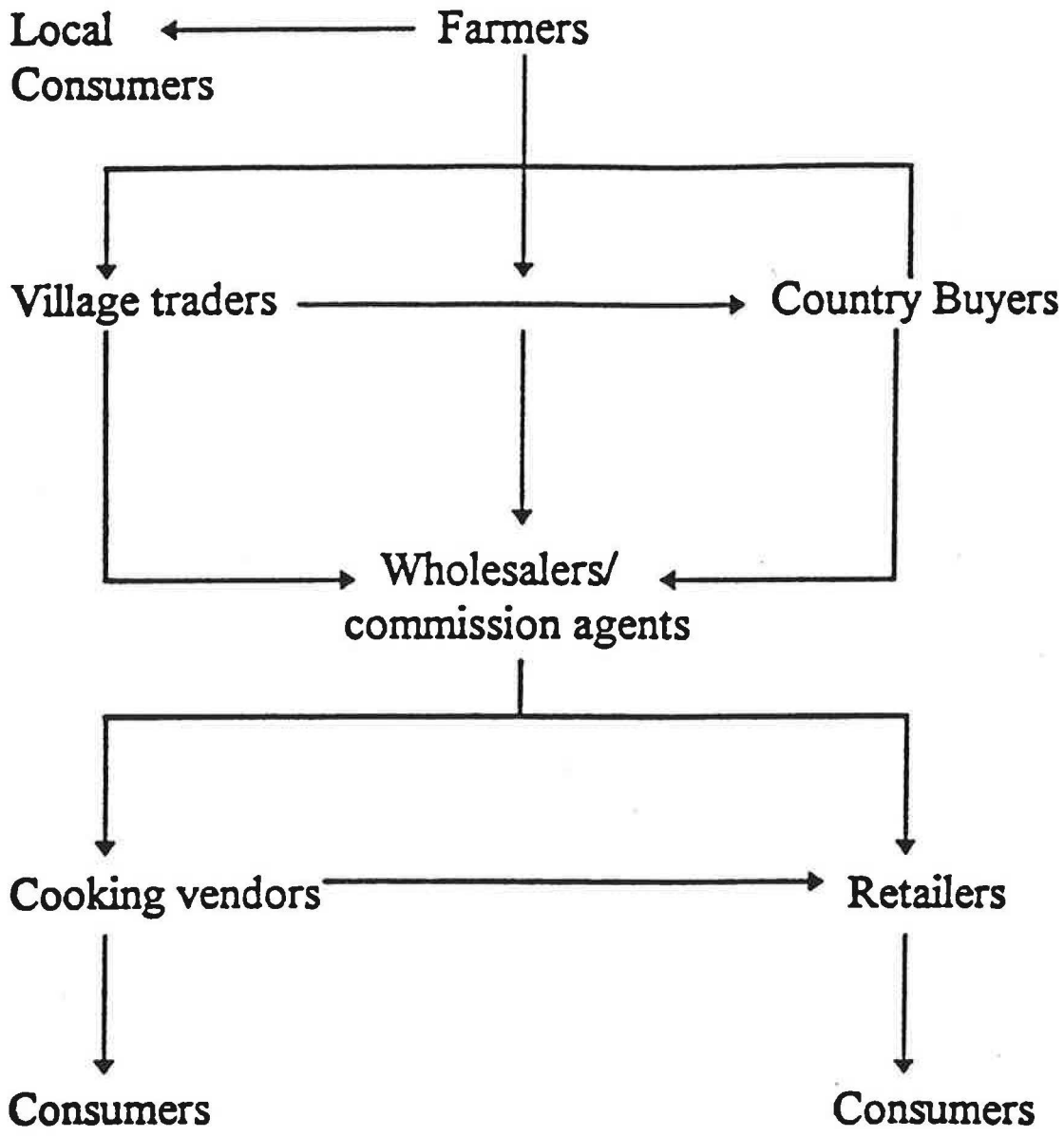
Table 1.6. Continued.

Identity and location	Number of copies of extension manual	Number of copies of user manual	Number of copies of poster
AGRICULTURAL EXTENSION OFFICES - DISTRICT LEVEL:			
Mtwara Region			
District:			
Mtwara	10	10	2
Masasi	10	10	2
Nernla	10	10	2
Tandaimba	10	10	2
Lindi Region			
District:			
Lindi	10	10	2
Nachingwea	10	10	2
Liwole	10	10	2
Kilwa	10	10	2
Pwani Region			
District:			
Kibaha	10	10	3
Rufiji	120	200	20
Kisarawe	100	250	10
Mukuranga	10	10	3
Mafia (island)	20	30	4
Rwuma Region			
District:			
Songea	10	15	3
Mbingu	10	15	3
Tunduru	10	15	3
Shinganga Region			
District:			
Shinganaga	10	15	3
Bariadi	10	15	3
Karama	10	15	3
Maswa	10	15	3
Kagera Region:			
District:			
Bukoba	10	15	3
Muleba	10	15	3
Biharamulo	10	15	3
Ngara	10	15	3
Karagwe	10	15	3
Dar es Salaam Region:			
District:			
Ilala	10	20	5
Temeke	10	20	5
Kinodoni	10	20	5
Mwanza Region:			
District:			
Mwanza	10	10	3
Lalita	10	10	3
Magu	10	10	3
Ukereme	10	10	3
Segerema	10	10	3

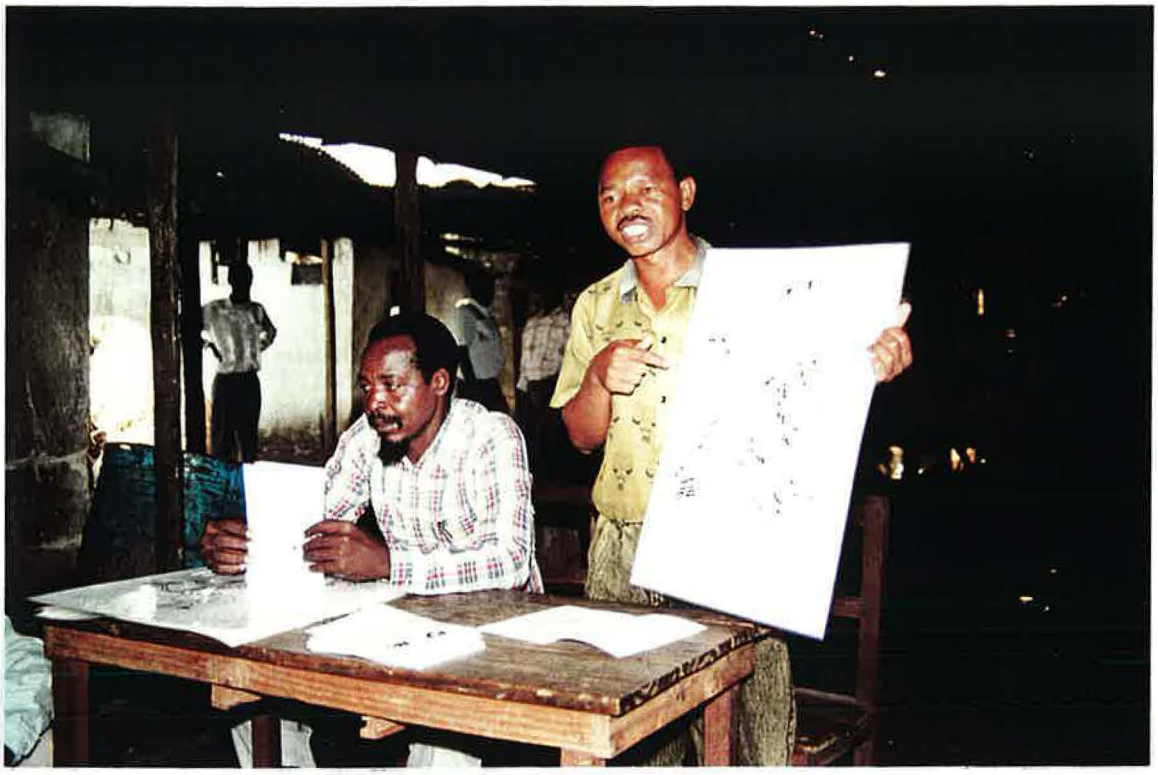
Table 1.6. Continued.

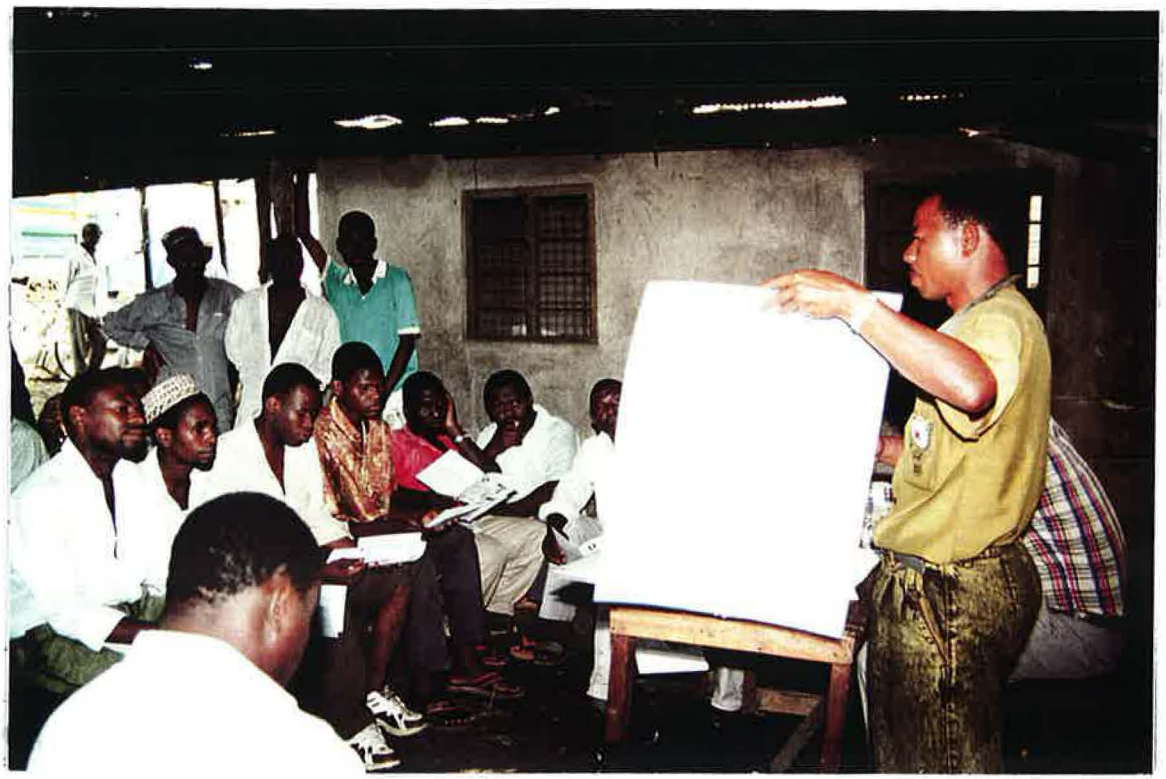
Mara Region:			
District:			
Musoma	5	5	3
Tarime	5	5	3
Serengeti	5	5	3
Bunda	5	5	3
Tabora Region:			
District:			
Tabora	5	5	3
Nzega	5	5	3
Igunga	5	5	3
Urambo	5	5	3
Morogoro Region			
District:			
Morogoro	20	30	5
Kilosa	20	30	5
Mahenge	20	30	5
Illanga	20	30	5
Iringa Region			
District:			
Iringa	10	15	3
Rudewa	10	15	3
Njombe	10	15	3
Makele	10	15	3
VILLAGES & MARKETS:			
Jaribu village Govt	150	250	10
Bungu village Govt	40	100	20
Masaki village Govt	80	200	12
Gumba village Govt	10	30	6
Pagal village Govt	5	10	2
Tandika Market DSM	20	30	3
Tandale Market DSM	20	30	3
Buguruni Market DSM	20	30	3
NON GOVERNMENT ORGANISATIONS:			
Christian Council of Tanzania DSM	20	20	10
Tanzania Home Economics Association	10	10	5
CDTF	10	10	5
CARE	5	5	5
RIPS (Mtwara)	5	5	5
CARITAS	5	5	5
Research Planning & Projects Association	20	20	5
SARRNET (Kibaha)	4	4	2
Lukange Parish	15	30	2
MEDIA:			
Radio Tanzania	2	2	0
ITV / Radio 1	4	4	0
Majira Newspaper	2	2	0
EVENTS:			
World Food Day	620	65	10
Farmers Day (Arusha)	100	200	20
TOTAL:	**2080**	**2365**	**410**

Figure 1.1. Fresh cassava marketing chain



Plates 1.1 & 1.2. Theory session on low cost fresh cassava root storage technology being conducted at Buguruni market, Dar es Salaam by market commission agents from Tandale and Tandika markets.





Plates 1.3 to 1.10 show villagers at Jaribu village participating in a practical training session, the individual steps of the technology are illustrated in plates 1.3 to 1.8.

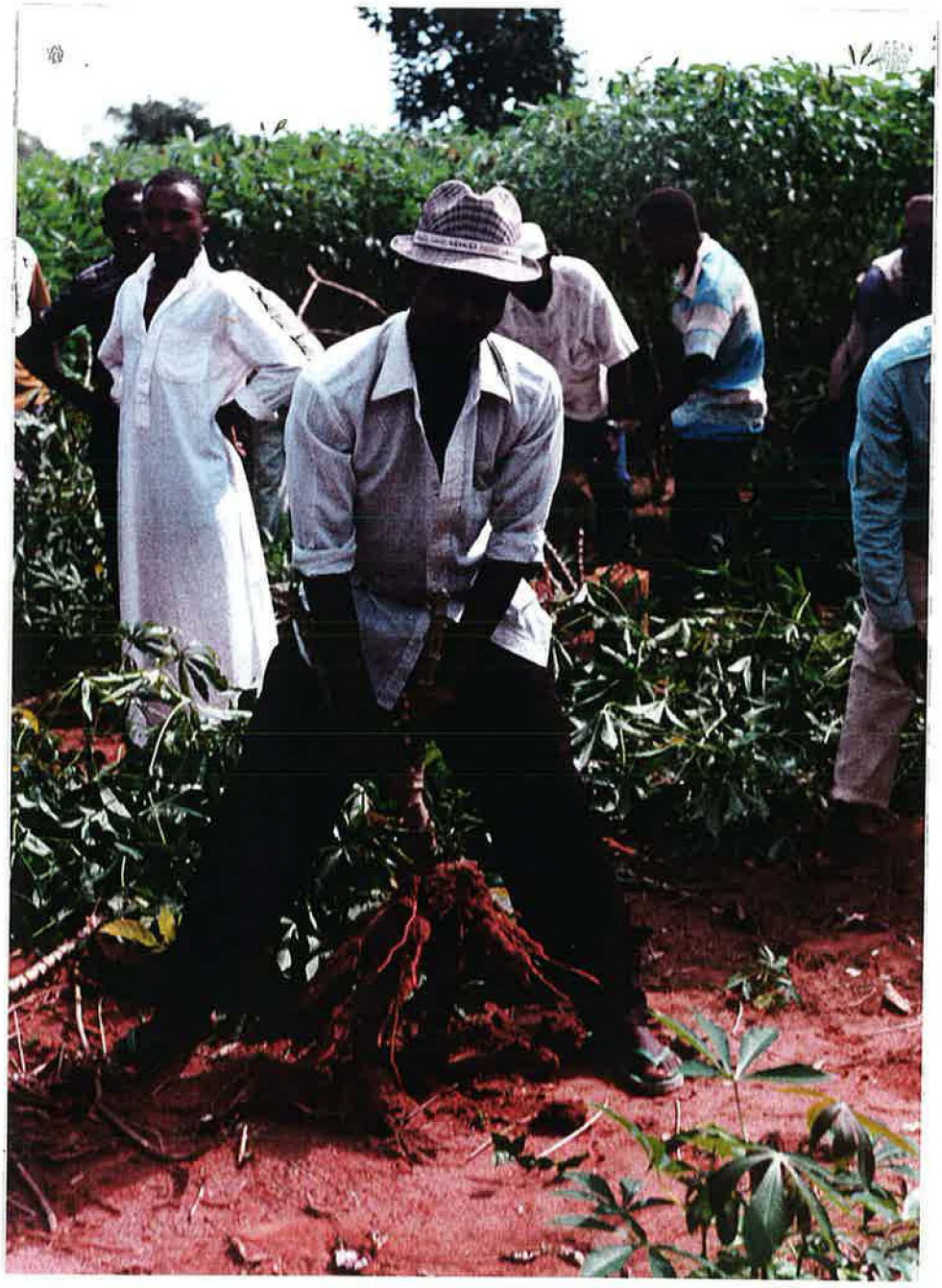


Plate 1.3. Uprooting cassava.

Plate 1.4. Sorting cassava.

Plate 1.5. Cutting away damaged tissue from cassava roots.

Plate 1.6. Dipping cassava roots in water and packing into sacks.

Plate 1.7. Closing sacks of cassava.

Plate 1.8. Sacks of cassava wrapped in a plastic sheet.

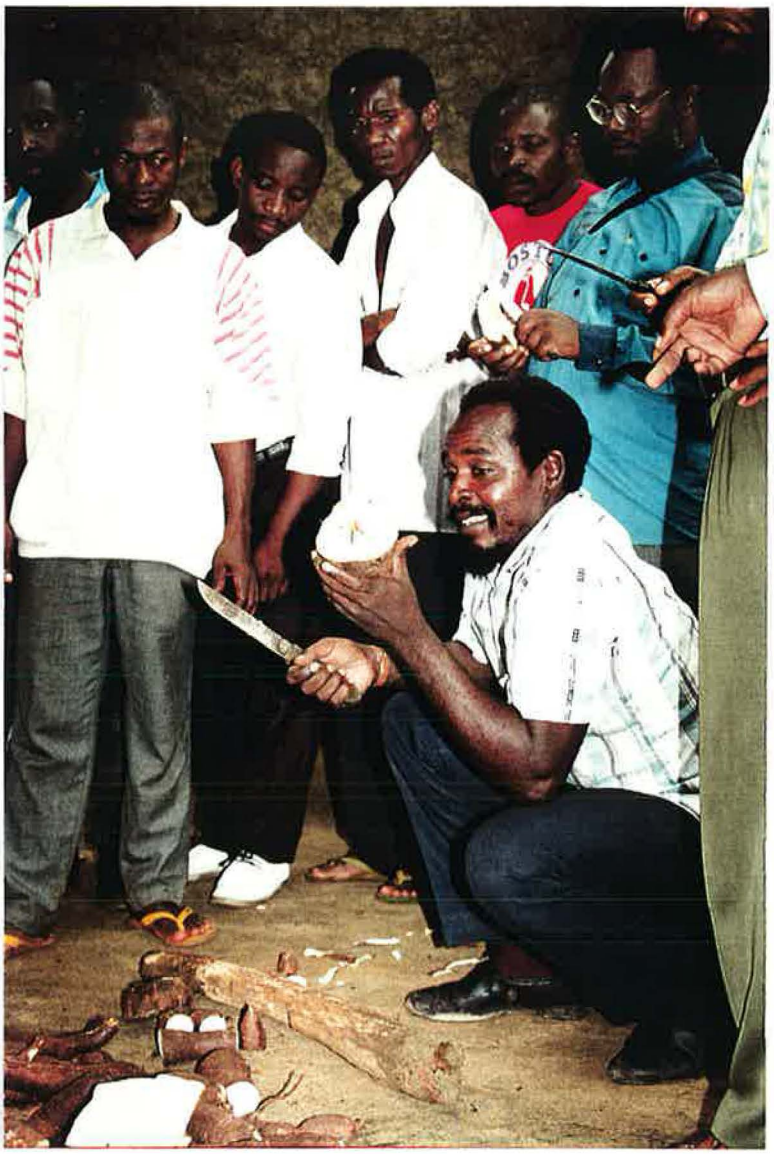


Plate 1.9. Examining cassava after seven days storage.

Plate 1.10. Examining cassava after seven days storage.

Plate 1.11. Typical (Tanzanian) open packaging for cassava known as a *lumbesa*.

APPENDIX 2.

ECONOMICS OF MARKETING FRESH CASSAVA FROM VILLAGES IN PWANI REGION TO DAR ES SALAAM.

(Text of Marketing Development Bureau Report)

ECONOMIC ANALYSIS OF POTENTIAL FOR LOW COST CASSAVA STORAGE TECHNOLOGY IN MARKETING OF CASSAVA FROM PWANI REGION TO DAR ES SALAAM

BY

MR. F. MASHAMBA

MARKETING DEVELOPMENT BUREAU

DECEMBER 1997

CONTENTS

SUMMARY

This report focuses on the economics of low cost fresh cassava root storage technology. The work reported here was undertaken by the Marketing Development Bureau (MDB) in collaboration with the Tanzania Food and Nutrition Centre (TFNC) and the Natural Resources Institute (NRI) of the United Kingdom. This study formed part of a project entitled "Transfer of needs assessment methodologies and post-harvest technologies for non-grain starch staple food crops in sub-Saharan Africa" which was funded by the Department for International Development (DFID) of the United Kingdom.

A micro-survey of the marketing chain for fresh cassava from villages in Pwani Region to markets in Dar es Salaam highlighted the major post-harvest problems faced by key players in the marketing system and the financial implications of these problems in terms of reduction in income. The major problem faced by farmers was damage to roots during harvest which often lead to a 5 to 10% loss of marketable cassava. Country buyers were affected by delays during transportation and in the market, and by damage caused to cassava roots during transportation. Root breakages during transportation could lead to losses of between 6 and 10% of value of the consignment. Losses due to delays varied according to the severity of the delay. Market personnel were affected by losses due to delays in marketing and transportation problems.

The results of the present study showed clearly that post-harvest problems and income levels from fresh cassava marketing are closely correlated with the time of harvest. Although cassava is available in the markets throughout the year three distinct cassava seasons were distinguished. These were; January - May, June - August and September - December. The factors of volume, price and quality were all subject to seasonal variations.

A comparative economic analysis indicated that low cost fresh cassava root storage technology has potential to improve nett income levels for all of the key players in the marketing system. Incomes for farmers could be improved by 5 to 10% dependent on season. In the case of country buyers, in the January to May season application of the technology could improve profits from 6.9% to 8.7% (expressed as a percentage of the total cost), in June to August profits can be increased from 1.2% to 5.8% and from 2.4% to 4.4% in the September to December season. For retailers in the January to May season application of the technology could improve profits from 14.3% to 16% (expressed as a percentage of the total cost), in June to August profits can be increased from 8.5% to 13% and from 10.5% to 12.5% in the September to December season.

Farmers, country buyers and market personnel interviewed during the study highlighted several potential problems that might hinder successful uptake of the technology, and made several recommendations which they felt would enhance uptake of the technology. These were: (a) an effective dissemination campaign is required to sensitise people at all points in the marketing system, (b) farmers should be given training in agri-business management and (c) farmers, country buyers and

market personnel should be encouraged to form co-operatives or trading associations for cassava.

ACKNOWLEDGMENTS

I would like to convey my sincere thanks to Dr. W. Lorri, Managing Director of the Tanzania Food and Nutrition Centre (TFNC) for allowing the study to be undertaken. Thanks should also be given to Mr. E. Rwiza, the Food Scientist from TFNC for his invaluable support with the survey work carried out in Dar es Salaam markets and villages in Kisarawe and Rufiji Districts of Pwani Region.

Special gratitude should go to Mr. G. T. Ndunguru, Principal Food Scientist and Project Field Manager (T0404), for his untiring support in facilitating the survey and providing fruitful comments and assistance in the preparation of this report.

Thanks also to Dr. A. J. Graffham, Senior Scientist from the Natural Resources Institute (NRI) for technical guidance for carrying out the study.

Thanks to all the market masters and traders at Tandale, Tandika and Buguruni markets; and farmers and village traders in Masaki, Bungu and Jaribu-Mpakani villages for providing the information required for this study.

Last but not least, I am thankful to Mr. A. L. Ngondo, Assistant Commissioner for the marketing Development Bureau (MDB) for giving me permission to carry out this study in collaboration with TFNC and NRI.

This report is an output from a project funded by the UK Department For International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.

ABBREVIATIONS

CIAT	-	Centro Internacional de Agricultura Tropical
MDB	-	Marketing Development Bureau
NGSS	-	Non-Grain Starch Staples
NRI	-	Natural Resources Institute
TFNC	-	Tanzania Food and Nutrition Centre
TSH	-	Tanzanian Shilling (Unit of Currency)

INTRODUCTION

Background

Needs and loss assessment studies carried out by the Tanzania Food and Nutrition Centre (TFNC) and Natural Resources Institute (NRI) in 1993-1994 identified reductions in income resulting from post-harvest losses as a major problem facing stakeholders involved in production and marketing of fresh cassava roots from rural production areas to markets in Dar es Salaam. In the period between October 1994 and December 1995 adaptive research was carried out in Tanzania by the TFNC and NRI to enable the transfer of a technology for low cost ambient storage of fresh cassava from Ghana to Tanzania. The results of this work clearly indicated that the technology was appropriate for local conditions pertaining in Tanzania and had the technical potential to reduce post harvest losses associated with marketing of fresh cassava.

The present study was initiated as a collaborative venture between TFNC and the Marketing Development Bureau (MDB) to assess the economic potential of the low cost fresh cassava root storage technology for improving income levels within the marketing chain by reducing post-harvest losses normally associated with marketing of fresh cassava.

Terms of Reference

The terms of reference for the study were as follows:

(a). To describe the marketing chain.

(b). To make a simple analysis of the economics of fresh cassava marketing at different points in the marketing chain (farmer, country buyer, transporter, commission agent and retailer); so as to determine which problems face particular players in the chain and what the financial implications of these problems are for each player.

(c). To assess the likely costs of using the storage technology versus reduction in financial losses during handling and marketing, and to predict the likely economic benefits of adopting the technology for different players in the market chain.

(d). To investigate seasonality of supply versus quality and prices.

(e). To provide best and worse case (for example; delay at farm level, transport difficulties and marketing problems) scenarios of fresh cassava marketing from the supply areas to the markets in Dar es Salaam, with an indication of how the low cost storage technology could have reduced losses associated with these problems.

METHODS

For this study, an urban to rural approach was adopted to trace the marketing system linking the markets in Dar es Salaam with their main supply areas. Visits were made to Tandale, Tandika and Buguruni markets as these are the principal markets for fresh cassava in Dar es Salaam, and had also been involved in validation and dissemination of the low cost fresh cassava root storage technology. Following discussions with representatives of the market co-operatives visits were made to three villages in Pwani (Coast) Region that supply cassava to these markets namely; Masaki (Kisarawe District), Bungu and Jaribu-Mpakani (both of Rufiji District). The survey team comprised of one food scientist from TFNC and an agricultural economist from the MDB. Primary field work was carried out in April 1997, with follow-up visits in December 1997 to take account of seasonal effects.

Primary data collection and analysis

Primary data collection was largely based upon individual and group interviews with key informants along the marketing chain. In villages visited, two farmers, two traders and two transporters were sampled for interview. In each market, two retailers, two commission agents and two transporters were sampled. Informal semi-structured interviewing techniques were used to maintain flexibility the discussions. Check lists were used as guides during the interviews so as to ensure that information obtained was relevant and consistent. A cost benefit analysis was used to analyse the data, and determine whether low cost cassava storage technology has potential to improve incomes within the marketing chain by reducing losses normally associated with marketing of fresh cassava.

SEASONALITY OF SUPPLY

Fresh cassava roots can be obtained from the markets in Dar es Salaam throughout the year. However, the present study demonstrated that supplies vary during the year and identified three main seasons for cassava which were: (i) January - May, (ii) June - August and (iii) September - December. The seasonality of supply of fresh cassava correlated with volume, price and quality. The correlation between the three components is illustrated in Table 2.1.

Table 2.1. Ranking matrix for fresh cassava traded in Dar es Salaam markets.

	January - May	**June - August**	**September - December**
Volume	* * * * * * *	* * * *	* * * * * * * * *
Price	* * * * * * * * * * * * *	* * * * * * * * * * * *	* * *
Quality	* * * * * * *	* * * * * * * * * *	* * * * *

Note: The number of stars denotes changes in variables from season to season. In relation to price, each star represents 500/- (TSH) on the average wholesale price per bag of cassava. For quantity (volume) each star represents one truck with a capacity of 36 bags of cassava. The star index also gives a rough indication of seasonal changes in quality but cannot be used to derive absolute values.

Volume seasonality

Discussions with farmers in Masaki, Jaribu and Bungu villages, and traders in Dar es Salaam markets revealed that the highest volume of fresh cassava is supplied between September and December. The reason for this is that cassava is easier to harvest during this period because the short rains have rendered the soil wet and loose. In addition the yield per plant is also higher at this time. In contrast the lowest volume of cassava is seen in the period between June and August when dry conditions make it difficult to harvest cassava.

Quality seasonality

Quality of fresh cassava is closely correlated with the time of harvest. Farmers interviewed during this study disclosed that cassava harvested during the dry season (June - August), just after the end of the long rains is of the highest quality. These roots have a high starch to water ratio and exhibit good cooking and sensory characteristics. Cassava harvested during the short rains between September and December were considered to be of the poorest quality. These roots have a low starch to water ratio and consequently exhibit poor cooking and sensory characteristics.

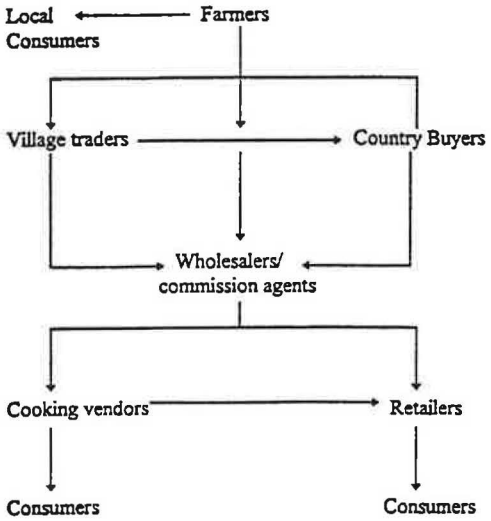
Price seasonality

The price at which fresh cassava is sold at any point in the marketing chain depends mainly on the quality of quality of fresh cassava supplied. High prices usually indicate good quality but may also result a shortage of cassava in the market. Cassava harvested between January and May commands the highest prices, prices peak during the festival of Ramadan when demand for cassava is also at its highest point. Cassava supplied during September to December commands the lowest price because of its poor quality and ready availability when compared to the other seasons. Cassava sold in June to August also commands a low price. This does not correlate with the principle of supply and demand illustrated by the other seasons. During this period cassava prices are depressed because sweet potato is readily available in the markets of Dar es Salaam.

Marketing chain for fresh cassava

Fresh cassava is marketed through various intermediaries from the farm gate to the ultimate consumer in urban areas. A schematic representation of the marketing system is given in Figure 2.1

Figure 2.1. Fresh cassava marketing chain.



Although various options exist for marketing of fresh cassava (Figure 2.1) the majority of farmers interviewed preferred to sell cassava directly to village traders, local consumers and country buyers. In a few cases the farmers took responsibility for harvesting and transporting the cassava to the urban markets for sale through a commission agent. However, in the majority of cases the responsibility for harvesting and transporting the cassava falls upon the country buyer. On reaching the markets in Dar es Salaam, country buyers hand over the consignment to market commission agents who are responsible for the wholesale section of the market. The commission agent charges a commission fee to sell the fresh cassava on behalf of the country buyer to either fresh cassava retailers or vendors of fried cassava. Thereafter the retailers and vendors sell the cassava on to the ultimate consumers.

Post-harvest problems (losses)

Qualitative and quantitative crop losses in handling are indicators of inefficiency; physical and quality losses imply additional costs and reduced income (Ndunguru *et al*; NGSS 94/95 IC3). Assessment of losses involves establishing the cause, location (within the marketing chain) and significance of the loss.

At farm level, the two primary causes of post-harvest losses were identified as root breakages during harvesting and the absence of reliable transport systems in rural areas. Approximately 5% of roots are broken when harvesting is done during the wet season, in the dry season this rises to 10% because of the difficulty of harvesting cassava from dry sun baked soil. Country buyers reject broken roots because these tend to deteriorate more quickly than whole roots. These harvest problems result in a loss of income but the broken roots are not wasted because they will be consumed by the farmer or sold locally for immediate consumption or processed into *makopa* (sun dried cassava). Unreliable transport represents a much more severe problem as it could lead to an almost complete loss of income in some cases. Interestingly many of the farmers interviewed in Jaribu, Bungu and Masaki did not consider transport problems as representing a loss because the roots could still be processed into *makopa*. However, in economic terms the loss in income would still be very high because *makopa* has a very low value when compared to fresh cassava.

Post-harvest losses were also observed to occur during transportation from the production area to the markets. These losses were due to damage to the roots resulting from poor handling practices compounded by the generally poor condition of the roads. Most damage (mainly crushing injuries) was likely to occur in loading and unloading of oversized packages. According to country buyers interviewed in Jaribu, Bungu and Masaki about 6% of roots in a consignment will be broken or crushed during transportation.

At the markets in Dar es Salaam, country buyers and commission agents highlighted delays in selling of cassava as the most important cause of post-harvest losses. It became clear that this a common problem that varies in importance according the harvesting season. Losses resulting from delays in selling ranged from 10% in January - May to 15% of roots traded during September and December when the supply of roots greatly exceeds demand. No delays in selling were reported during June and August because only small amounts of roots are traded during this period. The post-harvest losses mentioned above contribute dramatically to price discounting where cassava loses value due to deterioration. Even under ideal conditions it is quite normal for a commission agent to require 4 days to sell all the bags in a typical consignment of cassava. Over this period the quality of the cassava will deteriorate thus leading to price discounting.

ECONOMIC ANALYSIS OF FRESH CASSAVA MARKETING

A detailed study of marketing operations, characterisation and profit margins for different players in the cassava marketing chain was made by TFNC, NRI and MDB in 1994 (Ndunguru *et al*, NGSS 94/95 IC3). This study provided useful baseline data and information of relevance to the present study. Information from both studies was combined and used to make an economic analysis of post-harvest problems occurring at different points in the marketing chain, and the financial implications associated with each problem. The results of the economic analysis are summarised in Table 2.2. Table 2.3 provides an indication of the financial implications of applying low cost fresh cassava storage technology at different points in the marketing chain. It is important to realise that from a technical point of view to be effective the technology must be applied at the point of harvest and maintained until the roots reach the consumer.

Economics of fresh cassava marketing without low cost fresh cassava root storage technology

Farmer

The major problem facing farmers is that of root breakages during harvesting as this accounts for a 5 to 10% reduction in the volume of salable cassava dependent on season (Table 2.2). In financial terms the loss of income for the farmer resulting from root breakages amounts to 100/- TSH per bag in September - December, 150/- TSH per bag in January - May and 250/- TSH per bag of cassava during the dry season. These losses are taken into account by the country buyer when negotiating a purchase price with the farmer, thus in many respects the farmer may not be consciously aware of the financial implications of broken roots during harvest.

Country buyer

Country buyers deal with farmers directly and take responsibility for arranging for harvest and transportation of cassava to the market in Dar es Salaam. At the market responsibility for wholesale marketing is handled by market commission agents who charge the country buyers a commission fee for each consignment of cassava.

Aging of cassava roots caused by selling delays at the market as well as breakages during transportation and harvesting of cassava roots were reported to be the key problems facing the country buyers. Traders and commission agents at Dar es Salaam markets estimated the loss resulting from delays in selling to amount to 15% of the value of the consignment, which is equivalent to 500/- TSH per bag for cassava traded in the January - May and September - December seasons (Table 2.2). Traders reported delays of 2-3 days as being most common in the Dar es Salaam markets.

Breakages associated with transportation resulted in losses of 6% and 10% of the consignment in the wet and dry seasons respectively. When expressed in monetary terms breakage's represent a loss of between 100/- and 750/- TSH per bag of cassava dependent on season. Price discounting also had an impact on losses associated with

breakages and delays in selling. During the two wet seasons, the discount applied to a bag of broken cassava was 1500/- TSH. In the dry season the discount increased to 2500/- TSH.

Despite the numerous opportunities for losses in income, country buyers continue to realise a nett profit from trading in fresh cassava. Nett profits varied according to season from as little as 70/- TSH per bag in June - August to as much as 420/- TSH per bag between January and May (Table 2.2).

Retailer

In financial terms retailers lost between 100/- TSH and 250/- TSH per bag of cassava during the wet and dry seasons respectively as a result of breakages during transportation. Delays in selling accounted for a 12.5% of income, which is equivalent to a loss of 300/- per bag of cassava sold. Table 2.2 shows that inspite of these losses retailers still realised nett profits of between 550/- TSH and 1000/- TSH per bag of cassava dependent on season.

Table 2.2. Costs and benefits associated with trading of cassava from villages in Rufiji and Kisarawe Districts to the markets in Dar es Salaam using conventional harvesting and handling procedures.

	Using conventional harvesting and handling techniques			
		Season I (Jan - May)	**Season II** (Jun - Aug)	**Season III** (Sept - Dec)
Farmer		TSH/bag	TSH/bag	TSH/bag
	Producer price	3,000	2,500	2,000
	Post-harvest losses	150	250	100
	Revenue gained	3,000	2,500	2,000
Country Buyer	Selling price	6,500	5,800	5,200
	Operational Costs:			
	Buying price	3,000	2,500	2,000
	Uprooting & packing	200	200	200
	Loading	100	100	100
	Carriage to collection point	130	130	130
	Village levy	50	50	50
	Transport to market	1,200	1,200	1,200
	Unloading	100	100	100
	2 empty bags	400	400	400
	Commission fee	170	170	170
	Market levy	100	100	100
	Security charge	30	30	30
	Sub-total	**5,480**	**4,980**	**4,480**
	Post-harvest losses:			
	Breakage's (X)	100	750	100
	Delays 2-3 days (10-15%)	500	0	500
	Sub-total	**600**	**750**	**600**
	TOTAL COST	**6,080**	**5,730**	**5,080**
	NETT BENEFIT	**420**	**70**	**120**
Retailer	Selling price	8,000	7,000	6,300
	Operational Costs:			
	Buying price	6,500	5,800	5,200
	Market levy	100	100	100
	Sub-total	**6,600**	**5,900**	**5,300**
	Post-harvest losses:			
	Breakage's (XX)	100	250	100
	Delays 2 days (12.5%)	300	300	300
	Sub-total	**400**	**550**	**400**
	TOTAL COST	**7,000**	**6,450**	**5,700**
	NETT BENEFIT	**1,000**	**550**	**600**

Source: TFNC/MDB Survey December 1997

Note: **(X)** = Breakage's during season I & III is 6.25%, and 10% in season II.
(XX) = Breakage's during season I & III is 6.25%, and 10% in season II.

Economics of fresh cassava marketing with low cost fresh cassava root storage technology

Farmer

The first step of new technology involves using careful harvesting techniques. If these are used correctly losses due to breakages and cuts will be minimised and the farmer will obtain a greater marketable yield per field of cassava. The increase in income for the farmer will amount to between 5 and 10% dependent on season (Table 2.3). This improvement in income should involve very little extra effort by the farmer as harvesting is normally the responsibility of the country buyer. It is also possible that some of the improvements in income seen further down the market chain might filter back to the farmer. However, it is more likely that country buyers will argue against this on the grounds of increased costs involved in applying the technology.

Country buyer

The low cost fresh cassava storage technology has the technical potential to dramatically reduce post-harvest losses associated with transport problems and delays which normally face country buyers. However, application of the technology requires some initial investment (purchase of plastic sheets) and also increases the operational costs of the country buyer (Table 2.3). Fortunately the increases in operational costs are outweighed by improvements in nett income when the technology is applied (Table 2.3). The level of improvement is dependent on season of harvest. In the January to May season application of the technology improves profits from 6.9% to 8.7% (expressed as a percentage of the total cost), in June to August profits can be increased from 1.2% to 5.8% and from 2.4% to 4.4% in the September to December season.

Retailer

Retailers in the urban markets face problems associated with losses due to breakages during transportation and delays in selling the cassava in the market leading to price discounting and sometimes complete loss of the consignment. The new storage technology has considerable potential to reduce the problem of breakages and reduce the impact of selling delays by keeping the cassava fresh for a longer period of time. Application of the technology in the market should be very simple as it will only involve keeping the sacks of roots moist and storing them in a shady place wrapped in a plastic sheet. However, to be successful the retailer must be able to obtain fresh treated cassava from the country buyer thus placing the onus on the country buyer to ensure that the cassava is handled correctly from point of harvest onwards. If fresh cassava storage technology is being used effectively throughout the market chain retailers in the markets can improve profit margins for a relatively small increase in operational costs (Tables 2.3 and 2.4). As with previous examples the level of increase is dependent on harvest season. In the January to May season application of the technology improves profits from 14.3% to 16% (expressed as a percentage of the total cost), in June to August profits can be increased from 8.5% to 13% and from 10.5% to 12.5% in the September to December season.

Table 2.3. Predicted costs and benefits associated with trading of cassava from villages in Rufiji and Kisarawe Districts to the markets in Dar es Salaam using low cost fresh cassava root storage technology.

	Using low cost fresh cassava root storage technology			
		Season I (Jan - May)	**Season II** (Jun - Aug)	**Season III** (Sept - Dec)
Farmer		TSH/bag	TSH/bag	TSH/bag
	Producer price	3,000	2,500	2,000
	Post-harvest losses	0	0	0
	Revenue gained	3,150	2,750	2,100
Country Buyer	Selling price	6,500	5,800	5,200
	Operational Costs:			
	Buying price	3,000	2,500	2,000
	Uprooting & packing	200	200	200
	Loading	100	100	100
	Carriage to collection point	130	130	130
	Village levy	50	50	50
	Transport to market	1,200	1,200	1,200
	Unloading	100	100	100
	2 empty bags	400	400	400
	Commission fee	170	170	170
	Market levy	100	100	100
	Security charge	30	30	30
	Sub-total	**5,480**	**4,980**	**4,480**
	Cost of using technology:			
	Water	50	50	50
	Plastic sheet	300	300	300
	Sorting, cleaning and dipping in water	150	150	150
	Sub-total	**500**	**500**	**500**
	TOTAL COST	**5,980**	**5,480**	**4,980**
	NETT BENEFIT	**520**	**320**	**220**
Retailer	Selling price	8,000	7,000	6,300
	Operational Costs:			
	Buying price	6,500	5,800	5,200
	Market levy	100	100	100
	Plastic sheet	300	300	300
	TOTAL COST	**6,900**	**6,200**	**5,600**
	NETT BENEFIT	**1,100**	**800**	**700**

Source: TFNC/MDB Survey December 1997

COMPARATIVE ECONOMIC ANALYSIS OF LOW COST FRESH CASSAVA ROOT STORAGE TECHNOLOGY

The findings of the present survey are summarised in Table 2.4 for comparative purposes. Table 2.4 clearly shows that although application of the technology involves increased effort by users and higher operational costs, it still has considerable potential to improve the incomes of each of the key players in the market chain. The data provided in Tables 2.2 - 2.4 presents an average case where delays in selling due to transportation and marketing problems amount to 2-3 days. If the delays in selling are greater than this, the potential profit margin with the technology will also increase because of the reduction in level of price discounting. If the delay in selling is prolonged beyond the effective limits of the technology (7-10 days post-harvest) the benefits of using the technology will be lost. It is very important however, to recognise that to be successful this technology must be applied from the point of harvest through to the point of sale to the final consumer. It is therefore vital that all players in the market chain recognise the financial benefits of the technology and co-operate to ensure its use at all points in the marketing system.

Table 2.4. Cost benefit analysis of using low cost fresh cassava root storage technology in the market chain between Rufiji and Kisarawe Districts and Dar es Salaam.

		Using conventional methods			**Using new storage technology**		
		Jan - May TSH/bag	Jun - Aug TSH/bag	Sep - Dec TSH/bag	Jan - May TSH/bag	Jun - Aug TSH/bag	Sep - Dec TSH/bag
Farmer	Revenue	3,000	2,500	2,000	3,000	2,500	2,000
	P-H Losses	150	250	100	0	0	0
	Rev Gained	3,000	2,500	2,000	3,150	2,750	2,100
Country Buyer	Revenue	6,500	5,800	5,200	6,500	5,800	5,200
	Total Cost	6,080	5,730	5,080	5,980	5,480	4,980
	Nett Benefit	**420**	**70**	**120**	**520**	**320**	**220**
	Profit % *	**6.9%**	**1.2%**	**2.4%**	**8.7%**	**5.8%**	**4.4%**
Retailer	Revenue	8,000	7,000	6,300	8,000	7,000	6,300
	Total Cost	7,000	6,450	5,400	6,900	6,200	5,600
	Nett Benefit	**1,000**	**550**	**600**	**1,100**	**800**	**700**
	Profit % *	**14.3%**	**8.5%**	**10.5%**	**16%**	**13%**	**12.5%**

Source: Tables 2.2 and 2.3.

Note: P-H Losses = Post harvest losses due to breakage's. The level of breakages in the June - August season amounts to 10% of each cassava consignment, in the other seasons only 5% of cassava will be lost through breakages.

* = Profit expressed as a percentage of the total cost.

Problems associated with application of low cost fresh cassava root storage technology

During the present study farmers and traders highlighted a number of potential problems which they felt might interfere with successful uptake of low cost fresh cassava root storage technology within the marketing system. These were as follows:

- The new technology is time consuming, and time spent on the storage technology could be used for other income generating activities.

- During the dry season water may not be readily available in many rural locations, and might be at a premium in the markets. This would make the technology difficult to apply and increase operational costs.

- Some potential users felt that the technology would be difficult to use effectively because successful application requires patience and commitment for some of the steps (careful uprooting, sorting, wound dressing and careful handling during transportation).

CONCLUSIONS

The present study confirmed that low cost fresh cassava root storage technology has the economic potential to improve incomes for all key players in the market chain by alleviating or preventing current post-harvest problems associated with the marketing of fresh cassava.

RECOMMENDATIONS

Although, the technology has the technical and economic potential to alleviate current post-harvest problems and improve incomes throughout the marketing system, it was evident that a number of factors need to be considered for successful uptake of the technology. To promote uptake of the storage technology the following are recommended:

- An effective dissemination campaign is required to sensitise people at all points in the marketing system as to the financial and technical benefits of adoption of the technology and the need for co-operation between farmers, country buyers and market personnel.

- Farmers would benefit from training in agri-business management as this would help them to understand the importance of efficient harvesting and handling practices in income generation.

- Farmers, country buyers and market personnel should be encouraged to form co-operative societies or trading associations for cassava as this would encourage co-operation between the different players in the marketing chain and thus ensure that the technology was applied and maintained from harvest through to the consumer.

REFERENCES

Ndunguru, G. T., Modaha, F., Mashamba, F. Digges, P. and Kleih, U. (1994). Urban demand/needs assessment study for non-grain starch staples in Dar es Salaam (July - September 1994). *Natural Resources Institute*, United Kingdom.

APPENDIX 3.

MEDIA COVERAGE IN KISWAHILI AND ENGLISH.

LIST OF ARTICLES

1. Matangazo (women's page) Namna ya kuhifadhi mhogo mbichi. - *Majira* 28/06/97 (Kiswahili). Article describing the technology published in the women's special interest section of Majira newspaper and aimed at urban consumers.

2. TFNC yatoa mufunzu ya hifadhi ya muhogo. - *Majira* 08/07/97 (Kiswahili). General article on low cost fresh cassava root technology published after the TFNC/NRI press briefing.

3. Technolojia rahisi ya kuhifadhi muhogo mbichi ni ukombozi kwa mkulima. - *Majira* 21/07/97 (Kiswahili). Article on training activities in Jaribu and Bungu villages.

4. NRI is working with TFNC. - *Africa Analysis* 08/08/97 (English).

5. Kuhifadhi na kuchachusha muhogo. - *PASUA* 30/09/97 (Kiswahili). Magazine article on low cost fresh cassava storage technology, cassava processing, konzo disease and potential for new products from cassava.

6. A look at the technology that keeps cassava fresh. - Daily News 21/11/97 (English). Article on the technology and project activities aimed at policy makers in Tanzania.

7. Wakulima wa mihogo wapatiwa mufunzo. - *Majira* 01/12/97 (Kiswahili). Article on training activities in Masaki village.

TAASISI YA CHAKULA NA LISHE - TANZANIA

NAMNA YA KUHIFADHI MHOGO MBICHI

Mhogo ni zao la Chakula linalofahamika na watu wengi. Majani yake yanatengeneza mboga safi ya kisamvu, au yanaweza kukaushwa na kutengeneza sansa ambayo hutumiwa na wenyeji wa kanda ya ziwa victoria na sehemu zingine za nchi yetu. Pia mhogo mbichi unaweza kuchemshwa, kuchomwa, kukaangwa na kutengeza makopa kwa ajili ya kusaga unga wa kutengenezea ugali.

Tatizo kubwa linalikabili zao la mhogo ni kuharibika haraka baada ya kuvunwa. Mtu yeyote anayekwenda kutunua au kuuza mhogo mbichi sokoni anajua kwamba mhogo huchukua muda mfupi kuharibika. Wakati mwingine inakuwa vigumu kupata mhogo bora/mzuri katika soko.

Njia ya kiasili ya kuzuia kuharibika kwa mhogo mbichi ni kuchimbia shimo na kuuzika (kufunika kwenye udongo) lakini njia hii ina ugumu wa kuitumia, kwani inatumia muda kwa kuchimba shimo na kufukua wakati unahitajika kupika. Pia kunaweza kuwa na tatizo la wizi kwa vile mhogo utakuwa umeachwa nje, na ni vigumu pia kupata sehemu za kuchimba hasa sehemu za mjini. Ili kutatua tatizo hili Taasisi ya Chakula na Lishe kwa kushirikiana na Taasisi ya Mafiasili (NRI) ya Uingereza kwa kusaidiwa / kufadhiliwa na serikali ya Uingereza Idara Maendeleo ya Kimataifa wamebuni teknolojia ya gharama nafuu ya kuhifadhi mhogo mbichi ambayo kwa sasa imeanza kutumika nchini Technolojia hii ya gharama nafuu ni rahisi kuitumia mahali popote na huweza kuweka mhogo wako mbichi kwa kipindi cha siku saba (wiki moja) tofauti na mihogo iliyohifadhiwa bila ya teknolojia ambayo huduma kwa siku moja hadi mbili tu. Teknolojia hiyo hutumia vifaa vya gharama nafuu na hupatikana kwa urahisi. Vifaa hivi ni kisu, maji, gunia (au kiroba) na turubai au karatasi ya nailoni.

Teknologia hii hufanya kazi kwa kuufanya mhogo kuwa katika hali ya joto na unyevunyevu. Hali hii imeonyesha kuhifadhi vizuri mhogo kwani hutengeneza (kufanya) mazingira (hali) kama mhogo unapokuwa chini ya ardhi (ndani ya udongo). Teknologia hii ni muhimu kwani inaondoa usumbufu wa kwenda kununua mhogo sokoni kila siku na kuondoa tatizo la kuoza / kuharibika nyumbani au sokoni.

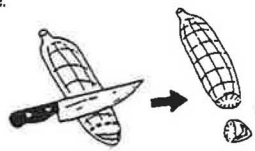
ILI KUTUNZA MHOGO WAKO UBAKIE MBICHI KWA WIKI MOJA UNAHITAJI KUFANYA YAFUATAYO:-

1. Uchambuzi

Tenganisha mihogo iliyoharibika (iliyokatwa, iliyochubuka, kukwaruzika na iliyopasuka) na ile iliyo mizima katika mafungu mawili tofauti. Mihogo iliyoharibika inahitaji kusafishwa vidonda wakati ambapo ile mizima inahitaji kunyunyiziwa maji na kuweka kwenye viroba-kama kielelezo kinayoonyesha.

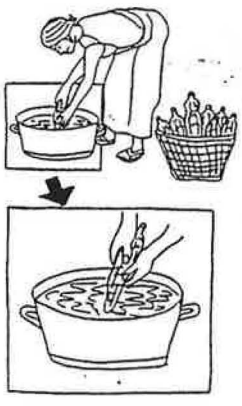
2. Usafishaji wa Vidonda

Kuosha au kusafisha vidonda kwa kisu kikali ili kufanya mkato wa safi bapa na kuondoa sehemu iliyoharibika. Sehemu iliyokatwa iachwe mpaka ikauke ili kutoruhusu maji yapenyeze kwenye muhogo wakati utakapotumbukizwa kwenye maji. Kusafisha ni muhimu kwa vile kunazuia mhogo wenye kidonda usioze.



3. Kutumbukiza kwenye Maji

Mimina maji kwenye ndoo au beseni halafu tumbukiza mihogo iliyokwisha chambuliwa na kusafishwa na uiache kwenye maji kwa dakika moja. Iloe mihogo kwenye maji kuruhusu majimaji yaliyo kwenye muhogo yarudi kwenye ndoo.

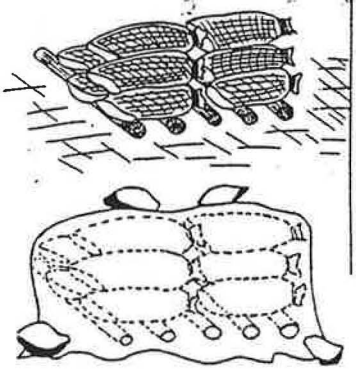


4. Uwekaji kwenye Viroba

Baada ya kutoa mihogo kwenye maji, iweke kwenye viroba hadi kiasi cha kuruhusu kutungwa vizuri. Hakikisha kiroba hakijai kiasi cha kusababisha michubuko wakati wa kufunga. Inaelekezwa kuwa mihogo iliyoharibika na mizima hujazwa kwenye viroba tofauti na kama imeshindikana, weka mihogo iliyoharibika kwenye kiroba juu ili iweze kuondolewa na kutumiwa mapema kabla ya ile mizima.

5. Ufunikaji wa Viroba/ Magunia ya Mihogo

Wakati viroba vya mihogo vimehifadhiwa juu ya mbao ni lazima vifunikwe vyema kwa karatasi ya nailoni. Karatasi ya nailoni huepusha upoteaji wa maji maji kutoka kwenye mihogo na hivyo kudumisha ubora wa mihogo. Ikiwa hakuna karatasi ya nailoni unaweza kutumia magunia au viroba vya zamani kwa kuvishona pamoja.



Kwa maelezo zaidi wasiliana nasi

P. O. Box 977 DAR ES SALAAM, TANZANIA
SIMU : 29621/2/3 Telegraphic Address: "LISHE"
Telex: Na. 41280 Fax: 255-51-44029

TFNC yatoa mafunzo ya hifadhi ya muhogo

TAASISI ya Chakula na Lishe Tanzania (TFNC) imeanza kampeni ya kutoa elimu ya teknolojia rahisi ya kuhifadhi muhogo mbichi vijijini.

Kikundi cha wataalamu wa chakula cha taasisi hiyo kilitoa mafunzo ya siku mbili mapema wiki iliyopita kwa wakulima wa muhogo wa kijiji cha Jaribu Mpakani katika wilaya ya Rufiji, Pwani.

Kikundi hicho chini ya Meneja wa mradi wa kusambaza teknolojia hiyo, Bw. Gabriel Ndunguru, kilifuatana na waandishi wa habari ambao watasaidia kutoa elimu ya teknolojia kwa wakulima wa zao hilo nchini kote.

Akizungumza katika mafunzo ya teknolojia yanayotolewa kupitia mradi huo unaofadhiliwa na Taasisi ya Maliasili ya Uingereza (NRI) inayowakilishwa na Dk. Andrew Graham, Bw. Ndunguru alisema

Na Jabir Idrisa, Rufiji

taasisi hiyo inaeneza teknolojia hiyo ambayo imeshafanyiwa utafiti wa kutosha nchini Ghana.

Bw. Ndunguru alisema kuwa teknolojia niyo imeanza kutumika kwa muda sasa nchini humo ambapo wakulima wameonesha kuridhishwa nayo kwa vile haihitaji gharama kubwa kuitumia.

Alisema teknolojia hiyo inachohitaji zaidi mbali na gharama ndogo za kuhifadhia zao hilo, ni uangalifu tu kuanzia wakati wa uvunaji, mpaka muhogo unapofikishwa sokoni kuuzwa. Alisema hifadhi ya muhogo kwa teknolojia hiyo, inaupa uhai zaidi muhogo ambao kwa kawaida hauwezi kuwa mzima zaidi ya siku mbili.

[illegible] kwa wakulima wa Jaribu Mpakani waliokusanyika kwenye shule ya msingi ya Jaribu, kilomita kadhaa kutoka mjini Mkuranga, muhogo ukihifadhiwa kwa kutumia teknolojia hiyo rahisi, unaweza kukaa bila kuharibika kwa zaidi ya wiki moja.

"Teknolojia hii unaweza kudhani kama ni mzaha lakini wenzetu wa Ghana wameanza kufaidika nayo na wanajivunia matunda kwa kuitumia," alisema.

Naye mtaalamu wa Taasisi ya Maliasili ya Uingereza akitoa changamoto kwa wakulima wakati wa mafunzo hayo, alisema teknolojia hiyo inafaa Tanzania ambayo ni moja ya nchi za joto zinazopoteza kati kiasi cha zao hilo mufuniko kwa Taifa hasa wakati [illegible]

MAJIRA July 8, 1997.

JAMII

Teknolojia rahisi ya kuhifadhi muhogo mbichi ni ukombozi kwa mkulima

MUHOGO ni moja ya mazao makuu ya chakula nchini na katika baadhi ya nchi za Afrika. Pamoja na umuhimu wa zao hilo, bado wakulima wake hawajapata njia bora ya kuuhifadhi kwa muda mrefu. Hivi karibuni Taasisi ya Chakula na Lishe Tanzania(TFNC) ilifanya majaribio ya teknolojia mpya ya hifadhi yamuhogo kwa wanakijiji cha Jaribu-Mpakani wilayani Rufiji Pwani na kuonesha matokeo mazuri. Mwandishi Wetu JABIR IDRISSA, alishuhudia majaribio hayo na anayaelezea katika makala hii.

SHABANI Ngamba (si jina halisi) ameketi barazani kwake akiwaza cha kufanya. Akiwa na familia ya mke na watoto sita, anafikiri ni vipi atajiokoa na balaa la kuikosesha familia yake mahitaji muhimu ya wiki inayofuata.

Wakati huo, wakulima wenzake katika kijiji maarufu kwa ukulima wa muhogo kiitwacho Jaribu-Mpakani katika wilaya ya Rufiji mkoani Pwani, wamo mbioni kwenda kuvuna ili kesho yake wapeleke mazao yao sokoni Dar es Salaam.

Wote waliokuwa wakipita hapo walisikika wakimsabahi kama kawaida ila walikuwa wakitoa matamshi ya kumliwaza bila shaka kwa kumhurumia kutokana na masahibu yaliyomfika.

Ngamba alihanbikiwa na muhogo mbichi gunia zipatazo 20 baada ya kukosa gari la kuusafirisha kwenda Dar es Salaam sokoni.

Kawaida ya muhogo mbichi, hauhimili kukaa kwa zaidi ya siku mbili bila kuharibika na isitoshe huoza kabisa ukifika siku tatu hadi tano ambapo unakuwa haufai tena kuliwa kwa kupikwa labda kwa matumizi mengine.

Kwa kukosa usafiri wa kuupeleka sokoni, Ngamba alikuwa amekumbwa na mkosi wa kupata hasara kubwa inayoashiria hali ngumu kwake katika kuhudumia familia yake.

"Nina tahzo kubwa linanisumbua na kwa kweli nimeshindwa la kufanya," alimweleza jirani yake alipomuuliza nini sababu ya kuwa mnyonge.

Ngamba alisema muhogo aliomkuta aking'oa shambani kwake siku za nyuma ulishindikana kupelekwa sokoni kwa sababu usafiri alioutazamia haukupatikana.

Hilo ni moja ya matukio kadhaa yanayowatokezea wakulima wa zao hilo nchini ambapo licha ya muhogo mwingi kupotea, suala la hifadhi duni ya muhogo limezidi kuchangia kwa kiasi kikubwa kupotea kwa tani kadhaa za zao hilo.

Kwa kuzingatia tatizo hilo linalowakumba wakulima wengi wanaolitegemea kwa maisha zao hilo, Taasisi ya Chakula na Lishe Tanzania (TFNC) imeanzisha elimu ya teknolojia mpya ya kuhifadhi muhogo mbichi.

Teknolojia hiyo rahisi imeonesha mafanikio makubwa nchini Ghana, baada ya kuanza kutumika kwa muda mrefu katika nchi maarufu kwa kilimo cha muhogo zilizoko Amerika ya Kusini.

Baada ya kuvunwa kwa uangalifu mkubwa ili kuepusha kuuharibu muhogo huwekwa katika ndoo ya maji safi ya baridi na kisha kwenye viroba vya plastiki ambamo baada ya kufungwa vizuri, huhifadhiwa sehemu isiyo na joto ili kuzuia unyevu kupenya.

Muhogo mbichi uliohifadhiwa kwa teknolojia hiyo, hubaki kwa siku sita au saba ndipo ufunguliwe na unapofunguliwa, unakuwa na hali yake ya ubichi kama vile ndiyo kwanza umevunwa.

Taasisi ya chakula na lishe nchini inaendesha teknolojia hiyo kwa kushirikiana na wataalamu wa Taasisi ya Maliasili ya Uingereza — *Natural Resources Institute (NRI)* ambayo pia inagharamia mradi wa kusambaza teknolojia hiyo kwa wakulima nchini Ghana.

Uenezaji wa teknolojia hiyo ulianza kufanyiwa majaribio miaka mwili iliyopita katika vijiji vya wilaya ya Kisarawe mkoani Pwani na miezi michache iliyopita kwa wafanyabiashara wa muhogo kwenye masoko ya Tandika wilayani Temeke na Tandale wilayani Kinondoni.

Kwa kuwa teknolojia yoyote kuhusu kilimo inapaswa kuwafikia wakulima wenyewe walko, taasisi hizo zimeanzisha mpango wa kuieneza kwa wakulima vijijini, hasa kwenye viji maarufu kwa kilimo cha muhogo.

Kwa siku mbili kuanzia mapema mwezi huu, wataalamu wa taasisi hizo walikwenda kijiji cha Jaribu-Mpakani kutoa mafunzo ya teknolojia hiyo. Baada ya mafunzo ya nadharia, walifanya majaribio shambani na kusubiri matokeo yake baada ya siku sita.

Katika majaribio hayo, muhogo mbichi uliowanywa katika makundi manne: ulio safi wakati wa kung'olewa na kuwekwa kwenye maji ndipo ukahifadhiwa; uliohanbika na ukasafishwa kiteknolojia; ulio safi bila ya kufanyiwa teknolojia na uliohanbika bila kufanyiwa teknolojia.

Wataalamu wakiongozwa na Meneja Mradi kutoka TFNC, Bw. Gabriel Ndunguru na Dk. Andrew Grafham kutoka NRI walporudi na kufungua vigunia, wakulima walishuhudia muhogo ukiwa bado mbichi.

Kulikuwa na kila aina ya mshangao kwao na kwa vile baadhi yao walieleza bayana kuwa walikuwa wameshindana na wengine wakiwa hawakuamini mabadiliko yaliyotarajiwa, matokeo yake yaliwafurahisha.

Hali hiyo ilikuja baada ya wakulima watatu kueleza waswasi wao wakati wa mafunzo ya nadharia kuwa kwa kawaida muhogo mbichi unapopata maji huoza, hivyo hawadhani kuwa teknolojia hiyo ingesaidia kuurudishia muhogo uhalisia wake.

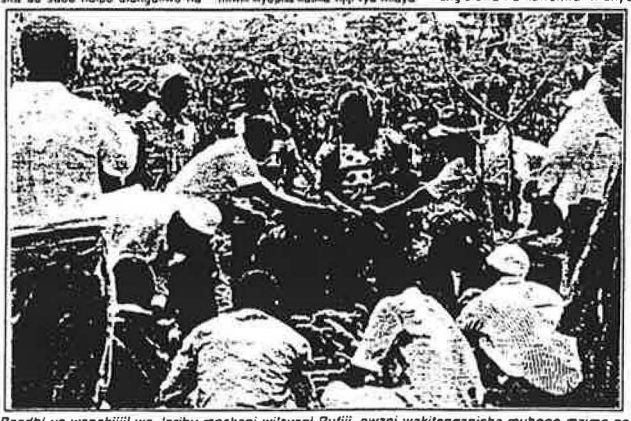
Mafanikio ya mafunzo ya teknolojia rahisi ya hifadhi ya muhogo mbichi yalizidi kuonekana siku ambayo wakulima walianglia filamu ilyotayanshwa nchini Ghana ikionesha jinsi teknolojia hiyo inavyotumika huko na matokeo yake.

"Wageni wetu waheshimiwa tunashukuru sana kwa kuwa nasi kwa muda mkituelimisha teknolojia hii na tunaahidi kuitumia mara moja kwa vile tumeshuhudia kwa macho yetu kuwa inasaidia kuuhifadhi muhogo ambao kwetu ni tegemeo kubwa kimaisha," alisema Bw. Abdu Mketo, Mwenyekiti wa Kijiji cha Jaribu-Mpakani baada ya filamu hiyo.

Bwana Shamba wa kijiji hicho, Bw. Orgenes Sebondo naye alikuwa na haya ya kusema: "Hii ni teknolojia inayowafaa hasa wakulima wetu kwa vile gharama zake ni ndogo na inaweza kutumiwa kirahisi, nagona tumefaidika sana."

Matumaini kama hayo yameelezwa na wafanyabiashara wa muhogo mbichi wa soko la Buguruni ambao walipata mafunzo ahayo kutoka kwa madalali Bw Kazi Ngogota wa Tandika na Bw. Mwadadi Mbukuzi wa Tandale.

Kwa jinsi wakulima na wafanyabiashara wa zao hilo walivyoonekana kupokea teknolojia hiyo, kuna matumaini makubwa kuwa ikiendelezwa kwa kufikishwa kwa walengwa itakiwa ukombozi



Baadhi ya wanakijiji wa Jaribu-mpakani wilayani Rufiji, pwani wakitenganisha muhogo mzima na uliovunjika kabla ya kuuhifadhi kwa kutumia teknolojia rahisi. (Picha kwa hisani ya TFNC).

ANDREW: "WOW".

A paragraph shrivelled up in Africa Analysis. With many thanks, David Sparks

Land and Development

Kao miners muddy Lesotho waters

MBABANE. Digging by 600 artisanal miners working individual claims at the Kao diamond mine are causing extensive pollution to watercourses that feed the Lesotho Highlands Water Project (LHWP), soon to be a key source of supply for South Africa. Worst affected are the rivers Kao and Malibamat'so, which feed the reservoir behind Katse dam.

Scientists employed on the water project warn that the operational longevity of the dam could be reduced; indeed, Lesotho might even prove unable to deliver to SA the minimum contracted quantities of good quality water envisaged in the two countries' bilateral agreement on the water project. That would lead to a fall in royalty income for this poor mountain state.

The scientists also point out that the addition of further silt could cause serious problems for SA's already turbid Vaal river, (into which the highlands scheme feeds).

The lack of discharge ponds at the Kao mine, a pick-and-shovel affair 3,000 metres up in the mountains, means that fine sediment seeps into the neighbouring river system, which is used for drinking, washing and swimming by local villagers as it travels 40km from Kao to Katse.

Water project scientists say the silt has killed the natural ecosystem in the rivers and is now piling up in the Katse dam lake, near the pipes and tunnels through which water bound for SA will be exported. The normal layering of productive and less productive water within the Katse lake could be affected.

The problem could worsen, as mining activity is expanding rapidly; SA miners have moved in, using earth movers to shift even larger quantities of rock and soil. Kao's artisanal diggers insist they are too poor to build appropriate slimes dams.

Commercial hopes for tough Mbeya bean

DAR ES SALAAM. Researchers studying farms around Mbeya in south-west Tanzania have found a small brown bean which resists two of the most important bean diseases worldwide — halo blight and anthracnose. Only one resistant bean had previously been found, in El Salvador, from which a commercial breeding programme has been developed.

Halo blight is a bacterial disease; anthracnose is fungal. Both attack in the cool, damp weather of higher altitudes. They are carried by the seeds, build up from year to year, and can kill seedlings. North American and European growers protect themselves from seed-prone disease by planting seeds raised in dry areas such as the state of Idaho. But in the rest of the world, farmers generally plant seed kept from their previous year's crop (thus passing on infection).

The bean resists nine strains of halo blight and four of anthracnose; it was found in 2% of the farmers' crop mixtures tested by Dr Dawn Teverson, a scientist from Britain's Natural Resources Institute (NRI).

However, among local buyers, brown beans are less popular than yellow and speckled red varieties, although preferences vary from area to area. Plant breeders at Arusha are now trying to transfer the resistance to a much more popular purple bean known as kablanketi ('small blanket').

Farmers plant mixtures of bean varieties, selected for their taste, yield and qualities when stored, but they are under commercial pressure to grow single-variety crops, because these are easier to sell. The NRI is trying to encourage them to continue growing mixed crops, to conserve the full range of varieties.

East African bean varieties have their own names: one brown one is known as mususu ('chicken dung'); a small white bean cultivated in Uganda is commonly known as 'bachelor's friend', because it cooks quickly — a bachelor can get his meal and soon be out on the town.

❑ NRI is working with the Tanzania Food & Nutrition Centre and local co-operatives to promote a new technique for conserving cassava, to help keep it fresh during the journey from village to city market place. The cassava is dipped in water and then put in sacks — a system developed in Ghana and South America.

IN BRIEF

LONDON. Anglo-Australian mining group Rio Tinto Zinc can be sued over health damage by a former British employee at its Rossing uranium mine in Namibia, Westminster's House of Lords has ruled.

The planned action by cancer sufferer Edward Connelly (*Africa Analysis, passim*) may open the way for Namibian miners also to seek compensation through the British courts. Miners' trade unions elsewhere in Africa might seek damages for similar cases.

SA housing builds up steam

PRETORIA. The pace of house construction in South Africa is expected to accelerate over coming months, thanks to an easing of log-jams in the subsidy system. Some 594,000 government subventions have been accorded, and there are reasons to believe that official figures for the number of homes completed understate the real position.

However, the government still seems set to fall well short of the target set by housing minister Sankie Mthembi-Mahanyele — a million new homes in five years. Many of the subsidies will go into 'site and service' schemes rather than actual buildings; the unbuilt sites are then occupied by shacks.

Moreover, the pace of development has slowed in recent months, despite ministry assurances to the contrary. Official figures show that plans for only 20,119 houses were passed in the first five months of this year — some 1,607 fewer than in January-May 1996.

The Central Statistical Service says only 150,000 houses were built between the 1994 general election and 31 March this year. However, the true picture is probably more encouraging than this, as a third of homes are completed without being recorded as such and the real total should probably be 200,000. This means the housing ministry's claim that 240,000 houses are finished or under construction is wholly believable.

Assessing future needs remains difficult because of uncertainty about the size of SA's population. There is increasing evidence that the preliminary results from the 1996 census — which put total population at 37.9m, rather lower than the 42m previously thought — may be too low. Officials have admitted failings in supervision; in some cases data may not have been collected at all and the true population may in fact be close to 40m.

AFYA

KUHIFADHI NA KUCHACHUSHA MUHOGO

Na Joseph Magangila

Muhogo ni zao ambalo linaanza kulimwa hapa nchini miaka mingi iliyopita. Mmea huu asili yake ni bara la Amerika Kusini, hususan nchi ya Columbia, na uliletwa bara la Afrika na wasafiri wa Kireno karne kadhaa zilizopita.

Hivi sasa muhogo unalimwa kwa wingi sana Afrika ya Magharibi. Hapa Tanzania zao hili linalimwa sana katika mikoa inayozunguka maziwa, Mwanza Shinyanga, Mara pamoja na Mkoa wa Ruvuma. Hata hivyo, muhogo unalimwa karibu nchi nzima ingawa ni kwa viwango vidogo vidogo ikilinganishwa na sehemu zilizotajwa.

Kitendawili.....Tega.....Juu muhoga, katikati kuni, chini ugali = Muhogo.

Gabriel Ndunguru, Mkuu wa Kitengo cha Uhifadhi wa Chakula katika Shirika la Chakula na Lishe

Mila na desturi zinekwisha jengeka katika makabila mengi kuhusu uzalishaji, au ulimaji wake, uhifadhi pamoja na utayarishaji wake kama chakula. Matumizi makuu ya muhogo ni kutayarisha au kupika ugali ambacho ndicho chakula kikuu cha makabila mengi hasa yale yanayoishi kusini mwa Tanzania kama vile Wangoni.

Kwa muda mrefu sasa Serikali imekuwa inatia mkazo na kuhimiza ulimaji wa muhogo kwa ajili ya kinga ya njaa kufuatia miaka kadha yenye uhaba wa mvua. Hata hivyo, wataalamu wengi wanaona kwamba wananchi wanajua umuhimu wa zao hili, hasa katika vipindi vya upungufu wa vyakula vingine hasa mahindi ambalo ndiyo zao kuu la chakula

'Lengo kubwa la utafiti unaofanyika kuhusu muhogo ni kuwawezesha watu kuutumia uzuri zaidi'

nchini pote. Kinachohitajika sasa ni kuwaelimisha wananchi njia bora zaidi za uzalishaji, na uhifadhi wa zao hili pamoja na njia bora za utayarishaji wa chakula na bidhaa nyingine kutokana na zao hili.

Shirika la Chakula na Lishe Tanzania, linayo programu mahususi ya utafiti juu ya zao hili la muhogo. Ndugu Gabriel Ndunguru, ambaye ni Mkuu wa Kitengo cha Uhifadhi wa Chakula katika Shirika hilo anachukua katika safari ya kuona hatua mbali mbali zilizofikiwa katika utafiti unaofanya juu ya kuhifadhi muhogo mbichi.

Tumelika katika ofisi zake zilizoko Mikocheni nyuma kidogo ya makazi ya Rais Mstaafu.

Ali Hassan Mwinyi. Ofisi hizi ndizo maabara za Shirika la Lishe. Kweli Ndugu Ndunguru ni mtafiti, ofisi yake ina vielelezo vyote vya kazi zake. Kuna sampuli mbali mbali za unga wa muhogo, picha zinazoning'inia ukutani zinaonyesha

Uvunaji mzuri wa muhogo

aina mbali mbali za mimea ya zao hili. Vitabu vimepangana kwenye kabati na anainieleza kwamba vyote hivyo vinaeleza kuhusu Muhogo. Anakaa kwenye kiti Mezani kwake kuna Kompyuta ndogo, nyenzo muhimu kwa mtafiti yeyote katika nyakati hizi za tenolojia ya kisasa.

"Lengo kubwa la utafiti unaofanyika kuhusu muhogo ni kuwawezesha watu kuutumia vizuri zaidi" anamwambia, na anaendelea kusema kwamba, mila na desturi zilizopo katika utunzaji wa zao hili zinapaswa kuboreshwa zaidi. Kwa hiyo utafiti huu unaangalia matatizo yaliyopo katika matumizi ya muhogo na moja kubwa ni jinsi ya kuhifadhi muhogo mbichi uweze kukaa zaidi ya siku saba bila kuharibika.

Anayoyaamini kuhusu sanaa ya kuendelea kunieleza juu ya utafiti huu, lakini namkatiza kidogo ili kabla yayote anieleze utafiti wake huu unahusu au unafanyika katika maeneo gani yanayohusiwa zao hili. Anamkazia macho kidogo, bila shaka anatatuta pa kuanzia. Kama mtu al vekumbuka jambo alilokuwa ameelezahau masema, "hapa Dar es Salaam, mihogo makuja kutoka Wilaya za Rufiji na Kisarawe ambapo huliliaa soko la Tandika Soko la Tandale hupokea mihogo kutoka Tanga na Morogoro, na soko la Buguruni hupokea mihogo kutoka Kisarawe kupitia Gongo la Mboto." Anaendelea, "kwa upande wa utafiti, tunatoa mafunzo katika vijiji vya Masaki, Gumba na Sungwi wilayani Kisarawe."

Sasa niko tayari kabisa kusikiliza

'.. ni lazima wakulima watumie mbegu nzuri na wayatunze mashamba yao'

kuhusu mafunzo yanayotolewa, lakini Ndugu Ndunguru anaendelea kwamba, ili mweze kuelewa zaidi atakayonieleza anaona ni muhimu anifahamishe kwanza mambo yote yanayohusu kuzalishaji bora wa zao hili.

Anaanza, na mimi namsikiliza bila kumkatisha. "Kwanza muhogo hustawi katika hali ya joto, unyevunyevu na udongo laini na hauhitaji kuongezewa aina yeyote ya mbolea. Katika ukanda wa pwani mihogo hukomaa baada ya mwaka mmoja, ambapo katika sehemu za baridi kidogo kama Songea huchukuwa miaka miwili. "Kuna mihogo mitamu na michungu, na ile michungu huchukua muda mrefu zaidi kuliko mihogo mitamu.

"Zaidi ya hayo," anaendelea Ndugu Ndunguru kwa makini kabisa kama mwalimu anapokuwa darasani, "ni lazima wakulima watumie mbegu nzuri na wayatunze mashamba yao kwa kuyapalilia kwa wakati na kuyalinda dhidi ya wanyama waharibifu, hasa nguruwe," anamaliza kusema na ananiangalia kwa makini, bila shaka anafikiri nilikuwa sisikilizi anayomeleza. Ananiuliza, "tulo pamoja bwana" namjibu "Naam."

Anatabasamu; na kuniuliza kama nnggependa kupata kikombe cha kahawa kabla hatujaendelea. Nakubali, na mara

anatoka nje ya ofisi ili kwenda kutoa maagizo. Anaingia msichana, mfupi kwa

'..muhogo mbichi uliweza kukaa bila kuharibikakwa muda wa kati ya siku saba na kumi tangu ulipotolewa shambani.'

wastani, maji ya kunde, amevaa gauni rangi ya zambarau iliyoiva amebeba vikombe viwili vya kahawa isiyo na maziwa. "Karibuni", anasema kwa sauti ya chini kidogo.

"Sasa naona tuongee juu ya mafunzo" anasema bila kuonyesha dalili za kuchoka. Kwanza kabisa anamieleza kwamba teknolojia inayotumika katika kuhifadhi muhogo mbichi imetokea pia Columbia, na inatumika sana nchini Ghana.

Hapa Tanzania, mafunzo au matumizi ya teknolojia hii inagharamiwa na Mashirika mawili ya Kimataifa, Overseas Development Agency (ODA) na Natural Resources Institute (NRI), Majaribio ya kwanza yalifanyika mwaka 1995 katika soko la Tandale na yalionyesha mafanikio ambapo muhogo mbichi uliweza kukaa bila kuharibika kwa muda wa kati siku saba na kumi tangu ulipotolewa shambani

Baada ya mafanikio hayo mafunzo yalianza kufanyika kwa wakulima, mwaka 1996 katika vijiji vya Masaki, Gumba na Sungwi wilayani Kisarawe. Hivi sasa mafunzo hayo yanafanyika kwa wafanyabiashara wa mihogo katika soko la Buguruni mjini Dar es Salaam.

Muda wote huu, namsikiliza Ndunguru bukukalamu sangu naweka kumbukumbu katika matumizi ya teknolojia hii: ananiambia:-

1. Ng'oa kwa uangalifu huku mihogo ikibaki kwenye mashina yake.

2. Chagua na kutenganisha mihogo ambayo haijaharibika na ile iliyoharibika katika mafungu mawili

3 Safisha vidonda kwenye mihogo iliyoharibika

4. Tumbukiza mihogo mibichi kwenye maji kwa dakika moja

5. Weka kwenye viroba

6 Weka viroba vya mihogo juu ya magogo kwenye kivuli

7. Funika vyema viroba vya mihogo kwa karatasi ya nailoni."

kwamba matumizi makubwa ya muhogo ni kutayarisha unga wa kupikia ugali, ingawa pia muhogo hupikwa au kuchomwa. Haya ni matumizi tuliyoyazoea," anasema. "Hata hivyo."

Naagana na Ndugu Ndunguru huku tukirarajia kuonana tena kesho kule soko la Buguruni.

Hapa Sokoni Buguruni, namkuta Ndugu Ndunguru akiwa na wafanyabiashara wanafunzi wakiichambua mihogo ilihifadhiwa kwa

'Tunalishukuru sana Shirika letu la Lishe kwa kututeletea teknolojia hii..'

siku saba kwa teknolojia mpya na ile ambayo ilihifadhiwa bila utaalamu wowote. Lofauti kati ya makundi haya ni ya wazi kabisa. Mihogo mingine imeharibika na kugeuka rangi ya kijani ambapo mingine bado ni mibichi na yenye utomvu na majimaji kama vile mtu alevyo shambani asubuhihii Kweli, mwenye macho haambiwi ona. Mimi nimesadiki, nimethibitisha kwamba teknolojia hii ni salulu na mafaa

ukweli uliokuwepo, na ananiambia, "jana tulizungumza sana, leo ni heri uongee na hawa tuliowafundisha" Nakubali.

Ninayeongea naye ni Ndugu Saidi Habibu ambaye ni Mwenyekiti wa wafanyabiashara wa soko la Buguruni lenye wafanyabiashara zaidi ya mia tano. Tumekaa kwenye ofisi yake, ambayo ni ndogo kwa nafasi, kuna meza moja na viti viwili, kimoja chake na cha pili nimekalia mimi. Kwa vile meza ni ndogo tumekaa tumeangaliana kwa karibu kama vile

'Waafrika kwa muda wote wamekuwa wakila vyakula viliwyochachushwa'

tunacheza karata.

Mwenyekiti huyo, mzaliwa wa Kisarawe, kijana wa miaka thelathini anasema kwamba katika soko hilo kuna wafanyabiashara wa mihogo ishirini na kati ya hao sita wanepatiwa mafunzo hayo na kati ya hao yeye ni mmoja wao ingawa anafanya biashara ya kuuza kuku wa kienyeji.

"Tunashukuru sana Shirika letu la Lishe kwa kututeletea teknolojia hii, kwani itatufanya tuongeze mapato kwa kuweza kukaa na mihogo yetu kwa muda mrefu zaidi," anasema Habibu huku akinyesha dhahiri kwamba anaongea kwa niaba ya

wanachama wake.

"Hebu nielezee kwa kifupi juu ya teknolojia hii," namuuliza Mwenyekiti ili nione kama amezingatia yote aliyofundishwa. Hasiti hata kidogo, ananipa maelezo kwa ufasaha wa mtu anayesoma kitabu. Kweli amefuzu.

Pamoja na mradi huo unaoendeshwa na Shirika la Chakula na Lishe katika kutafiti njia bora za kuhifadhi mhogo mbichi, kuna utafiti mwingine unaofanyika hapa nchini juu ya njia bora za kuchachusha vyakula.

"Kulingana na mila zao, Waafrika wamekuwa, kwa muda wote, wakila vyakula vilivyochachushwa," anayeyasema hayo ni Dk. G. Njau, wakati akifungua mahojiano yetu naye katika ofisi za Sirika hilo zilizoko Msasani mjini Dar es Salaam.

Kabla ya kuendelea kunieleza kinachofanyika katika utafiti, huo, Dk. Njau ananieleza kwamba mradi huo unagharimiwa na Jumuiya ya Ulaya na unafanyika kwa ushirikiano wa nchi kadhaa za Afrika ambazo ni Ghana, Burkina Faso, Kenya, Nigeria, Zimbabwe na Tanzania.

Dk. G. Njau: Mkurugenzi wa Utafiti TIRDO

Hapa Tanzania, utafiti huu unahusu muhogo.

Kuna njia mbili kuu ambazo zinatumika hapa Tanzania katika kuutayarisha muhogo ili uwe chakula. Ingawa muhogo hupikwa au huchemshwa kabla ya kuliwa, matumizi haya siyo makubwa sana ikilinganishwa na matumizi yake yake kama ugali. Katika makabila tatu au tano ili uvunde na kulainika na kisha hutolewa na kuanikwa. Vile vile muhogo huvundikwa kwa kuufunika na majani baada ya kumenywa na baada ya siku mbili au tatu hutolewa ukiwa umeota ukungu mweusi na huanikwa juani.

"Njia hii ya kuchachusha muhogo kwa kuloweka huondoa sumu zilizomo katika muhogo mbichi na zinazoweza kumdhuru mtumiaji

Hata hivyo utafiti huu unajihusisha na kupata njia zilizo bora za kuloweka muhogo ili kupata unga ulio na ubora wa hali ya juu. "Njia hii ya kuchachusha muhogo kwa kuuloweka huondoa sumu zilizomo katika muhogo mbichi na zinazoweza kumdhuru mtu" anasema Dk. Njau. Anaendelea kusema kwamba ugonjwa ulioitwa KONZO ulitokea mwaka 1988 huko Mtwara, ulitokana na watu kutumia muhogo ambao ulikuwa haujachachushwa vya kutosha ili kutoa sumu. "Kwa hiyo utafiti huu ni muhimu sana" anasisitiza Dk. Njau.

A look at the technology that keeps cassava fresh

CASSAVA is the second most important food crop in Tanzania (after maize) and has an ever increasing importance not only for food security but also as a cash crop which can improve the income of farmers around Dar es Salaam and other major towns and villages.

Much of the popularity of cassava is due to the ease of production of the crop (it will grow on poor land not suited for other crops such as maize and is tolerant of drought) and its versatility as a food (it can be boiled, roasted, fried, or sun-dried and pounded for making cassava ugali).

The only weakness of this important crop is its high tendency to perish. Fresh cassava starts to spoil immediately after harvest and will deteriorate from high to poor quality within two days of uprooting.

In 1993 the Tanzania Food and Nutrition Centre (TFNC) in collaboration with the Natural Resources Institute (NRI) of the United Kingdom made an assessment of the needs of those involved in the marketing of fresh cassava from Coast and Tanga regions to the markets in Dar es Salaam and elsewhere, found that spoilage was the major problem facing anyone involved in marketing of fresh cassava.

Fresh cassava deteriorates rapidly after harvest, which makes it a difficult crop to market from rural areas into the city. If transport fails to arrive or breaks down, or the cassava does not sell quickly in the city market or elsewhere, quality will be lost and its sale price will fall leading to serious economic losses for the farmer, trader market masters and retailers.

The problem of cassava spoilage also affects urban housewives who sometimes have difficulty finding good quality cassava in the market and must visit the market every day because cassava cannot be kept fresh in the home.

Traditional Tanzanian solutions to the problem of fresh cassava spoilage include burying the cassava in pits or sun-drying them to make *"makopa."*

A VILLAGE girl takes a jumbo cassava root home. (File photo)

By Correspondent ANDREW GRAFFHAM

In South America fresh cassava for export is preserved by freezing or by dipping the roots in hot wax mixed with fungicides.

However, these solutions do not meet the needs of Tanzanian farmers and traders. The foreign solutions are too expensive and the traditional solutions are either unsuitable for commercial use (pit storage) or reduce the value of the cassava *(makopa* production).

With this in mind TFNC and NRI with funds from the British government's Department for International Development initiated a project to identify and develop a simple low cost cassava fresh root storage technology for introduction to Tanzania.

After consultations, a simple technology, which had been originally developed by the International Centre for Tropical Agriculture (CIAT) and NRI in Colombia and then successfully modified and transferred to Ghana by the ministry of Food and Agriculture (Government of Ghana) in collaboration with the National Resource Institute, was selected.

According to the TFNC project field manager, Mr Gabriel Ndunguru, the first objective of the project was to evaluate the new technology under field conditions in Tanzania. Field trials carried out between 1994 and 1995 in Tandale and Tandika markets in the city of Dar es Salaam and three villages (Masaki, Sungwi and Gumbai in Kisarawe District proved highly successful.

Not only was the technology shown to be suitable for Tanzania, but the high level of enthusiasm shown by ordinary people involved in the project gave a strong indication of the potential for the new storage technology.

Mr Ndunguru emphasized the simplicity of the low cost fresh cassava root storage technology, which can be used by anybody who wants to keep cassava fresh. "All that is needed for this technology is a sharp knife, water, sacks (of any type) and a plastic sheet. Using these simple materials cassava can be kept fresh for seven to ten days, as compared to one to two days for roots stored without the new technology," he said.

To keep cassava fresh, roots should be harvested carefully and wounds cleaned with a sharp knife. Clean roots should be dipped or sprinkled with water to make them moist and then packed into sacks which are closed with string or rope. Sacks of cassava are then wrapped in a plastic sheet and stored in a shady place.

Mr Ndunguru explained that the technology works by maintaining a warm moist atmosphere around the roots. These conditions are similar to those experienced by the cassava roots when they are buried underground and have been shown to be the best conditions for keeping cassava roots fresh.

Asked about who might benefit from using low cost storage technology, Mr Ndunguru said this technology is suitable for anybody who is involved in the production, handling, marketing or consumption of fresh cassava roots.

In 1996, the TFNC collaborated with the Agricultural Extension Service in Kisarawe District and market masters in Tandika market to disseminate the technology to potential users in several villages in Kisarawe District and Tandika market.

CASSAVA roots normally deteriorate quickly losing both nutritional quality and market value. (File photo).

When TFNC and NRI returned to these areas later in the year they found that elements of the technology had already been adopted by 65 farmers around Masaki village and a number of wholesalers and retailers in Tandika market.

Practical sessions in Tandika and Tandale markets had generated a lot of interest from farmers and traders in Rufiji and Mkuranga Districts who requested that the technology be extended to them.

The fresh cassava root storage technology benefits users because it keeps cassava fresh for longer, thus ensuring that the cassava will sell for a good price in the market. This means that the user is less likely to suffer economic losses due to transport problems or inability to sell the cassava within one day of reaching the market.

Housewives can benefit from using the technology because cassava can be kept in fresh condition in the house for up to one week, thus avoiding the need for daily trips to the market to buy cassava.

Mr Ndunguru said 1997 has been an important year for the project. The TFNC/NRI project team have carried out widespread dissemination of the low cost fresh cassava root storage technology in the three major markets for cassava in Dar es Salaam, (Tandale, Tandika and Buguruni) and villages in Rufiji and Kisarawe districts.

This work is being carried out in close collaboration with the Agricultural Extension Services and representatives of the Tandale Food Product Co-operative Society Limited at the Tandale market, Tandika market and Wauza Mazao Sokoni Buguruni Co-operative Society Limited.

Leaflets and posters (in Kiswahili) describing the technology have been prepared for distribution to interested parties throughout Tanzania. In conclusion Mr Ndunguru stressed that the new technology was proving beneficial to persons involved in the marketing of fresh cassava because it increased the economic return from fresh cassava marketing and the reliability of income.

For more information on this technology and copies of leaflets (at no cost) please write to the Managing Director of the Tanzania Food and Nutrition Centre, P.O. Box 977, Dar es Salaam. Leaflets are normally supplied in Kiswahili but English language versions can also obtained on request.

TANZANIA

Wakulima wa mihogo wapatiwa mafunzo

Na Abdul Njaidi, Kisarawe

WAKULIMA wa vijiji mbalimbali wilayani hapa wamepatiwa mafunzo ya Teknolojia ya gharama nafuu juu ya namna ya kuhifadhi muhogo mbichi.

Mafunzo hayo yaliyoendeshwa na mtaalamu kutoka taasisi ya chakula na lishe nchini na kudhaminiwa na taasisi ya Maliasili ya Uingereza, yalicnukua siku tatu.

Katika siku mbili za kwanza, wakulima hao walifundishwa kwa nadharia ambapo mtaalamu kutoka Taasisi ya Lishe, Bw. Euniace Rwiza aliwaelezea faida ya njia hiyo ya kuhifadhi muhogo, ambapo aliwaeleza kwa njia hiyo muhogo huweza kukaa kwa siku 7 mpaka 10 bila kuharibika.

Mafunzo hayo yana lengo la kuinua vipato vya wananchi ambao zao la muhogo ndilo unalotegemea kuwaingizia fedha.

Mihogo ikihifadhiwa kwa njia hiyo inaweza kukaa kwa siku nyingi bila kuharibika kwa hiyo kufanya mkulima kuuza mihogo hiyo kuuza kwa bei ile ile.

Kwa kawaida mihogo ikivunwa hukaa kwa siku moja hadi tatu na baada ya hapo huharibika.

Mafunzo hayo ambayo yaliwahusisha wataalamu mbali mbali kutoka wilayani Kisarawe na madalali kutoka masoko makuu ya jijini Dar es Salaam ilifanyika katika kijiji cha Masaki, ambapo shamba la Mwenyekiti wa Kijiji hicho, Bw. Said Mwanahombaza lilitumika kwa mafunzo.

Akifunga mafunzo hayo, Diwani wa Kata ya Masaki, Bw. Hamu Kinogile aliwataka watu wote waliohudhuria mafunzo hayo wakatoe utaalamu huo kwa wananchi wote wa wilaya hiyo.

Mafunzo hayo ni sehemu ya mpango wa Taasisi ya Chakula na Lishe wa kutoa utaalamu huo kwa wakulima wa mihogo nchini.

Dk. Omar ahimiza u

Na Said Mtalaam

MAKAMU wa Rais, Dk. Omar Ali Juma amewaagiza wenye viwanda nchini kuweka mfumo bora wa uzalishaji wenye lengo la kudhibiti uharibifu wa mazingira.

Dk. Omar alitoa agizo hilo jana baada ya kutembelea viwanda vinavyomilikiwa na makampuni ya Abood vinavyozalisha sabuni aina ya *Komoa* na mafuta ya *Asante Moproco.*

Aliyapongeza makampuni hayo kwa kutekeleza maagizo ya serikali na Baraza la Mazingira nchini kwa kurekebisha mfumo wa uzalishaji katika viwanda hivyo kwa lengo la kudhibiti uchafuzi wa mazingira.

Dk. Omar aliwataka wenye viwanda na wawekezaji wengine katika sekta hiyo k serikali kwa kuchar mazingira kwa kuten mapato kwa viwa kuboresha mazingira.

Dk. Omar aliw viwanda wajali na waz mazingira ili kue kukumbwa na janga mazingira.

Alisema suala lisionekane kuwa b wafanyabiashara n wengine na alisem mazingira huathiri afy uchumi wa nchi.

Halmashauri

Na Keneddy S
Sumbawa

HALMASHAURI y Sumbawanga imeku 42,366 ikiwa ni

APPENDIX 4.

LIST OF PROJECT OUTPUTS

LIST OF SELECTED PROJECT OUTPUTS

NGSS 93/94 V1: Poulter, N. and Westby, A. Project establishment visit to Tanzania: East Africa Regional Component of the Transfer of Needs Assessment methodologies and Post Harvest Technologies for Non-Grain Starch Staples Food Crops in Sub-Saharan Africa. 18-28 July 1993.

NGSS 93/94 V4: Westby, A., Cropley, J. and Digges, P. Report on a visit to Tanzania for a resource persons planning workshop for the East Africa Regional Component of the Transfer of Needs Assessment methodologies and Post Harvest Technologies for Non-Grain Starch Staples Food Crops in Sub-Saharan Africa. 31 October - 6 November 1993.

NGSS 93/94 V5: Digges, P. and Cropley, J. Validatory needs assessment case study in Lake Zone, Tanzania in collaboration with Cassava Biotechnology Network. 3-27 October 1993.

NGSS 93/94 V6: Digges, P., Ndunguru, G., Hamed, L., Laswai, H., Mbiha, E. and Mwamanga, G. Report on a visit to Tanga Region, Tanzania to validate needs assessment methodologies for non-grain starch staples food crops 24 January - 12 February 1994.

NGSS 93/94 V7: Digges, P., Kleih, U. and Bainbridge, Z. Report on a visit to Tanzania for national and regional needs assessment workshops for the East Africa Regional Component of the Transfer of Needs Assessment methodologies and Post Harvest Technologies for Non-Grain Starch Staples Food Crops in Sub-Saharan Africa. 14-25 March 1994.

NGSS 93/94 V9: Bainbridge, Z. Report on a visit to Tanzania to contribute to components II & III of the Regional Africa Technology Transfer Project on Non-Grain Starch Staples Food Crops. 9-27 march 1994.

NGSS 94/95 V1: Westby, A. Report on a visit to Tanzania to develop the work programme and agree memorandum of understanding for the Transfer of Needs Assessment methodologies and Post Harvest Technologies for Non-Grain Starch Staples Food Crops in Sub-Saharan Africa project. 2-7 may 1994.

NGSS 94/95 V3: Digges, P. Report on a visit to Tanzania to initiate urban demand/needs assessment study for NGSS in Dar es Salaam. 10-22 July 1994.

NGSS 94/95 V4: Kleih, U. Report on a visit to Tanzania to orient and guide urban demand/needs assessment study for NGSS in Dar es Salaam. 28 August - 9 September 1994.

NGSS 94/95 V8: Bancroft, R. D. An assessment of post-harvest losses of fresh cassava in Dar es Salaam and recommendations on how best to extend the storage life of roots. January 1995.

NGSS 94/95 IC1: Thro, A. M. Report on "village perspectives on cassava and implications for biotechnology research" related to report NGSS 93/94 V5.

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Mashamba, F. Economic analysis of potential for low cost cassava storage technology in marketing of cassava from Pwani Region to Dar es Salaam. Marketing Development Bureau Report. December 1997.

APPENDIX 5.

PROJECT PROPOSAL:
THE PROMOTION AND DISSEMINATION OF A STORAGE TECHNOLOGY THAT IMPROVES THE LIVELIHOODS OF PEOPLE DEPENDENT ON THE MARKETING OF FRESH CASSAVA IN TANZANIA.

PROPOSAL

PROJECT TITLE: The promotion and dissemination of a storage technology that improves the livelihoods of people dependent on the marketing of fresh cassava in Tanzania.

PRINCIPAL INVESTIGATOR: Dr. Andrew John Graffham

ADDRESS: Natural Resources Institute
University of Greenwich
Central Avenue, Chatham Maritime,
Kent, ME4 4TB

COLLABORATORS: Tanzania Food and Nutrition Centre (Mr. G. Ndunguru)
Ministry of Agriculture - Tanzania (Mr. B. Rwenyagira)
Tanzania Home Economics Association (Mrs. F. Chale)
Community Development Trust Fund (Mrs. A. Mgaya)

TOTAL COST OF PROJECT: £118,000

DURATION OF PROJECT: 2 years

DATE OF SUBMISSION: March 1998

LOCATION OF PROJECT: Tanzania

BACKGROUND

In this proposal all references to work already undertaken refer to the DFID funded Regional Africa Project on Non Grain Starch Staples (NGSS). This project was implemented by the Natural Resources Institute (NRI) and Tanzania Food and Nutrition Centre (TFNC).

During this project, participatory needs assessment studies identified the marketing of fresh cassava as an important source of income for people in Tanga, Pwani (Coast), Dar es Salaam, Morogoro and Mwanza Regions. In the market system centred around Dar es Salaam, trading in fresh cassava accounted for between 30 and 80% of estimated household income. The studies showed that post-harvest problems significantly reduced income levels for key players at all points in the market chain (Ndunguru *et al.* 1998). To address these problems, a low-cost fresh cassava root storage technology (developed by CIAT and NRI) was selected for testing and adaptation under Tanzanian conditions.

This is a simple technology involving: good harvesting practice; separation of damaged and undamaged roots; removal of damaged tissue from roots; dipping roots in water; packing roots into closed sacks; wrapping sacks of roots in a plastic sheet; and keeping packages of roots in the shade.

Testing demonstrated that the introduced storage technology could maintain the freshness of cassava roots for 7-10 days under field conditions, as opposed to just 1-2 days using traditional techniques. Farmers, buyers and market personnel agreed that the technology was simple, easy to apply and only required limited materials (water and plastic sheets).

An economic evaluation of the potential of the technology demonstrated that it could significantly improve the nett income of the key players in the market chain regardless of the harvesting season (Mashamba 1997 and Ndunguru *et al.* 1998). The potential maximum increases in profits were as follows:

Key Players	**Percentage increase in profits using new storage technology, taking account of seasonal variations.**		
	Jan to May	**Jun to Aug**	**Sep to Dec**
Farmer	5%	10%	5%
Buyer	24%	357%	83%
Retailer	10%	45%	17%

Source: Mashamba (1997)

NB: The figures for June to August could not be achieved in practice due to the difficulty of harvesting cassava during this season.

During the final phase of the project a sensitisation campaign was carried out to promote the new technology, and in particular to deliver the technology to the three major cassava markets in Dar es Salaam and selected villages in two Districts of Pwani Region. The campaign was developed and modified in partnership with representatives of formal and informal organisations and entrepreneurs over a period of 18 months.

The level of interest in the technology increased to the point where the village governments and market co-operatives had assumed ownership of the technology and were collaborating together to promote uptake in the market chains from the target villages to Dar es Salaam. Particularly encouraging was the introduction of new bylaws for fresh cassava trading in Jaribu Ward following discussions between the village governments of Jaribu, Bungu and Mjawa, and representatives of the market co-operatives in Dar es Salaam, TFNC and the Agricultural Extension Services.

The success of the sensitisation campaign in Pwani Region indicated that the new storage technology has the potential to achieve significant impact in all regions of Tanzania where fresh cassava marketing is important for income generation.

A new project is proposed to consolidate the previous sensitisation campaign and promote the uptake of the storage technology, to potential beneficiaries in Tanga, Pwani (Coast), Dar es Salaam, Morogoro, Zanzibar and Mwanza Regions of Tanzania. These are the Regions of Tanzania where fresh cassava marketing is most important for income generation. The new project proposes to use a participatory approach to focus dissemination activities at the community level, and to promote wider awareness of the technology throughout Tanzania. The main dissemination campaign will encourage participation and ownership among the entrepreneurs involved in marketing of fresh cassava. Support at community level will be provided by appropriate NGOs who already work within the target communities and the Agricultural Extension Services of the Ministry of Agriculture. NRI and TFNC will provide technical support and will also play a co-ordinating role to support working partnerships between potential beneficiaries, NGOs and formal institutions involved in the promotion of the storage technology.

PROJECT PURPOSE

The purpose of this project is to improve the livelihoods of those involved in marketing fresh cassava in Tanzania, by promoting the uptake of low-cost fresh cassava root storage technology.

ACTIVITIES

1. *Participatory dissemination of low-cost fresh cassava root storage technology to beneficiaries in Pwani, Tanga, Dar es Salaam, Morogoro, Zanzibar and Mwanza Regions*

1.1. To carry out stakeholder analysis studies in Pwani, Tanga, Dar es Salaam, Morogoro, Zanzibar and Mwanza Regions to assess the importance of fresh cassava for income generation in these areas, identify production areas and urban markets, characterise the market chains and identify key personnel for future dissemination activities (these studies will build on the needs assessment case studies made in Tanga, Dar es Salaam and Lake Zone during the DFID-funded Regional Africa Project on NGSS).

1.2. Partnerships will be established with NGOs working within the target communities. Technical backstopping will be provided by TFNC and NRI. Financial support will be provided using existing micro-credit schemes. NGOs will be encouraged to integrate the storage technology into their work programmes with community groups in the targeted areas.

1.3. At the community level, key players from the market chain (farmers, traders and market personnel) and representatives of village governments will be encouraged to take an active role in the dissemination process by acting as community trainers.

1.4. Partnerships will also be established with the Agricultural Extension Services in the target areas. The MoA personnel are envisaged as having a role in promoting wider awareness of the technology (and implications for fresh cassava marketing)

within the target areas through existing mobile education support units, existing national programmes and promotional literature such as the farmers magazine (Ukulima Wa Kisasa) and extension newsletter.

1.5. To promote wider awareness of the low-cost storage technology, media representatives will be encouraged to publicise project activities through the use of radio, newspapers and television.

1.6. In their co-ordinating role, TFNC and NRI will: provide technical backstopping; agree a series of time-bound milestones with each partner organisation; and assess progress in the dissemination of the technology at regular intervals.

2. *Establishment of support groups for new users of the technology*

2.1. In areas targeted for dissemination activities, use will be made of existing networks of groups (supported by the partner NGOs) to provide training and technical and financial support to users of the technology. The financial component of the support package will involve making loans to individuals or teams within the group to purchase materials required to use the storage technology. Loans will be provided through existing micro-finance schemes established by the partner NGOs to support the activities of the community groups. The loans would involve small sums (typically 3-5 thousand Tanzanian Shillings), but are needed to enable entrepreneurs to purchase the plastic sheets required for application of the technology.

3. *Integration of low-cost fresh cassava root storage technology into existing work programmes of partner NGOs and MoA to promote sustainable dissemination.*

3.1. Training packages will be developed to promote integration of the storage technology into the existing training and dissemination programmes of the partner NGOs.

3.2. To revise a small part of the curriculum of the Ministry of Agriculture Training Institutes (MATI) to include fresh cassava marketing, low-cost storage technology (including technical and economic benefits of the technology) and approaches for dissemination.

3.3. Training packages will be developed to integrate dissemination of the storage technology into the existing T&V (Training and Visits) programme of the Agricultural Extension Service.

OUTPUTS

1. Low-cost storage technology disseminated to identified beneficiaries in Pwani, Tanga, Dar es Salaam, Morogoro, Zanzibar and Mwanza Regions.

2. Support groups for users established within existing systems to provide training, financial and technical support to new users of the technology.

3. Low-cost storage technology integrated into work programmes of partner NGOs, curricula of MATIs and national extension programmes to ensure sustained promotion and support for the technology.

CONTRIBUTION OF OUTPUTS

The outputs of this project will contribute significantly to the uptake of a technology developed initially using DFID RNRRS funds that has demonstrated positive impact on the livelihoods of poor people in Tanzania.

BENEFICIARIES

The principal beneficiaries will be those people whose livelihoods depend on the marketing of fresh cassava roots.

The other beneficiaries will include the Ministry of Agriculture and selected NGOs whose capability for making post-harvest interventions will be strengthened.

RISKS AND ASSUMPTIONS

It is assumed that:

- representatives of all informal and formal groupings and individuals targeted will be willing to co-operate in the proposed activities;

- that fresh cassava continues to play a significant role in income generation in the areas targeted for dissemination activities; and

- that key players in targeted market systems will be willing to collaborate to implement the storage technology at all stages in the system (preliminary findings indicate this to be the case).

REFERENCES

Mashamba, F. (1997). Economic analysis of the potential for low-cost fresh cassava root storage technology in marketing of cassava from Pwani Region to Dar es Salaam. *Marketing Development Bureau Report.*

Ndunguru, G. T., Graffham, A. J., Modaha, F., Rwiza, E., Bancroft, R. D. and Westby, A. (1998). The use of needs assessment methodologies to focus technical interventions in root and tuber crop post-harvest systems: A case study to improve incomes and reduce losses associated with marketing of fresh cassava from rural areas to Dar es Salaam. *Joint TFNC and NRI Report.*

INDICATIVE FINANCIAL SUMMARY

	FY 1998/1999	FY 1999/2000	TOTAL
Staff costs	20	20	40
Travel	6	6	12
Dissemination Materials*	13	17	30
Local Travel & Per Diems	13	17	30
Internal Airfares	2	4	6
TOTAL COSTS	**54**	**64**	**118**

* = includes micro-finance schemes, training activities, leaflets and posters.

NB: All figures are in thousands of Pounds Sterling (£).

OUTLINE PROJECT LOGICAL FRAMEWORK

Narrative Summary	Objectively Verifiable Indicators (OVIs)	Means of Verification (MoV)	External Risks and Assumptions
Goal			
Purpose			**Purpose to Goal**
To improve the livelihoods of those involved in marketing fresh cassava in Tanzania, by promoting the uptake of low-cost fresh cassava root storage technology.			
Outputs			**Output to Purpose**
1. Low-cost storage technology disseminated to identified beneficiaries in Pwani, Tanga, Dar es Salaam, Morogoro, Zanzibar and Mwanza Regions. 2. Support groups for users established and integrated into existing networks and micro-finance schemes established by the partner NGOs. 3. Work programmes of partner NGOs, curricula of MATIs and national extension programmes revised to ensure sustained promotion and support for the technology.			
Activities			**Activities to Outputs**
1.1. To carry out stakeholder analysis studies in key Regions to identify potential beneficiaries in these areas. 1.2. To form partnerships with appropriate NGOs to enable them to integrate the new storage technology into their work programmes with community groups in the target areas. 1.3. To form partnerships with key players at community level, and encourage active participation in dissemination activities and ownership of the technology by beneficiaries. 1.4. To form partnerships with the Agricultural Extension Services to promote wider awareness of the technology in the target areas. 1.5. To promote wider awareness of the technology in Tanzania through the use of radio, newspapers and television. 1.6. To provide technical backstopping, agree time-bound milestones with each partner, and assess progress at regular intervals. 2.1. To establish community groups and provide training, technical and financial support to group members adopting the storage technology. 3.1. To develop training packages to promote integration of the technology into the work programmes of the partner NGOs. 3.2. To revise a small part of the curriculum of the MATIs. 3.3. To develop training packages to promote integration of the storage technology into the T&V programme of the MoA.			

APPENDIX 6.

PROJECT DISSEMINATION MATERIALS

1. Reproduction of "A3" format laminated promotional poster illustrating low cost fresh cassava storage technology (Kiswahili version).

2. Reproduction of "A5" format brochure for potential users of the low cost fresh cassava storage technology (Kiswahili version).

3. Reproduction of "A5" format manual for extension workers on the low cost fresh cassava storage technology (Kiswahili version).

4. Reproduction of "A5" format brochure for potential users of the low cost fresh cassava storage technology (English language version).

5. Reproduction of "A5" format manual for extension workers on the low cost fresh cassava storage technology (English language version).

Natural Resources Institute
The University of Greenwich

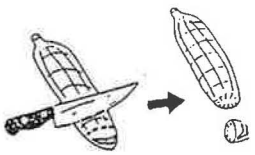
JINSI YA KUHIFADHI MHOGO MBICHI

TAASISI YA CHAKULA NA LISHE TANZANIA

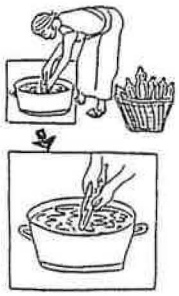
HIFADHI YA GHARAMA NAFUU YA MIHOGO MIBICHI NI NJIA ILIYORAHISI NA HUTUMIA MAJI, MAGUNIA NA KARATASI ZA NAILONI NA HUTUNZA MIHOGO KWA MUDA WA SIKU 7 HADI 10 IKIWA MIBICHI KAMA ILIVYOVUNWA. ZIFUATAZO NI NJIA ZA KUFUATA KATIKA KUHIFADHI MIHOGO MIBICHI.

1. NG'OA MIHOGO KWA UANGALIFU SANA ILI MIZIZI IBAKIE IMESHIKAMANA NA SHINA. TENGANISHA MIHOGO NA SHINA KWA KUKATA KWA UANGALIFU.

2. TENGANISHA MIHOGO MIZIMA NA ILIYO HARIBIKA KATIKA MAFUNGU MAWILI.



3. TUMIA KISU KIKALI KUKATA NA KUONDOA SEHEMU MBOVU WAKATI UNAPOSAFISHA VIDONDA KWENYE MIHOGO. HII NI PAMOJA NA KUFANYA USO BAPA.

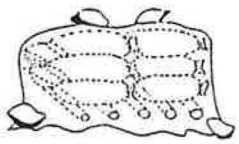


4. MIMINA MAJI KWENYE NDOO AU BESENI KUBWA HALAFU ZAMISHA MIHOGO KWA DAKIKA MOJA NA KUITOA.

Kwa maelezo zaidi wasiliana

Mkurugenzi Mtendaji,
Taasisi ya Chakula na Lishe
Tanzania
S.L.P 977,
DAR-ES-SALAAM

5. WEKA MIHOGO ILIYOLOWANISHWA KWENYE VIROBA.



6. FUNGA VIROBA VIZURI KWA KAMBA. PANGA VIROBA JUU YA MAGOGO KWENYE KIVULI. FUNIKA VIZURI VIROBA VYENYE MIHOGO KWA KARATASI YA NAILONI AU VIPANDE VYA VIROBA VILIVYOSHONWA PAMOJA.

Andiko hili ni matokeo ya mradi wa uhamishaji wa teknolojia kanda ya Afrika uliofadhiliwa na Idara ya Maendeleo ya Kimataifa (DFID). Hata hivyo, idara hiyo haitakubali kuhusika kwa habari au maoni yaliyotolewa.

Andiko hili ni matokeo ya mradi wa uhamishaji wa teknolojia kanda ya Afrika uliofadhiliwa na Idara ya Maendeleo ya Kimataifa ya Uingereza (DFID). Hata hivyo Shirika la Maendeleo la Uingereza halitakubali kuhusika kwa habari au maoni yaliyotolewa.

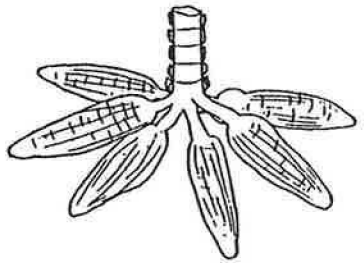
Mradi wa Uhamishji wa teknolojia umetekelezwa na Taasisi ya Chakula na Lishe Tanzania na Taasisi ya Mali Asili ya Uingereza (NRI).

TAASISI YA CHAKULA
NA LISHE TANZANIA

Natural Resources Institute
The University of Greenwich

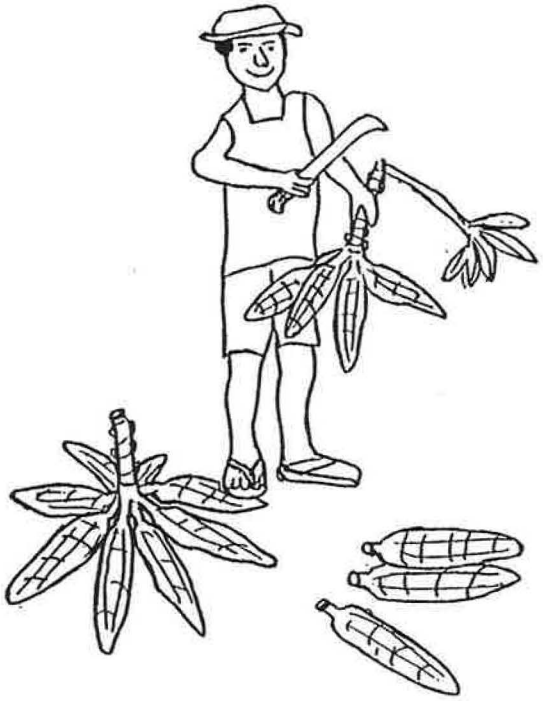
JINSI YA KUHIFADHI MHOGO MBICHI

Teknolojia ya gharama nafuu ya kuhifadhi mihogo mibichi



TANDIKA MARKET

1. NG'OA MIIOGO KWA UANGALIFU SANA ILI MIZIZI IBAKIE IMESHIKAMANA NA SHINA.

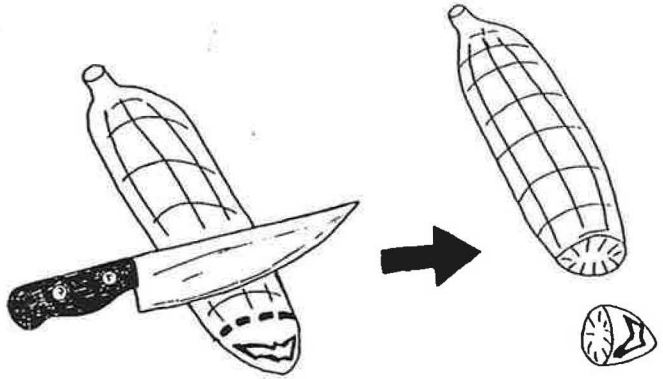


2. TENGANISHA MIIIOGO NA SIIINA KWA KUKATA KWA UANGALIFU.

ILIYOMIZIMA

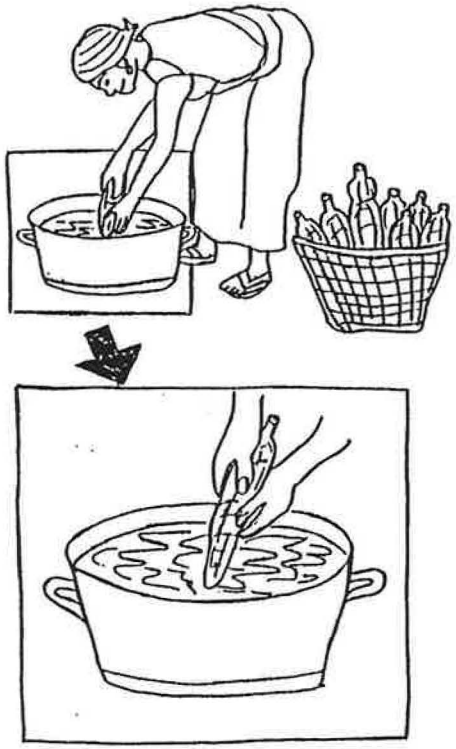
ILIYOHARIBIKA

3. TENGANISHA MHOGO MIZIMA NA ILIYO HARIBIKA KATIKA MAFUNGU MAWILI.



4. TUMIA KISU KIKALI KUKATA NA KUONDOA SEHEMU MBOVU WAKATI UNAPOSAFISHA VIDONDA KWENYE MHOGO. HII NI PAMOJA NA KUFANYA USO BAPA.

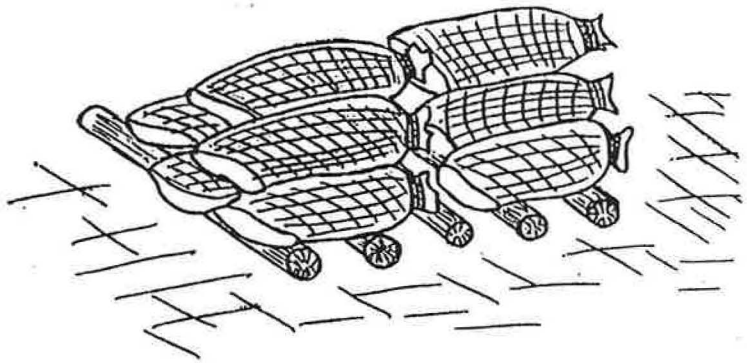
RUHUSU SEHEMU ILIYOKATWA IKAUKE VYEMA KABLA YA KUTUMBUKIZA KWENYE MAJI.



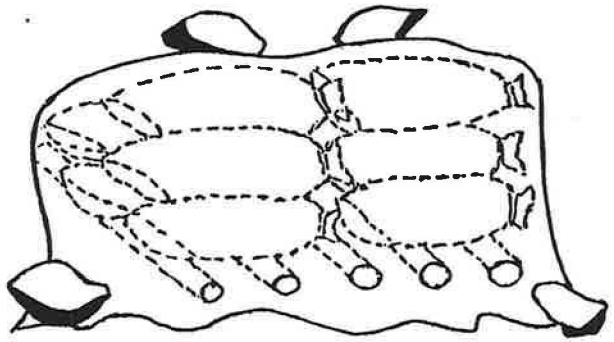
5. MIMINA MAJI KWENYE NDOO AU BESENI KUBWA HALAFU ZAMISHA MIHOGO KWA DAKIKA MOJA NA KUITOA.

6. WEKA MIHOGO ILIYOLOWANISHWA KWENYE VIROBA.

7. FUNGA VIROBA VIZURI KWA KAMBA.



8. PANGA VIROBA JUU YA MAGOGO KWENYE KIVULI.



9. FUNIKA VIZURI VIROBA VYENYE MIHOGO KWA KARATASI YA NAILONI AU VIPANDE VYA VIROBA VILIVYOSHONWA PAMOJA.

Kwa maelezo zaidi wasiliana na:

Mkurugenzi Mtendaji,
Taasisi ya Chakula na Lishe Tanzania
S.L.P 977,
DAR-ES-SALAAM

Andiko hili ni matokeo ya mradi wa uhamishaji wa teknolojia kanda ya Afrika uliofadhiliwa na Idara ya Maendeleo ya Kimataifa (DFID). Hata hivyo, idara hiyo haitakubali kuhusika kwa habari au maoni yaliyotolewa.

Mradi wa Uhamishaji wa teknolojia umetekelezwa na Taasisi ya Chakula na Lishe Tanzania na Taasisi ya Mali ya Asili ya Uingereza (NRI).

TAASISI YA CHAKULA
NA LISHE TANZANIA

Natural Resources Institute

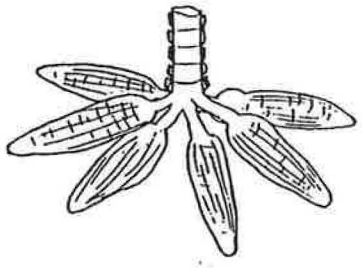
The University of Greenwich

JINSI YA KUHIFADHI MHOGO MBICHI

KWA

KUTUMIA

Teknolojia ya gharama nafuu



Mwongozo kwa
Wafanyakazi wa ugani na Elimu kwa uma

UTANGULIZI

Ni rahisi kupanda muhogo, lakini ukishavunwa huchukua muda mfupi kuharibika (siku 1-2). Kuharibika haraka na kushuka thamani ni tatizo linalowakumba wakulima wa mikoa ya Pwani na Tanga ambao huuza muhogo wao kwa masoko ya Dar es Salaam. Kadri muhogo unavyocheleweshwa kumfikia mlaji baada ya kuvunwa, thamani yake inazidi kupungua na hivyo kupunguza pato kwa wakulima, wafanyabiashara na madalali.

Hifadhi ya gharama nafuu ya muhogo mbichi ikoje?

Hifadhi ya gharama nafuu ya muhogo mbichi ni njia iliyo rahisi na hutumia maji, magunia, na makaratasi ya nailoni na kutunza muhogo wetu kwa muda wa siku 7-10 ukiwa kama ulivyovunwa. Njia hii huzia muhogo kupoteza ubichi (maji maji) na husababisha hali kuwa kama muhogo unavyokuwa kwenye udongo (unyevu na vuguvugu).

Nani anapaswa kutumia njia ya gharama nafuu ya kuhifdhi muhogo mbichi?

Kwa teknolojia kuwa ya manufaa zaidi inapaswa ianze kutumika pindi tu baada ya mihogo kung'olewa na mkulima/mfanyabiashara na kuendelezwa (na msafirishaji, mchuuzi na mfanyabiashara reja reja) hadi mihogo imfikie mlaji. Walaji wanaweza kuhifadhi mihogo yao kwa kila kaya kadiri ya mahitaji.

JE KUNA MATATIZO GANI WAKATI WA KUUZA MUHOGO MBICHI?

Mihogo huvunjika vunjika wakati wa kuvuna na kusafirisha.
Mihogo huoza na kupoteza ubora wake kutokana na kuchelewa kuuzwa sokoni.

NI YEPI MANUFAA YA KUTUMIA TEKNOLOJIA YA GHARAMA NAFUU YA KUHIFADHI MIHOGO MBICHI?

Hupunguza hasara kwa wale wote wanaohusika na biashara ya mihogo hadi mlaji wa mwisho.

MAHITAJI KWA HIFADHI YA MUHOGO MBICHI

1. **Kisu kikali** - Kwa kukata muhogo toka kwenye shina baada ya kuvuna na kusafishia vidonda.

2. **Maji** - Kulowesha/kunyunyizia muhogo kabla ya kupakia kwenye gunia.

3. **Chombo** - Ndoo au bakuli kubwa ya kuhifadhia maji ya kulowesha mihogo kabla ya kuhifadhi.

4. **Gunia** - Kwaajili ya kupakia mihogo kamba kwaajili ya kufungia gunia lililojazwa muhogo.

5. **Karatasi ya nailoni** - Ya kufunikia/zungushia gunia lililojazwa muhogo.

6. **Magogo** - Kwaajili ya kuwekea magunia ya muhogo na kuzuia yasigusane na udongo.

7. **Kivuli** - (Chini ya miti) kuzuia muhogo usikauke kwa kuchomwa na jua.

JINSI YA KUHIFADHI MHOGO MBICHI - kwa kutumia teknolojia ya gharama nafuu.

Vipengele vya teknolojia ya gharama nafuu ya hifadhi ya mihogo mibichi.

1. Ng'oa kwa uangalifu huku mihogo ikibakia na mashina yake.

2. Chagua na tenganisha mihogo ambayo haijaharibika na ile iliyoharibika katika mafungu mawili.

3. Safisha vidonda kwenye mihogo iliyoharibika.

4. Tumbukiza mihogo mibichi kwenye maji kwa dakika moja .

5. Weka kwenye viroba.

6. Weka viroba vya mihogo juu ya magogo kwenye kivuli.

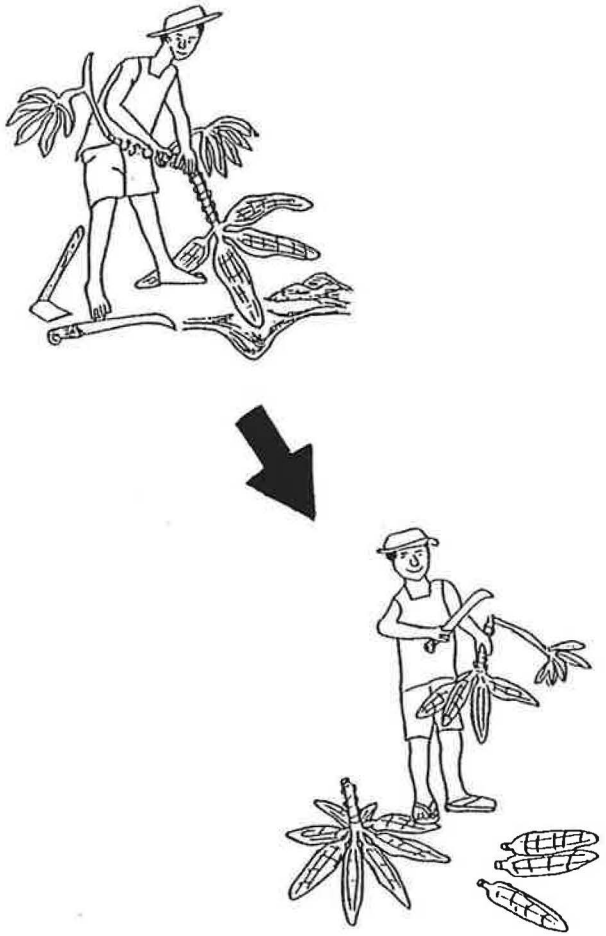
7. Funika vyema viroba vya mihogo kwa karatasi ya nailoni.

1. UVUNAJI/UNG`OAJI

Ili kupata mihogo ambayo haijaharibika, tifua ardhi kando kando ya mmea wa mhogo, halafu n'goa kwa kuvuta shina la mmea wa mhogo kwa uangalifu. Tenganisha mihogo na shina kwa kukata juu kidogo ya mahali ambapo mizizi inaposhikana na shina kwa kutumia kisu kikali.

Ung'oaji/uvunaji kwa uangalifu ni muhimu sana kwani mihogo ambayo haijakwaruzika hudumu kwa kipindi kirefu zaidi inapohifadhiwa kwa teknolojia ya gharama nafuu na hununuliwa kwa bei nzuri sawa na iliyong'olewa siku hiyo hata kama imehifadhiwa kwa zaidi ya wiki moja. Uvunaji kwa uangalifu pia hupunguza upotevu wa vipande ambavyo vingekatwa na kutupwa wakati wa kusafisha makovu.

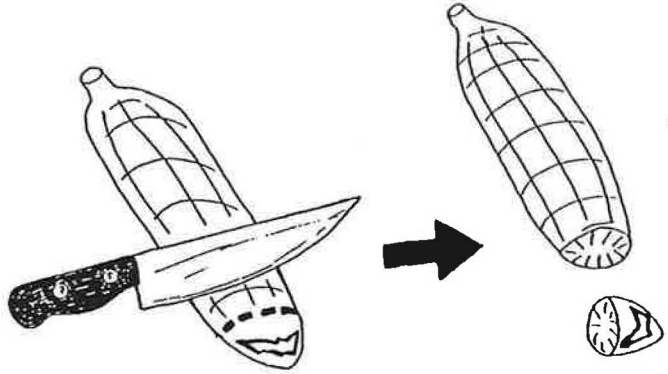
Baada ya zoezi la uvunaji/ung`oaji kukamilika hatua zinazofuatia (yaani kuchambua, kusafisha makovu,
Kunyunyizia maji, kuweka kwenye viroba na kufunika kwa karatasi ya nailoni) hufanywa bila kuchelewa, kwani mihogo hupoteza haraka ubora wake pindi inapovunjwa kwa kupoteza unyevunyevu ulionayo. Upoteaji wa maji katika mhogo unakuwa mbaya zaidi mihogo inapoachwa kenye jua baada ya kuvunwa. Kwa sababu hiyo, mihogo inatakiwa ivunwe mapema asubuhi au jioni sana wakati jua siyo kali sana. Panapowezekana mihogo iliyokwisha vunwa iwekwe kivulini huku ikiwa imefunikwa kwa majani hadi itakapochambuliwa tayari kwa kuhifadhiwa.



ILIYOMIZIMA ILIYOHARIBIKA

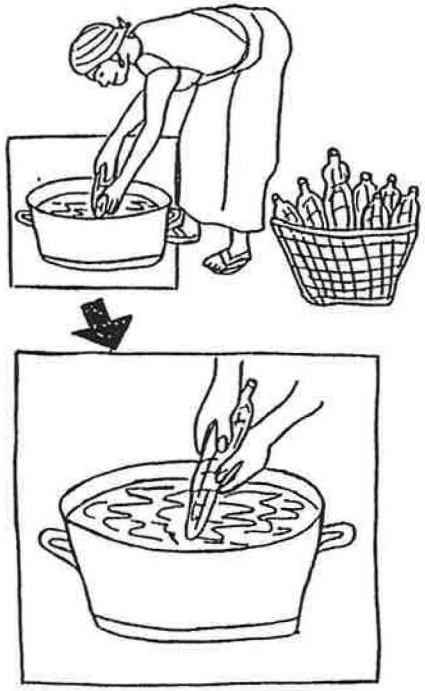
2. UCHAMBUZI

Tenganisha mihogo iliyoharibika (iliyokatwa, iliyochubuka, iliyokwaruzika na iliopasuka) na ile iliyo mizima katika mafungu mawili tofauti. Mihogo iliyoharibika inahitaji kusafishwa vidonda wakati ambapo ile mizima inahitaji kunyunyiziwa maji na kuwekwa kwenye viroba.



3. USAFISHAJI WA VIDONDA

Kuosha au kusafisha vidonga kwa kisu kikali ili kufanya mkato safi bapa na kuondoa vipande vilivyoharibika. Sehemu iliyokatwa iachwe mpaka ikauke ili kutoruhusu maji yasipenyeze kwenye mhogo wakati utakapotumbukizwa kwenye maji.



4. KUTUMBUKIZA KWENYE MAJI

Mimina maji kwenye ndoo au beseni halafu tumbukiza mihogo iliyokwishachambuliwa na kusafishwa na uiache kwenye maji kwa dakika moja. Itoe mihogo kwenye maji na kuruhusu maji maji yaliyo kwenye mihogo yarudi kwenye ndoo.

5. UWEKAJI KWENYE VIROBA

Baada ya kutoa mihogo kutoka kwenye maji, iweke kwenye viroba hadi kiasi cha kuruhusu kufungwa vizuri. Hakikisha kiroba hakijai kiasi cha kusababisha michuboko wakati wa kufunga.

Inaelekezwa kuwa mihogo iliyoharibika na mizima hujazwa kwenye viroba tofauti au kama imeshindikana, weka mihogo iliyoharibika kwenye kiroba juu ili iweze kuondolewa na kutumiwa mapema kabla ya ile mizima.

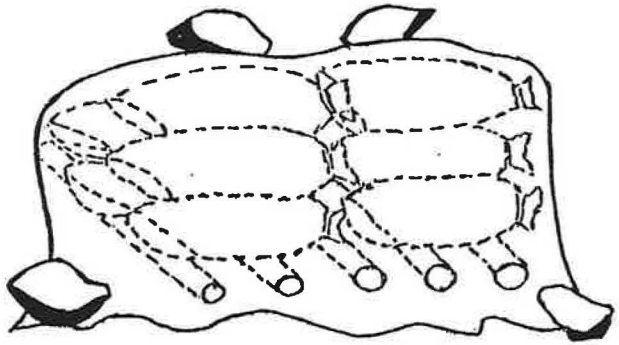
6. JINSI YA KUPANGA VIROBA

Kijijini/sokoni:

Ilikuhakikisha ubora wa mihogo mibichi inadumu, viroba lazima vihifadhiwe kwenye kivuli na visiwekwe/visilazwe kwenye udongo mbichi au wenye unyevunyevu. Kuepusha viroba vya mihogo kutokana na joto la jua na udongo wenye unyevunyevu, laza viroba juu ya magogo kwenye kivuli.

Usafirishaji kwa barabara:

Mhogo unaposafirishwa kwa barabara, viroba vyenye mihogo iliyojeruhiwa vipangwe karibu kabisa na juu ya viroba vingine vya mihogo mizima na upakiaji na upakuaji ufanywe kwa uangalifu kupunguza uwezekano wa kuongeza uharibifu zaidi. Baada ya kupakia viroba, mihogo ifunikwe kwa ukanda wa majani ambayo husaidia kupunguza uharibifu zaidi. Karatasi ya nailoni ifungwe kwa kamba kusaidia kufunika vizuri.



7. UFUNIKAJI WA VIROBA VYA MIHOGO

Wakati viroba vya mihogo vimehifadhiwa juu ya mbao au wakati vikiwa kwenye gari, ni lazima vizungushwe ndani ya karatasi ya nailoni. Karatasi ya nailoni huepusha upoteaji wa maji kutoka kwenye mihogo na hivyo kudumisha ubora wa mihogo.

MANUFAA YA KUTUMIA TEKNOLOGIA YA GHARAMA NAFUU YA KUHIFADHI MUHOGO MBICHI.

Gharama ya kununua na kuuza muhogo viroba 12 bila kutumia teknolojia ya gharama nafuu

shs. 110,940/=

Gharama ya kununua na kuuza muhogo viroba 12 kwa kutumia teknolojia ya gharama nafuu

shs. 125,540/=

Mapato ya kuuza muhogo kwa siku 4 sokoni ni kama ifuatavyo: -

Bila teknolojia	**Kwa kutumia teknolojia**
Siku ya kwanza viroba 4 x 12,000 = shs. 48,000	4x12 = shs. 48,000
Siku ya pili viroba 3 x 10,200 = shs. 30,600	3 x12 = shs. 36,000
Siku ya tatu viroba 3 x 8600 = shs. 25,800	3 x12 = shs. 36,000
Siku ya nne viroba 2 x 6000 = shs. 12,000	2 x12 = shs. 24,000
Jumla 116,400	**144,000**
Faida 5%	**12%**

Je hifadhi ya gharama nafuu inaweza kutumika nyumbani?
Njia hii inafaa kuanza kutumika mara tu baada ya kuvuna na ni muhimu hifadhi hii iendelee mpaka muhogo unapomfikia mlaji.

Je hifadhi ya gharama nafuu inaweza kutoka nyumbani?
Ni njia rahisi, kwani unahitaji maji, plastiki na nailoni ili kutunza muhogo wako kwa muda mrefu.

Kuvuna kwa uangalifu kuna umuhimu gani?
Ukivuna kwa uangalifu utapata muhogo mzuri usio a makovu wala kuvunjika. Hivyo utapata bei nzuri ikilinganishwa na muhogo uliovunjika na kuchubuka.

Je Bila kusafisha makovu hifadhi ya gharama nafuu itakuwa sawa?
Ni muhimu kusafisha makovu kwenye muhogo wetu, kwani kuoza huanzia kwenye sehemu iliyokuwa na kidonda na kuenea kwenye sehemu zingine. Kama vidonda havikusafishwa njia hii haitasaidia kuhifadhi mihogo hiyo.

Je tunahitaji maji kwa ajili ya hifadhi ya gharama nafuu?
Njia hii inahitaji maji na joto joto ili tuweze kupata hali ya uvuguvugu kama inavyokuwa kwenye udongo. Bila maji hifadhi hii haiwezekani kwani muhogo utapoteza maji (ubichi) na kukauka kwa kupoteza ubichi.

Tunapaswa kutumbukiza kila mzizi kwenye maji au kunyunyizia maji juu ya viroba vya mihogo?
Ili njia hii ya hifadhi ya gharama nafuu ifanye kazi yake kwa ufanisi zaidi. Uso wote wa mzizi lazima ugusane na maji. Hii inaweza kufanywa kwa kutumbukiza mizizi kwenye maji au kwa kunyunyizia maji kidogo juu ya viroba vilivyojazwa mihogo. Unyunyizaji maji juu ya viroba vilivyokwisha jazwa mihogo na halafu kuizungushia ndani ya karatasi ya nailoni ni mzuri kutumia sokoni.

Je kutumbukiza kwenye maji kunaweza kusababisha mihogo kuoza?
Ikiwa mihogo itatumbukizwa kwenye maji na kutolewa na maji ya ziada kuruhusiwa kuchuruzika kiasi cha kufanya ngozi ya juu kubaki na unyevunyevu hakuna uwezekano wa kuoza ili mradi vidonda vimesafishwa na mihogo mizima na iliyojeruhiwa imetenganishwa.

Je, tunapaswa kuhifadhi mihogo kwenye viroba vilivyofungwa au vilivyo wazi?
Hifadhi ya gharama nafuu ya mihogo mibichi hufanya mazingira (vuguvugu na unyevu) kando kando ya mizizi yafanane sana na yale wakati mihogo ingali bado chini kwenye udongo. Kwa hiyo yatupasa kuhifadhi mihogo kwenye viroba vilivyofungwa ili kudumisha hali ya uvuguvugu na unyevu katika mazingira ya mihogo. Viroba vilivyo wazi huruhusu joto na hali ya unyevunyevu kutoweka, hali inayofanya teknolojia kutofanya kazi.

Je tunapaswa kutenganisha mihogo mizima na ile iliyo na majeraha wakati wa kuhifadhi?
Ndiyo, tunapaswa kutenganisha mihogo mizima na iliyo na majeraha kwani uozaji huanzia kwenye mihogo iliyo na majeraha na kuenea hadi kwenye mihogo iliyokuwa mizima. Iwapo italazimika kuhifadhi mihogo mizima na ile iliyo na majeraha pamoja, basi mihogo mizima iwekwe kwanza kwenye kiroba ikifuatiwa na iliyo na majeraha ili wakati wa kutoa kutoka kwenye kiroba itolewe na kuuzwa kwanza na muuzaji wa reja reja.

Kwa nini tufunike viroba vya mihogo katika karatasi ya nailoni au turubai?
Karatasi ya nailoni au turubai huzuia upotevu wa joto na unyevunyevu na hivyo kufanya mihogo ibakie kuwa katika hali nzuri hata baada ya kipindi kirefu baada ya kuvunwa.

Je, tunaweza kutumia majani kufunikia viroba badala ya karatasi ya nailoni?
Majani hayawezi kutumika badala ya karatasi ya nailoni kwani hayawezi kuzuia upotevu wa joto na hali ya unyevunyevu. Kuzuia upotevu wa hali ya unyevunyevu, yatupasa tutumie karatasi ya nailoni au vipande vya viroba vilivyoshonwa pamoja.

Je, nyakati za ukame/kiangazi tunaweza kutumia majani makavu kufunika viroba vya mihogo?
Majani makavu hayawezi kutumika kufunika viroba kwani hayawezi kuzuia upotevu wa hali ya unyevunyevu katika mazingira ya mihogo iliyo kwenye viroba.

Je, iwapo karatasi za nailoni hazitakuwepo tunaweza kutumia vipande vya viroba vilivyoshonwa pamoja?
Vipande vya viroba vilyivyoshonwa pamoja vinaweza kutumika sawa na karatasi ya nailoni ili mradi havina matobo mengi.

Je, ni wapi karatasi za nailoni zinapatikana na kwa bei gani?
Karatasi ya nailoni zinapatikana katika kiwanda cha Tegry Plastics kilichopo barabara ya Nyerere au maduka ya reja reja jijini Dar-es-Salaam. Karatasi hizo huuzwra shilingi za kitanzania elfu moja mia nne hadi elfu moja mia sita (1400 - 1600 /-). Kwa mita za mraba mmoja na nusu (1.5m²) na hutosheleza kufunika viroba viwili vya mihogo mibichi.

Kama utakuwa na swali lolote au utahitaji taarifa/habari zozote inayohusu hifadhi ya gharama nafuu ya mihogo mibichi, wasiliana na:

Mkurugenzi Mtendaji,
Taasisi ya Chakula na Lishe Tanzania
S.L.P 977,
DAR-ES-SALAAM

This publication is an output from the Regional Africa Technology Transfer Project funded by the Department for International Development of the United Kingdom. However the Department for International Development can accept no responsibility for any information provided or views expressed.

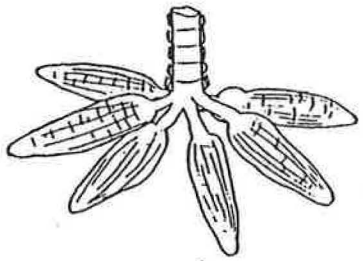
The Regional Africa Technology Transfer Project was implemented by the Tanzania Food and Nutrition Centre and the Natural Resources Institute (NRI) of the United Kingdom.

TAASISI YA CHAKULA
NA LISHE TANZANIA

Natural Resources Institute
The University of Greenwich

HOW TO STORE FRESH CASSAVA

Low Cost Fresh Cassava Root Storage Technology

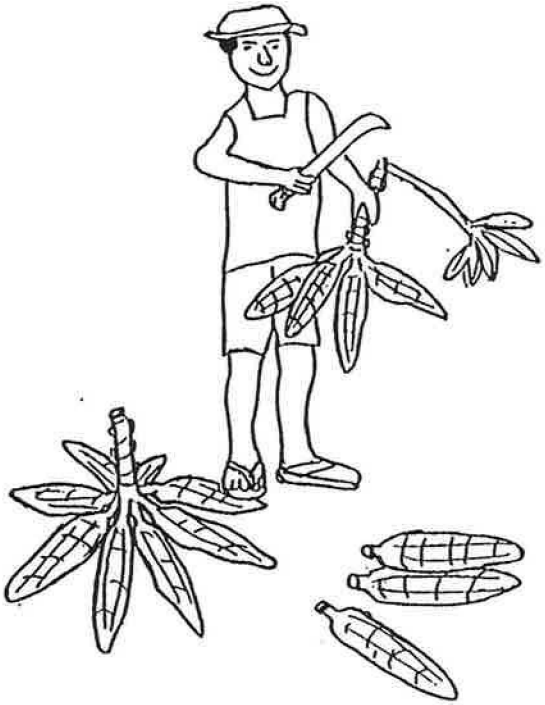


WAMBU CO-OPERATIVE SOCIETY LTD

TANDIKA MARKET

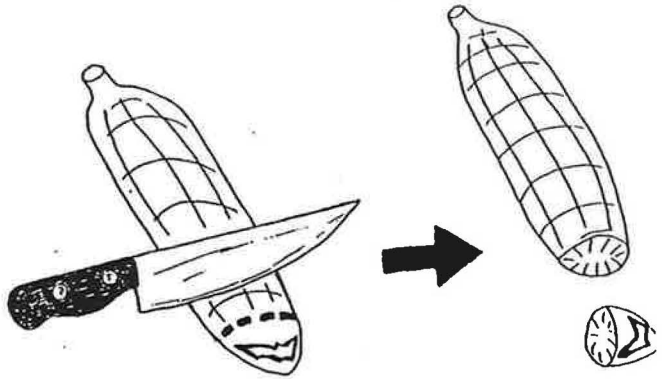
TANDIKA FOOD PRODUCT CO-OP SOCIETY LTD
P.O. BOX 9583 DSM

1. HARVEST CASSAVA CAREFULLY WITH ROOTS INTACT ON THE STEM.

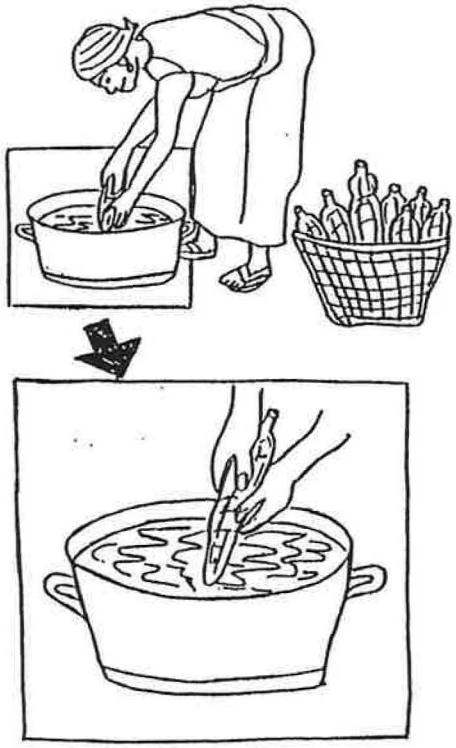


2. CUT THE ROOTS OFF THE STEM CAREFULLY.

3. SEPARATE DAMAGED AND UNDAMAGED ROOTS INTO TWO HEAPS.



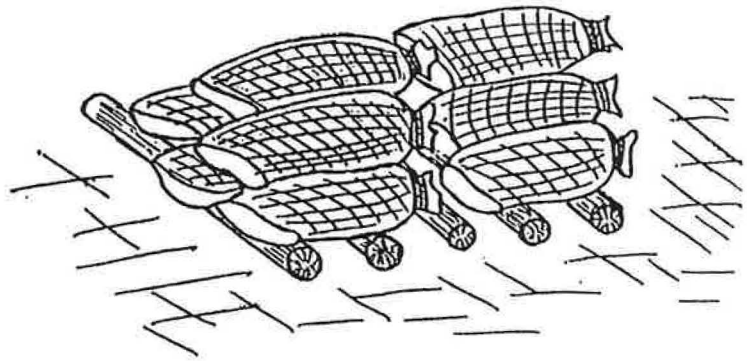
4. USE A SHARP KNIFE TO CUT AWAY DAMAGED PIECES FROM DAMAGED ROOTS BY MAKING CLEAN SMOOTH CUTS. ALLOW CUT SURFACES TO DRY BEFORE DIPPING ROOTS IN WATER.



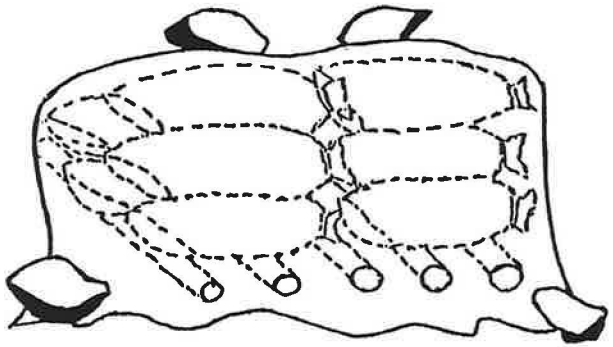
5. POUR WATER INTO A BIG CONTAINER, AND DIP ROOTS IN THE WATER.

6. PUT DIPPED (WET) ROOTS INTO SACKS.

7. TIE SACKS WITH STRING.



8. PLACE SACKS ON A PLATFORM OF LOGS IN THE SHADE.



9. WRAP SACKS WITH PLASTIC SHEETS OR SHEETS MADE FROM OLD KIROBAS SEWN TOGETHER.

For further information please contact either:

The Managing Director,
Tanzania Food and Nutrition Centre (TFNC)
PO Box 977,
Dar-es-Salaam
TANZANIA

or

Dr Andrew Westby,
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Central Avenue, Chatham,
Kent ME4 4TB
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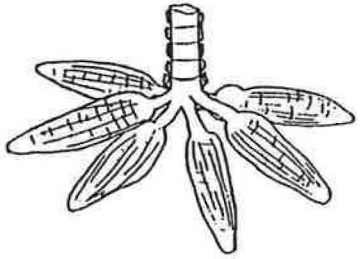
TAASISI YA CHAKULA
NA LISHE TANZANIA

Natural Resources Institute
The University of Greenwich

HOW TO STORE FRESH CASSAVA

USING

Low Cost Fresh Cassava Root Storage Technology



A manual for
Agricultural Extension Officers and Community Trainers

INTRODUCTION

Cassava is very easy to grow, but spoils quickly after harvesting (within 1-2 days), Rapid loss of quality and hence sale price is a major problem for farmers in Pwani and Tanga Regions who supply cassava to the markets in Dar es Salaam. Any delay in getting the cassava from the field to the consumer in the city will reduce its quality and sale price, and thus reduce the income of the farmers, traders, commission agents and retailers who supply the cassava to the consumer.

What is low cost fresh cassava root storage technology?

The low cost fresh cassava root storage technology is a very simple method for keeping cassava roots fresh for 7-10 days using water, sacks and a plastic sheet. This method keeps the cassava fresh by preventing water loss from the roots, and creating conditions in the storage sacks which are like those found when the cassava is buried underground (warm and moist conditions).

Who should use low cost fresh cassava root storage technology?

This technique is suitable for use by farmers, farmer/traders, commission agents, retailers and consumers of fresh cassava.

For the technology to work properly the storage technique needs to be applied immediately after harvest by the farmer/trader and maintained (by the transporter, commission agent and retailer) until the root reaches the consumer. Consumers can keep their cassava fresh by using the technique at the household level.

What problems are associated with marketing of fresh cassava?

Breakage of cassava roots during harvest and transportation.

Deterioration of fresh cassava roots due to delays in marketing.

What are the benefits of low cost fresh cassava root storage technology?

This technology reduces losses incurred by all those involved in the marketing of fresh cassava roots including final consumers who benefit from a higher quality more durable product.

MATERIALS REQUIRED FOR STORING FRESH CASSAVA

1. **Sharp knife** - To use for removing cassava roots from the plant stem after harvesting and wound dressing.

2. **Water** - To moisten roots before packing into sacks.

3. **Container** - A bucket or large bowl to hold water for dipping roots before packing.

4. **Sacks** - Jute or rice sacks for packing cassava roots, and string for closing the sacks after filling.

5. **Plastic sheet** - Used to wrap sacks after they have been filled with cassava roots.

6. **Wooden pallets** - Pieces of wood on which sacks of cassava are stored to prevent them coming into contact with the ground.

7. **Shade** - To protect roots from direct sunlight which causes roots to dry out.

HOW TO STORE FRESH CASSAVA-using the low cost fresh cassava root storage technology.

Summary of low cost fresh cassava root storage technology:

1. Harvest roots carefully with roots intact on stem.

2. Sort undamaged (good) and damaged roots into two piles.

3. Clean and dress wounds on damaged roots

4. Dip roots in water.

5. Pack dipped roots into sacks.

6. Place sacks on a platform of logs in the shade.

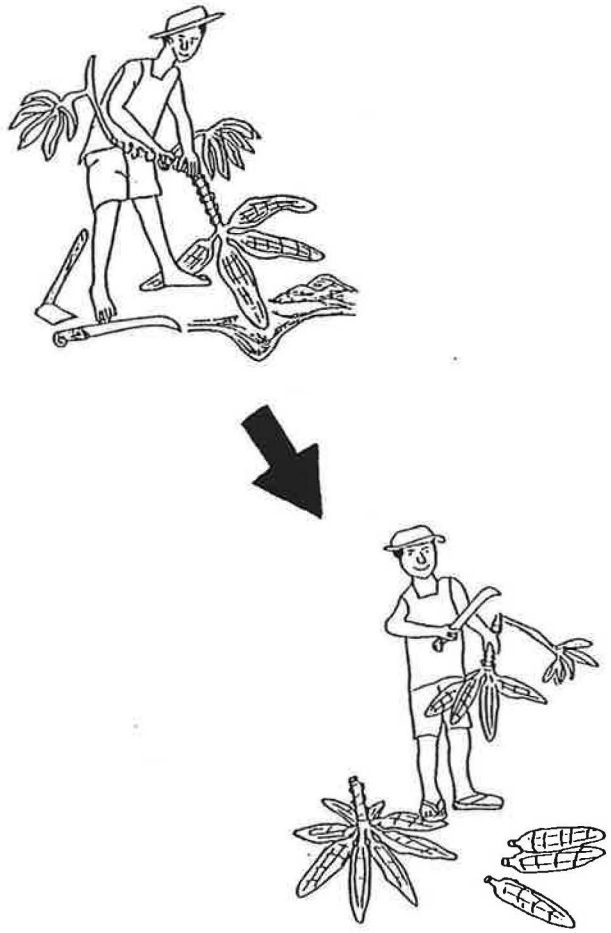
7. Wrap sacks in plastic sheet.

1. HARVESTING

To maintain high root quality loosen the soil around the base of the plant remove from the ground taking care to avoid damaging the roots (by bruising, cutting or breaking roots). Cut the roots off the stem carefully by making a clean cut with a sharp knife just above the point where the root attaches to the plant.

Careful harvesting is very important because undamaged roots can be kept fresh for longer using the low cost storage technology, and will give farmers a better return on their investment. Good harvesting technique also reduces losses resulting from the need to cut out damaged pieces of root (wound dressing).

After harvesting the remaining steps of the technology (sorting, dressing, dipping packing and wrapping) should be done without delay because cassava roots lose their freshness rapidly after removal from the ground as a result of water loss. Water loss is made worse if roots are left in the hot sun after harvest. For this reason harvesting should be done in the early morning or late afternoon when the sun is not so hot, if possible cassava should be stacked i in the shade or covered with grass and leaves until it can be sorted.

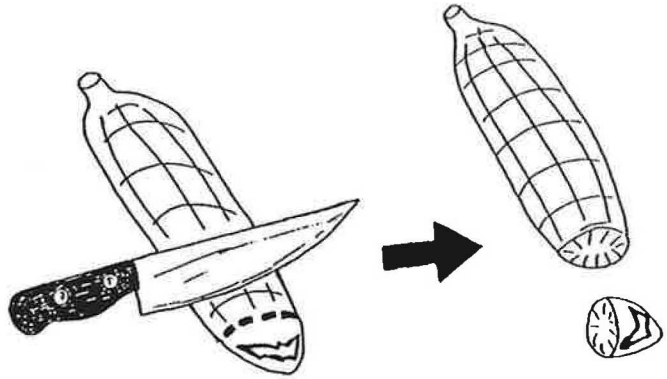


UNDAMAGED DAMAGED

2. SORTING

Separate the damaged (those with cuts, tears, bruises, abrasions and splits) and good (undamaged) roots into two piles. Damaged roots will require wound dressing, good roots can be dipped in water and packed immediately.

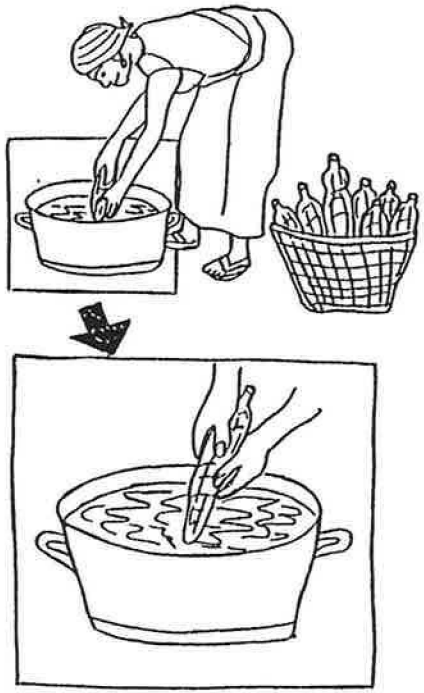
This is an important step because damaged roots need to be separated from good roots as they will not keep as long as the good roots.



3. WOUND DRESSING

To dress or clean wounds use a knife to make a sharp flat clean cut to remove damaged pieces of root, allow the cut surfaces to dry before carrying out the dipping step. When the cut surfaces dry they seal, and will not allow water to get inside the root during dipping.

Wound dressing is important because rots tend to start in damaged parts of the root and then spread to the rest of the root. Cutting away damaged root pieces helps to prevent rotting of damaged roots.



4. DIPPING

Pour water into a large bucket or bowl and dip the sorted roots into the water for a few seconds, remove roots and allow excess water to drain back into bowl.

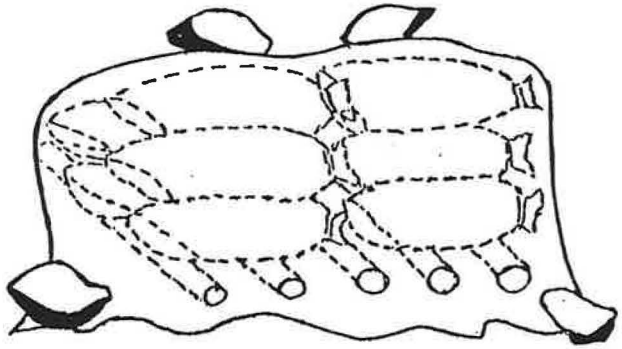
5. PACKING

After dipping, pack the roots into closed sacks, and tie the sacks securely with string. Care should be taken not to overfill the sacks as this would cause damage to the surface of the roots (bruising and abrasion). Undamaged and damaged roots should be packed into separate sacks. If this is not possible damaged roots should be placed in the top of the sack, so that they get removed and used before the undamaged roots.

6. ARRANGEMENT OF SACKS

Village/market: To keep cassava roots in fresh condition sacks of cassava should be stored in a shady place, and not allowed to lay on wet ground. To protect sacks from the heat of the sun and prevent them from laying on the ground and getting wet, place them on a platform of logs in a shady position.

Road transport: When sacks are to be transported by road, sacks of damaged roots should be placed near the top of the load and care should be taken in loading and unloading to reduce the risk of causing further damage to the cassava. After loading the sacks should be covered with a layer of leaves or grass and a plastic sheet which should be firmly secured with ropes. The layer of leaves will help to protect the cassava during transport.



7. WRAPPING SACKS

When sacks have been placed on a storage platform or vehicle they should be wrapped loosely in a plastic sheet. The plastic sheet will prevent water loss from the roots and so keep the cassava fresh.

IMPORTANCE OF DIPPING, PACKING AND WRAPPING

The three most important steps are dipping, packing and wrapping because they help to create the best conditions for root storage. When these steps are properly carried out a warm and moist environment is created around the roots which prevents loss of water from the roots. Roots remain fresh for longer when the low cost storage technology is used because the storage conditions are similar to those found when the roots are buried underground.

QUESTIONS AND ANSWERS

How long will cassava roots remain fresh?
Without the low cost storage technology cassava roots start to go bad within 1-2 days of harvesting. When the low cost storage technology is properly applied undamaged roots will remain fresh for 7-10 days after harvesting. Damaged roots with dressed wounds will remain fresh for 3 days after harvesting.

What are the benefits of the technology for me?

This technology will enable you to keep your cassava in fresh condition for more than 7 days. In this way you will be able to sell your cassava at a premium price in the whole period from day 1 to day 7. This kind of storage will also help you to reduce losses which would otherwise occur if the technology was not used.

Is the technology simply a method for shading cassava roots from strong sunlight?
Shade is only one part of the technology. This technology is designed to create conditions around the roots which are similar to those found when the roots are buried underground. To do this warm and moist conditions must be created and maintained around the roots by dipping them in water, packing them into closed sacks and wrapping the sacks in a plastic sheet.

Who should use this technology?
To keep cassava fresh for the longest possible time (7-10 days after harvest) the technology should be applied by everybody who handles the cassava (from the farmer through to the retailer). It is most important for farmers, farmer traders and country buyers to apply the technology because they store the cassava for the longest time after harvest. If these people use the technology correctly the cassava should reach the market in fresh condition and sell quickly.

ADVANTAGE OF LOW COST CASSAVA FRESH ROOT STORAGE TECHNOLOGY

The cost of buying and selling 12 bags (viroba) without using the low cost technology

shs 110,940/-

The cost of buying and selling 12 bags (viroba) using the low cost technology

shs 125,540/-

The income from selling 12 bags of cassava in the market over 4 days is as follows:

Without the technology	**With technology**
First day 4 bags 4 x 12,000 = shs. 48,000	4x12 = shs. 48,000
Second day 3 bags 3 x 10,200 = shs. 30,600	3x12 = shs. 36,000
Third day 3 bags 3 x 8600 = shs. 25,800	3 x12 = shs. 36,000
Fourth day 2 bags 2 x 6000 = shs. 12,000	2x12 = shs. 24,000
Total 116,400	**144,000**
Profit 5%	**12%**

Can this technology be used for keeping cassava fresh at home?
This technology is easy to use, requires only water and a plastic sheet (or a layer of grass or leaves) and will help to keep cassava fresh for longer in any home.

Is careful harvesting important?
Careful harvesting will improve the income of the cassava farmer and trader because it will reduce the numbers of damaged and broken roots which sell for a lower price.

Will the technology work if we don't dress wounds on damaged roots?
Wound dressing for damaged roots is necessary because rots tend to start in damaged parts of the root and then spread to the rest of the root. If wounds on damaged roots are not treated the technology will not work for those damaged roots.

Do you need water for the technology to work?
This technology needs water and warmth to create conditions around the roots which are similar to those found when the roots are buried underground. If water is not used the technology will not work and the roots will dry out and lose their freshness.

When should the technology be used?
The technology should be applied as soon as possible after harvest and then maintained until the cassava reaches the consumer.

Do we have to dip each root or could we just sprinkle some water over the sacks?
For the technology to work the skin of each root must be moist. This can be done by dipping the roots in water or sprinkling a little water over packed sacks. Sprinkling water over filled sacks and then wrapping in a plastic sheet is the best method for use in the markets where there is no time to dip roots and repack sacks.

Will dipping in water cause the roots to rot?
If roots are dipped in water and the water allowed to drain so that only the skin of the root is moist there is no risk of the roots rotting as long as wound dressing has been done and undamaged and damaged roots kept separate.

Do we have to use closed sacks for packaging, or could we use the technology on open kirobas?
This technology creates conditions (warm & moist) around the roots which are like those found when the root is still buried in the soil. This can only be done in a closed sack which traps heat and moisture close to the roots. Open kirobas allow the heat and moisture to escape, and the technology is unable to work.

Do we have to keep damaged and undamaged roots separate?
Damaged and undamaged roots must be kept separate because rots tend to start in damaged roots and then spread to undamaged roots. If damaged and undamaged roots have to be packed into the same sack, pack the undamaged roots first and then place the damaged roots at the top of the sack so that they can be removed and sold first by the retailer.

Why should we wrap sacks of cassava in a plastic sheet?
The plastic sheet will prevent water loss from the roots and keep the roots warm, and so keep the cassava fresh.

Can we use grass and leaves instead of plastic sheets for wrapping sacks of cassava?
Freshly cut leaves and grass cannot be used instead of a plastic sheet because they will not prevent water loss from the roots. To prevent water loss use either a plastic sheet or a sheet made from old kirobas sewn together.

In the dry season can we use dry grass for wrapping sacks?
Dry grass cannot be used for wrapping sacks as it will not prevent water loss from the roots.

If a plastic sheet is not available, can we use a sheet made from old kirobas sewn together?
A sheet made by sewing pieces of old kirobas together should work just as well as a plastic sheet as long as it doesn't have too many holes in it.

Where can I get plastic sheets, and how much will they cost?

Plastic sheets are available from Tegry Plastics Industries situated along Nyerere Road (DSM) or retail shops in Dar es Salaam. The plastic sheets cost between 1400 and 1600/- Tanzanian Shillings per 1.5m^2 which is enough to cover two bags of fresh cassava roots.

NOTES

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If you have any questions or require more information on storage of fresh cassava please contact:

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