NARO
NATIONAL AGRICULTURAL RESEARCH ORGANISATION

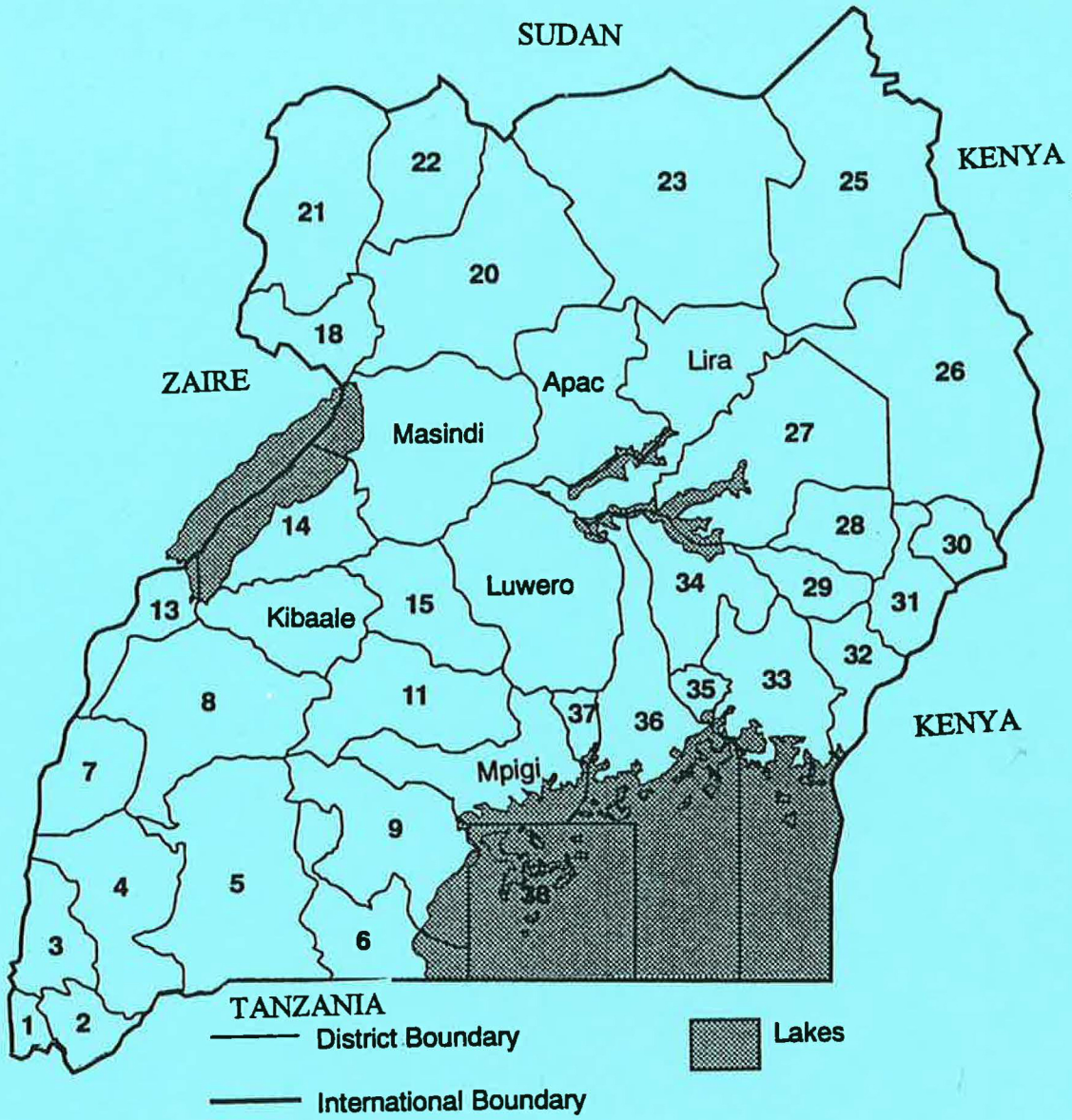
NRI
Natural Resources Institute
The University of Greenwich

PROGRESS IN CASSAVA TECHNOLOGY TRANSFER IN UGANDA

Masindi, Uganda
9-12 January 1996

National Agricultural Research Organization, Uganda
Gatsby Charitable Foundation, UK
Natural Resources Institute, University of Greenwich, UK

Sketch map of Uganda showing the six Gatsby and 32 other districts.



1	Kisoro	11	Mubende	21	Arua	31	Mbale
2	Kabale		Kibaale	22	Moyo	32	Tororo
3	Rukungiri	13	Bundibugyo	23	Kitgum	33	Iganga
4	Bushenyi	14	Hoima		Lira	34	Kamuli
5	Mbarara	15	Kiboga	25	Kotido	35	Jinja
6	Rakai		Luwero	26	Moroto	36	Mukono
7	Kasese		Masindi	27	Soroti	37	Kampala
8	Kabarole	18	Nebbi	28	Kumi	38	Kalangala
9	Masaka		Apac	29	Pallisa		
	Mpigi	20	Gulu	30	Kapchorwa		

Cassava in Kamuli district of Uganda severely affected by African cassava mosaic disease and abandoned.

Virus-resistant cassava in an area of Luwero district that was formerly severely affected by African cassava mosaic disease.

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This publication contains the full text of papers presented at a Workshop held in Masindi, Uganda, 9-12 January 1996, and sponsored by the Gatsby Charitable Foundation.

During the Workshop the need became evident for additional statistics on the multiplication, distribution and uptake of improved varieties of cassava in the six districts where activities are supported by The Gatsby Charitable Foundation and also elsewhere. The results of a subsequent survey in selected sub-counties of each of the six Gatsby districts are also presented here, together with estimates of the amount of improved material that has been distributed and the area now grown. These latest figures (Appendix 1) represent the best available estimates and in some instances differ substantially from those compiled and presented in the earlier district reports.

PROGRESS IN CASSAVA TECHNOLOGY TRANSFER IN UGANDA

Proceedings of the National Workshop on Cassava Multiplication

Masindi, Uganda
9-12 January 1996

Edited by:

G W Otim-Nape
A Bua
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National Agricultural Research Organization, Uganda
Gatsby Charitable Foundation, UK
Natural Resources Institute, University of Greenwich, UK

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ACRONYMS AND ABBREVIATIONS

ACMD	African cassava mosaic disease
ADP	Agricultural Development Project
AEP	Agricultural Extension Programme
ARDP	Action Research and Development Programme
c.	*Circa*
CAO	Chief Administration Officer
CARD	Cassava Action Research and Development Project
CIAT	Centro Internacional de Agricultura Tropical
cm.	Centimetre
COSCA	Collaborative study of cassava in Africa
DAO	District Agricultural Officer
DCC	District Cassava Coordinator
DCTF	District Cassava Task Force
DFI	District Farm Institute
DLC	District Local Council
FEO	Field Extension Officer
FER	Farmer Extension Representative
FEW	Field Extension Worker
FSSP	Farming Systems Support Programme
ha.	Hectare
IARC	International Agricultural Research Centre
IDRC	International Development Research Centre, Canada
IITA	International Institute of Tropical Agriculture
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MNR	Ministry of Natural Resources
mt.	Metric tonne
NAARI	Namulonge Agricultural and Animal Production Research Institute
NANEC	National Network of Cassava Workers
NARS	National Agricultural Research System
NARO	National Agricultural Research Organisation, Uganda

NGO	Non-Governmental Organisation
NURP	Northern Uganda Reconstruction Programme
NYH	Not yet harvested
OFT	On-Farm Trial
RC	Resistance Council
RDC	Resident District Commissioner
RELU	Research Extension Liaison Unit
SAARI	Serere Agricultural and Animal Production Research Institute
SMS	Subject Matter Specialist
SOCADIDO	Soroti Catholic Diocese Development Organisation
SS	Serere Selection
TMS	Tropical Manihot Selection
UK	United Kingdom
UNFA	Uganda National Farmers' Association
URCIP	Uganda Root Crops Improvement Programme
URDP	Ugandan Rural Development and Training Programme
UgSh	Ugandan shilling
UYT	Uniform Yield Trial
VTC	Varietal Trial Centre
VT	Vision Terudo
WB	World Bank

OPENING STATEMENT

F.A. Ojacor

Research Extension Liaison Unit,
National Agricultural Research Organization
Secretariat, Entebbe.

Mr. Chairman,
Distinguished Guests,
Ladies and Gentlemen.

I would like to welcome all of you to this workshop, particularly Mr. Lawrence Cockcroft (Gatsby Foundation) and Dr. Mike Thresh (Natural Resources Institute) from the U.K. Their presence will no doubt greatly contribute to the success of the workshop. I would also like to recognize the presence of Mr. Grace Lubwama, a farmer from Luwero, whose experiences gained from a close involvement in the cassava programme will help to guide the workshop when drawing up future strategies.

To those of you who went on the field trip yesterday, let me also welcome you back. You will agree with me that it was a good exposure to the programme activities in part of Masindi district. The interaction we had with the farmers was very revealing in indicating the impact achieved in Buliisa county.

I should like to assure you that NARO attaches much importance to joint training of staff, as it promotes:-

- close interaction among those involved
- mutual understanding of issues of common interest
- sharing of experiences for mutual benefit.

As you are all aware, cassava is an important food crop in much of Africa and contributes greatly to food security in Uganda. This was very apparent in Buliisa yesterday. You will recall that the current outbreak of African cassava mosaic disease (ACMD) was first observed in Luwero in 1988 when the Ministry of Agriculture, Animal Industry and Fisheries initiated sensitization campaigns in the Migyera area. This was followed by effective research on cassava including on-farm trials with promising new varieties. Varieties which were supplied from other parts of Uganda as a stop-gap measure also became seriously affected. The disease soon spread to the east and north where it virtually wiped out the crop, particularly in Pallisa, Soroti and Kumi districts.

The situation was, however, saved by the release of three cassava varieties which are resistant to ACMD: Nase 1, Nase 2 and Migyera. Limited bulking of these varieties had been started through a multiplication programme which had been established earlier. The multiplication programme in areas badly hit by the disease was boosted by the assistance provided by donors including the Gatsby Charitable Foundation. The districts covered include Luwero, Masindi, Mpigi, Lira, Apac and Kibaale.

The Agricultural Development Programme (ADP) and some Non-Governmental Organizations (NGOs) also supported the provision of the varieties Bao and Aladu in Soroti and Kumi districts.

In addition, the Action Research and Development Programme has supported the bulking of Nase 1 and Nase 2 in Soroti, Kumi, Pallisa, Mbale and Kapchorwa districts. Other varieties are now being developed for release.

We would like to assure the Gatsby Charitable Foundation that the assistance given is being put to good use for the benefit of farming communities in the districts involved.

In order for us to ensure that the programme makes an impact:

- we need to promote close interaction and communication between research, extension and farmers,

- we should recognize that farmers have their own innovations which can be used to improve our knowledge for the benefit of farming communities

- we should always respond to the farmers expressed needs.

In conclusion, I would like to thank the Gatsby Foundation for the support given so far and hope that it will continue beyond 1997. I would also like to thank Dr. Mike Thresh who has been a keen supporter of the cassava programme, and to express our appreciation for your continued support.

I wish each one of you successful deliberations.

With these remarks, it is now my great pleasure to declare the workshop open.

Thank you for listening.

STATEMENT

L. Cockcroft
Gatsby Charitable Foundation, London.

The objectives of the Gatsby Charitable Foundation in supporting the programme in Uganda since 1991 have been:-

(a) to assist government to arrest the spread of African cassava mosaic disease (ACMD)

(b) to increase cassava yields and so meet the needs of farmers and consumers

(c) to assist in the development of a cadre of agricultural scientists capable of generating direct benefits to farmers.

These objectives had, therefore, developmental, nutritional and organisational components.

On the basis of my annual visits to the districts affected by the project since 1990 it is very clear that there has been a major impact. This was further confirmed by the visit of members of this workshop to Buliisa county of Masindi district on January 10th, 1996.

Whilst the strength of this impact is indisputable, as reflected in the papers given by District Agricultural Officers (DAOs) and Cassava Programme Officers, there are, nevertheless, various issues which need to be addressed. These include:-

1. The fact that data on impact outside the target area are very limited and largely unreliable. There is a need for the cassava programme management to develop a standard format for data collection and ensure that it is used systematically. This particularly relates to measures of the areas planted to both new and local varieties.

2. There is still considerable uncertainty as to whether the key characteristic of the new varieties is their resistance to ACMD or to their high yield in relation to local varieties. In other words if and when the threat from ACMD subsides will these varieties retain their relative attraction? If not, should more emphasis be placed on breeding for yield and quality?

3. The programme has developed very specific systems for linking the energies of research scientists, extension officers and farmers. The National Network of Cassava Workers (NANEC) is in fact 'research driven' in an unusual way, which may serve as a model for other programmes. However, it may not be an appropriate or sustainable method of working over the next ten years because it may be more appropriate for the Ministry of Agriculture to take prime responsibility for the diffusion process. A hybrid management system may also be feasible.

4. Successful as the programme has been in relation to cassava, it has addressed the crop in isolation from the farming system as a whole and has had little to say about the interelationship of cassava and other crops. The fact is that the area planted to

cassava has dropped significantly as a consequence of the ravages of ACMD. There is a need to address this in the context of the performance of other crops. What has been the net impact on food supplies of this process?

5. At the farm level, there is apparently a need for more research on the relationship between crops (e.g. the impact of cassava monoculture over say five years, the yield impact on cassava of intercropping and the most effective way to sustain soil fertility and overall productivity). Ultimately, there is a need for an extension "package" which deals with more than planting systems and roguing to lessen the impact of ACMD.

Whilst each of these points probably requires attention there are three priority areas:

(a) Breeding strategies: will the priority be on disease resistance or yield as noted above, or on other mixed criteria? I have not seen any discussion of this in papers, although it may exist.

(b) What is the role and place of bio-technology, tissue culture and micro-propagation in the programme? Can it really 'add value' to the breeding and multiplication process and if so how should it be structured?

(c) What should be the institutional basis for the programme in the future and the relative roles of research and extension, as discussed above?

These comments should not be taken as questioning the success of the programme to date. Some of our discussions have focused on the economic impact of the programme. Mr. Bua's paper quantified this in various ways and at the sub-county level. I would suggest that an additional way of looking at national impact is to ask what level of output from the new varieties would be necessary to recoup the investment cost of the programme to date?

Investment in the programme by Gatsby since 1990 will total 750 million Ug. Shs. (*c.* $750,000) by the end of 1996. One tonne of cassava is worth 100,000 Ug.Shs (ten -100 kg bags at 10,000 Shs. per bag). So to recoup 750 million Shs. p.a. an incremental output of 7500 tonnes is needed neglecting input costs. The new varieties reportedly yield an average of 20 t/ha. and so 375 ha. are needed to yield 7500 tonnes. Even if the value of cassava is halved to account for input costs, an area of only *c.* 700 ha. is required. I think we can be more than confident that the total hectarage now planted to the new varieties is many times this area. In fact, I am sure that I have seen at least 700 ha. myself on recent visits. On this basis one can be confident that the rate of return on the investment greatly exceeds 100%.

I would like to congratulate everyone present whether at national, district, sub-county or parish level on this achievement, but of course the greatest credit should be given to Dr. Otim-Nape as the chief designer and manager of the programme. I should also like on behalf of Gatsby to thank Dr. Mike Thresh of the Natural Resources Institute of the U.K. for his very helpful advice and enthusiasm for the programme over the last 5 years. I know this has been highly valued by Dr. Otim-Nape and his colleagues. Finally, I should also like to pay tribute to the farmers of Uganda for their flexibility and energy in utilizing the new varieties so extensively. NARO has indeed "helped people to help themselves".

THE ROLE OF THE RESEARCH EXTENSION LIAISON UNIT IN TECHNOLOGY TRANSFER

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At an International Conference on Technology Development and Transfer I participated in a year ago, it was observed that one of the most significant and chronic bottlenecks for agricultural research centres mandated to serve farm communities in developing countries has been the lack of effective programmes for delivering technologies to farmers. Clearing the hurdle of transferring research findings to the farmer is a challenge to all societies, but is more so in much of the food-insecure regions of Africa.

Extension programmes in many of these countries are often under-manned and under-funded. At the same time the majority of farmers in developing countries have not developed the "culture" of looking out for new advances in technology emerging from research centres.

Research programmes both national and international, tend to treat technology transfer as a peripheral responsibility to their mandate of technology development. As a result useful technologies fail to reach the end users. This results in two significant shortfalls. Farm communities are denied access to new technologies that can make a difference to their lives. Researchers are also unable to demonstrate and measure the impact of their efforts, which often requires long-term investment of time and financial resources.

Institutionalisation of Research-Extension-Farmer Linkages in NARO

The Ugandan National Agricultural Research Organisation (NARO) has established a special liaison unit (RELU) within its structure in order to strengthen research-extension-farmer linkages. The unit is charged with the task of promoting and co-ordinating such linkages. It operates closely with the Ministries of Agriculture, Animal Industry and Fisheries (MAAIF) and Natural Resources (MNR) at all levels and also with farmers/farmer organisations, agro-industries and other users of technologies generated by NARO. The unit is manned by personnel from MAAIF and MNR.

Specifically the unit is charged with ensuring that:

- farmers, producers and extension workers of the relevant ministries as well as Non-Governmental Organisations gain access to research information and assistance from the research system.

- ensuring participation of extension workers, farmers and producers in identifying production problems and formulating research projects.

- ensuring participation of researchers in regular extension meetings, extension training and technical and pre-season planning workshops.

- coordinating joint activities between research and extension workers such as surveys, on-farm trials, field days, agricultural shows, preparation of extension publications and joint field visits.

- participating in reviews of research results with the research institutes to determine future direction of research.

Linkage Mechanisms

There are various means of ensuring that the above listed roles are fulfilled and several activities are being promoted.

(a) Diagnostic surveys

These are being undertaken by researchers in collaboration with extension workers and farmers. Through these surveys, information gaps and production constraints requiring research support are identified, and feedback is recommended.

(b) On-farm research

Researchers, RELU and SMS of MAAIF are encouraged to jointly plan and carry out adaptive research and on-farm trials. The teams involved analyse field results and formulate recommended practices which are targeted to specific farmer groups.

(c) Training support to extension

This covers:

(i) *Technical workshops.* These are now being planned to be conducted by researchers for SMSs from MAAIF and other relevant ministries. Specific focus is on: identifying technological gaps, formulating production recommendations and training extension workers on specific production recommendations.

(ii) *Pre-season planning workshops.* Researchers and RELU staff participate in these to assist in preparing seasonal plans, developing technological packages and finalising and agreeing on the on-farm trials to be undertaken.

(iii) *Training in specialised areas.* These courses are arranged so as to equip extension staff with the new knowledge and practices required to build up production skills.

(iv) *Monthly training.* Researchers participate in monthly training courses for extension workers as needed. These courses ensure that extension staff are kept up-to-date with recommended practices, provide opportunity to review seasonal plans and provide a venue to receive and discuss feedback.

(d) Joint technical publications

The RELU, the Directorate of Agricultural Extension of the MAAIF and the Research Institutes:

- up-date an inventory of the availability of appropriate technologies

- process scientific findings into usable technologies

- publish and circulate research-based information as brochures and leaflets for use by extension workers and farmers and other interested groups.

- prepare material for mass media

- monitor the reception and application of information to provide feedback for further consideration.

(e) Joint participation in field visits and other activities
The following joint field activities are organized:

- visits to research institutes
- field supervisory visits/study tours
- field/open days
- agricultural shows

(f) Research programme planning review committees
RELU co-ordinates and facilitates the participation of extension staff, farmers representatives of agro-based industries, universities, NGOs and donors in the committee meetings at the institutes. Their participation helpes to ensure:-

- relevance and feasibility of the proposed research
- adoptability of research results
- identification of farmers' innovative practices

Action Research and Development Programme (ARDP)

Following a review of the *Headstart for Agricultural Research and Extension Project* in July 1994, NARO identified viable technologies which awaited further on-farm testing, seed multiplication and eventual transfer to farmers. The technologies identified were formulated into an Action Research and Development Programme (ARDP) which was drawn up in close consultation with the Directorates in the MAAIF.

The ARDP's objectives are to:

- demonstrate benefits of new technologies to extension staff and farmers
- produce basic planting material to meet the requirements of primary seed producers
- train extension staff and farmers in the application of the new technology packages
- train the farmers and private entrepreneurs in the production of planting material
- produce publications for use by extension workers and other clients.

Of the research and development activities identified initially the following twelve sub-programmes were approved:

(i) Transfer of cassava production technologies to farmers
(ii) Promotion of new varieties of groundnut and sesame
(ii) Multiplication and distribution of new bean seed
(iv) Multiplication and distribution of sweet potato planting material

(v) Demonstration and production of basic and certified seed potato stocks
(vi) The control of tsetse flies using the monoscreen trap and "spot on" (10% deltamethrin)
(vii) Fish fry production and distribution
(viii) Packaging of fishing gear technology for formulation of regulatory laws
(ix) On-farm grain storage trials, training and technology dissemination
(x) Agroforestry research and extension
(xi) Introduction and utilisation of forest plantations
(xii) Improving small-holder dairy production

By the end of the first rainy season, the cassava sub-programme had:-

- planted 350 hectares of Nase 1, and Nase 2 in Soroti, Kumi, Pallisa, Mbale and Kapchorwa districts
- released 144,000 adult *Epidinocarsis lopezi*, which is a natural enemy of the cassava mealybug (*Phenacoccus manihoti*)
- trained 254 extension staff and 448 farmers
- established 24 on-farm trials in the five districts

The ARDP programme is co-ordinated by RELU.

THE NEED TO MULTIPLY NEW CASSAVA VARIETIES IN UGANDA

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Summary

Cassava was introduced into Uganda between 1862 and 1875 by Arab traders. It quickly spread in the country as its value was soon appreciated by farmers. The crop is currently one of the most important food crops and the area of cassava has continued to increase since 1981. About 0.36 million hectares were grown in 1992 resulting in an estimated production of *c.* 2.9 million metric tonnes. A severe form of African cassava mosaic virus disease appeared in 1988 and has since eliminated cassava in many districts. An aggressive programme of on-farm trials, multiplication of mosaic-resistant varieties, and training of extension staff and farmers was carried out in order to restore cassava production. A National Network of Cassava Workers (NANEC) and an integrated strategy for cassava multiplication and distribution were developed and used to implement the programme.

Introduction and spread of cassava in Uganda

Cassava was introduced to Uganda through what is now Tanzania by Arab traders between 1862 and 1875 (Langlands, 1972). By 1877 cassava was being used to supplement banana and sweet potato as food crops in Buganda (now the districts of Mukono, Mpigi, Kampala, Luwero, Masaka, Mubende and Mityana) (Langlands, 1972). Following its initial introduction, cassava quickly spread to other areas of Uganda. It reached Bunyoro (now Masindi and Hoima districts) and some parts of western, northern and north-western Uganda in 1891, 1883, and 1910-1919, respectively.

Cassava cultivation increased greatly during the outbreak of the tropical migratory locust *(Locusta migratoria migratorioides* between 1931 and 1933 (Jameson, 1964). Increases also occurred after the droughts of 1939 and 1941 when it became imperative to conserve local foods during the Second World War (Jameson, 1964). The outbreak of African cassava mosaic virus disease (ACMD) and the shortage of food in some parts of Uganda notably Teso (now Kumi and Soroti districts) in 1943-44 encouraged an eradication campaign and introduction by the district councils of a by-law which made it mandatory for each farmer to grow at least 0.4 ha. of a mosaic-resistant variety as a safeguard against famine. Consequently, cassava plantings increased rapidly as the crop became a cheap source of food in quantity (Jameson, 1964). By 1950, 191,200 ha of cassava were grown in Uganda (McMaster, 1962) and by 1990 there were *c.* 450,000 ha. (Anon. 1991).

Economic Importance

Cassava is currently one of the most important food crops in Uganda. It ranks second to banana in terms of area occupied, total production and *per capita* consumption (Otim-Nape, 1990). It was regarded as most important and as a staple crop by over 50% of the farmers surveyed in eastern, central, southern and northern areas of the country (Otim-Nape and Zziwa 1990). Over 71% of the farmers interviewed grew cassava as a subsistence crop. In addition to subsistence, some 19% of the farmers grew the crop for cash, drinks and animal feeds and 9% used it as a cementing agent in local construction, etc (Otim-Nape and Zziwa, 1990). It is now a main food source and is eaten

throughout the year. The *per capita* consumption in 1990 was estimated at 119 kg. (Ocitti p'Obwoya and Otim-Nape, 1986). Fresh tuberous roots are cooked and eaten in over 70% of the villages surveyed in Uganda and dry cassava, is eaten in over 40% of the rural households. It is mixed with cereals (sorghum or finger millet) and ground into flour to make a local bread (a sort of thick porridge called atapa, kwon or kalu) (Otim-Nape and Zziwa, 1990) which is consumed with either green vegetables, legumes or meat sauce. Usually consumption of cassava is highest during the dry season (December-March) when all other food reserves are depleted (Otim-Nape and Zziwa, 1990). Pancakes, distilled spirits (enguli or lira-lira) and other local brews (kwete, malwa, or ajono) are other important products from cassava (Otim-Nape and Zziwa, 1990).

Traditional cash crops (cotton, coffee, and tea) which were formerly the main source of income for the rural farmers of Uganda have declined in status in recent years because of the poor marketing system and unattractive prices (Ocitti p'Obwoya and Otim-Nape 1986). This has led to the emergence of cassava as the main source of income for over 60% of rural farmers who regard it as a 'new' cash crop in their farming systems (Ocitti p'Obwoya and Otim-Nape, 1986). Fresh tubers, dry cassava chips and flour; distilled spirits (enguli or lira lira) and local beer (malwa, kwete, and ajono) and pancakes are important sources of cash for the farmers in over 59%, 16%, 13% and 6% of the villages studied, respectively (Otim-Nape and Zziwa, 1990). In most cases the tuberous roots are sold while the crop still stands in the field and the buyers (usually traders or ordinary consumers from within the village) are responsible for harvesting (Ocitti p'Obwoya and Otim-Nape, 1986). Peak selling of tubers occurs in April-May and September-October (Otim-Nape and Zziwa, 1990).

Production Trends

Since its introduction to Uganda, cassava has been quickly adopted and production expanded rapidly. The high-yielding ability of the crop and its flexibility in the farming and food systems, its ability to do well in marginal and stressed environments and its apparent resistance or tolerance to pests and diseases, particularly locusts (Jameson, 1970) encouraged its rapid spread and adoption. Moreover, its value was appreciated as a famine reserve crop that was available when others were not (Jameson, 1970). By 1992, an estimated total of *c.*2.90 million metric tonnes of cassava were produced from *c.*362,000 hectares of land, mainly in the eastern, northern and northwestern regions (FAO, 1995).

This indicates substantial increases from the estimates of 2.13 million tonnes and 305,000ha. for the years 1979 to1981. The increases were mostly realised in eastern and central regions where the crop was rapidly replacing sorghum, finger millet, and bananas, respectively. The increase in production was mostly due to increases in the area planted. Over 60% of the farmers in the regions surveyed reported increased production (Otim-Nape and Zziwa, 1990).

Cassava is grown throughout Uganda (Table 1). The districts of Mbale, Iganga, Arua, Apac, Kamuli, Lira, Tororo and Kumi were the leading producers in 1989 (Table 1). Cassava production was relatively low in the districts of central and western regions where bananas and plantains are the traditional staple food crops. Production of cassava was expanding rapidly at the time as farmers realised its advantages compared to bananas, whose production was decreasing due to declining soil fertility and the effects of pests and diseases. Cassava is often intercropped with cereals or legumes in small plots by peasant farmers. Intercropping cassava with bananas or coffee is also common.

Table 1: Area and production of cassava by regions and districts of Uganda (1989).

Region:	District	Area (10^3 ha)	Production (10^4 mt)
Eastern:		**137.2**	**129.8**
	Mbale	33.1	30.2
	Iganga	23.3	21.2
	Tororo	20.7	18.9
	Kamuli	21.6	19.6
	Kumi	20.0	18.2
	Soroti	15.6	14.2
	Jinja	2.3	2.1
	Kapchorwa	0.6	5.4
Northern:		**124.9**	**113.8**
	Arua	28.8	26.2
	Apac	23.3	21.2
	Lira	21.4	19.4
	Kitgum	17.0	15.5
	Nebbi	16.2	14.8
	Gulu	13.8	12.6
	Moyo	4.1	3.8
	Moroto	0.2	0.2
	Kotido	0.1	0.1
Western:		**75.6**	**69.0**
	Hoima	16.6	15.1
	Masindi	15.4	14.0
	Kabarole	14.8	13.5
	Mbarara	10.6	9.6
	Busenyi	6.0	5.5
	Rukungiri	3.9	3.6
	Kabale	3.7	3.5
	Kasese	2.7	2.5
	Bundibugyo	1.9	1.7
Central:		**54.0**	**49.0**
	Mukono	17.3	15.7
	Masaka	11.5	10.4
	Rakai	9.5	8.6
	Mpigi	9.3	8.4
	Mubende	3.3	3.0
	Luwero	3.1	2.9
	Total Uganda	**391.7**	**361.6**

Source: Planning unit, Uganda Ministry of Agriculture, Animal Industry and Fisheries, Entebbe.

Constraints on cassava production in Uganda

Constraints that affect cassava production are listed by Ocitti p'Obwoya and Otim-Nape (1986) and Otim-Nape and Zziwa (1990) as:-

(a) the use of inferior and low-yielding varieties;
(b) lack of good quality planting material;
(c) pests and diseases;
(d) land availability and deteriorating soil conditions;
(e) lack of credit facilities and farm inputs;
(f) poor price incentives;
(g) labour bottlenecks and poor cultural practices;
(h) cyanogenic glucosides which hinder crop utilisation;
(i) bulkiness and perishability which hinder commercialization of the crop;
(j) poor methods of utilisation.

Farmers in over 54% of the villages interviewed in the Rockefeller-funded Collaborative Study of Cassava in Africa (COSCA) in many parts of Uganda identified diseases and pests as the main hazards in cassava production (Fig. 1) (Otim-Nape and Zziwa, 1990; Ocitti p'Obwoya and Otim-Nape, 1986). ACMD is the most important of the pests and diseases.

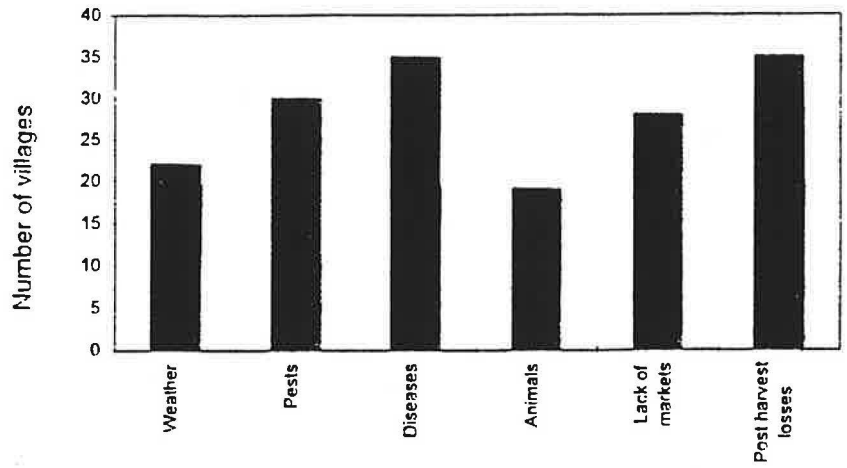
African cassava mosaic disease (ACMD)

ACMD is caused by whitefly-transmitted geminiviruses (Bock and Woods, 1983) and it was first reported in Uganda in 1928 (Hall, 1928; Martin, 1928). It is considered to be the most important and serious disease of cassava in Uganda, as in many other parts of sub-Saharan Africa (Otim-Nape 1990). A severe epidemic devastated crops in the eastern region of Uganda from 1933-1944 (Jameson, 1964). Vigorous breeding and selection for mosaic-resistant varieties at Amani, Tanzania, resulted in genotypes that were widely tested and released in Uganda as varieties Bukalasa 8, Bukalasa 11, etc. that were multiplied and distributed to farmers (Jameson, 1964). A by-law instituted in the 1950s made it mandatory for farmers to uproot all infected and susceptible local varieties and replace them with the new resistant ones (Jameson, 1964). This led to the control of the disease for several decades (Jameson, 1964). The recent upsurge in epidemics in many parts of the country indicates that these methods of control have not been sustained or they have become ineffective.

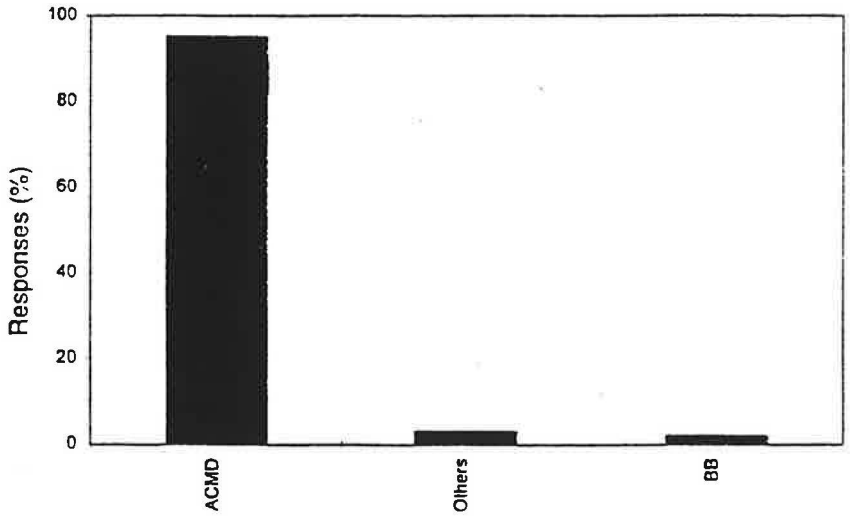
The current epidemics of African cassava mosaic disease in Uganda

Since 1988, severe epidemics have traversed the country from north to south and caused devastating losses and food shortages. Comprehensive surveys carried out in 1990-1992 (Otim-Nape, 1993) and again in 1994 in all cassava-growing districts revealed that ACMD occurred throughout the country. The overall incidence was least and ranged from 20-30% in southern areas bordering Lake Victoria. By contrast there was almost total infection in central and northern districts where symptoms were very severe. Healthy planting material of local Ugandan varieties introduced to the high incidence areas encountered high inoculum pressure and became heavily infected within a few months of planting.

Fig. 1



(a) Number of villages ranking risk factors in cassava production



(b) Farmers perception of diseases threatening cassava production

Figure . Risk factors affecting cassava production in Kasese, Apac and Arua districts of Uganda. BB = Bacterial blight; "others" includes mostly the fungus disease caused by *Cercospora henningsii*.

Movement of the current epidemic

Observations on the progress of the epidemic across Uganda revealed that since 1988, it has moved *c.* 140 km southwards to reach Kampala in 1996. The epidemic continues to spread southwards along a broad front at a rate of *c.* 15-20 km per annum. The front is characterized by large population densities of whiteflies and by a high incidence of ACMD, mainly due to recent infection by the whitefly vector *(Bemisia tabaci)*. The lower leaves of plants infected in this way seem healthy while the youngest leaves show severe symptoms. They are reduced in size and show marked distortions and malformation which give infected plants a paint-brush-like appearance (Fig. 2). The plants harbour numerous adult whiteflies on the young shoots and large nymphal populations on the undersides of the lower leaves (G. W. Otim-Nape, unpublished).

Impact of the current epidemic on cassava production

Fifteen to twenty kilometres behind the front, all plants show severe ACMD symptoms due to the use by farmers of cuttings from plants infected by whiteflies the previous year. Diseased material is used in the absence of adequate stocks of healthy cuttings. The ensuing plants are severely stunted and produce no or very poor yields (Fig. 3). Consequently, farmers become discouraged and in the continued absence of sufficient healthy planting material abandon growing cassava (Fig. 4a, b). It has been estimated that some 60,000 ha of cassava are being lost each year in this way, which is equivalent to 600,000 tonnes worth US $60 million. The causes of the epidemic are being investigated and a new biotype of *B. tabaci*, and a more aggressive strain or type of the virus, or both are suspected.

The current epidemic has led to a drastic decrease in cassava production and in some areas to the virtual elimination of the crop. Moreover, over 500 local cassava genotypes are threatened with extinction and special measures have been required to protect them. The epidemic has had serious consequences on communities heavily dependent on cassava as a staple food and cash crop. There have been massive food shortages and starvation in some districts, especially in the east and north.

The cassava multiplication project

Over many years of research, the Uganda cassava programme has developed new varieties that are resistant to ACMD. The varieties are high-yielding and have good tuber qualities. Moreover, the programme had also developed sanitation (roguing and use of healthy planting material) and other cultural methods of controlling the disease including isolation, reduction of inoculum pressure, and cultivation of cassava in large blocks. Unfortunately these methods were not previously available to farmers in Uganda. Moreover, extension staff and farmers lacked adequate knowledge on ACMD and on improved cassava production practices. To control the disease and restore cassava production, it became essential to accelerate the development and transfer of appropriate ACMD control technologies to farmers.

Consequently in 1991 the government of Uganda approached the Gatsby Charitable Foundation, U.K. for financial support for the transfer of mosaic control technologies to farmers. Phase 1 (pilot phase) of this project involved assessing the concepts and technologies in three districts (Lira, Masindi and Mpigi) representing areas of high, medium and low rates of spread of ACMD, respectively. The phase lasted for three years starting in 1991 with a budget of (£167,000). This was followed by a second phase (£330,000, over three years) extended to include Luwero, Apac and Kibaale districts. The specific objectives of the project were to:

Fig. 2: Cassava infected recently by whitefly: early growth normal.

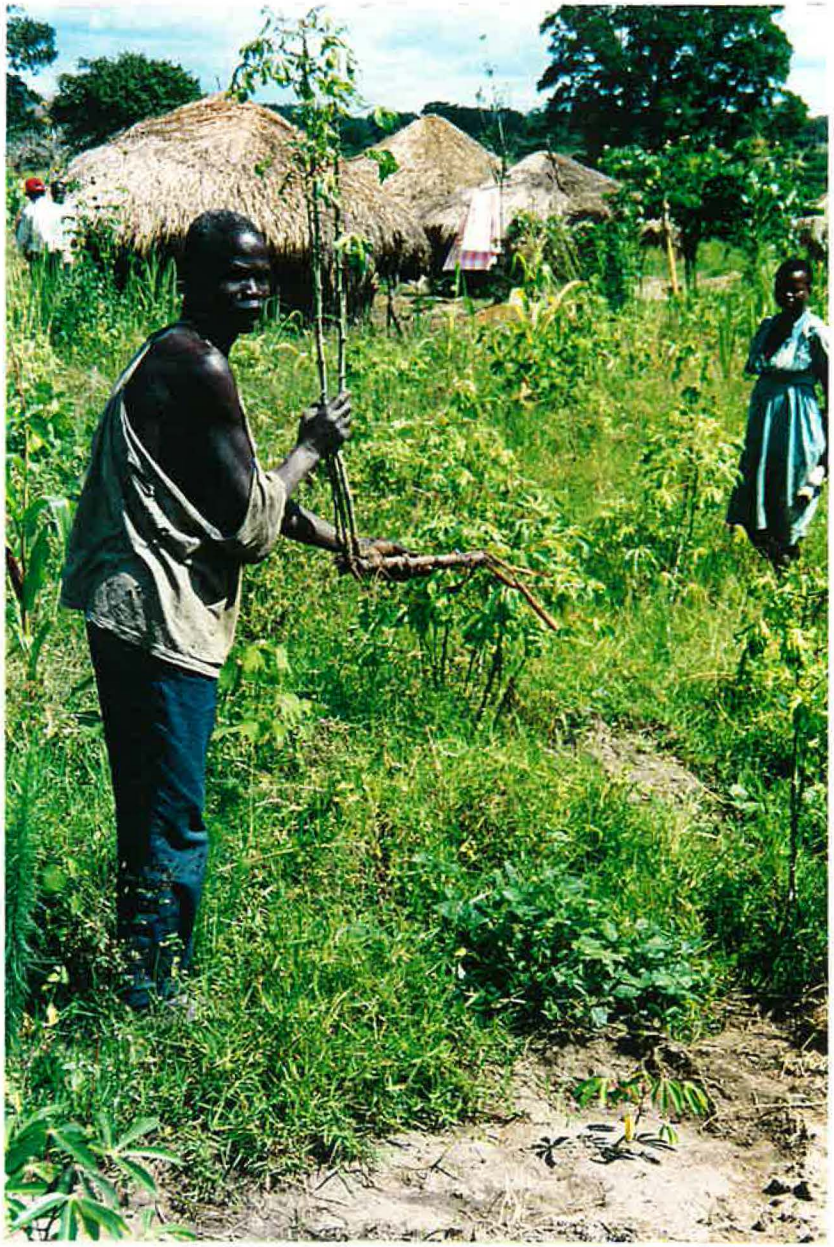


Fig. 3: Severely diseased plant grown from an infected cutting

Fig. 4a: Severely diseased planting established with infected cuttings and later abandoned

Fig. 4b: Meagre production from a household planting established with infected cuttings and totally affected by ACMD

(a) conduct accelerated on-farm trials (OFTs) of promising cassava genotypes and other mosaic control methods in important cassava growing areas with a view to identifying those acceptable to farmers.

(b) rapidly multiply and distribute mosaic-free planting material of high-yielding and resistant varieties to farmers in major cassava growing areas of the country.

(c) train subject matter specialists and other extension agents on improved cassava production technologies with special emphasis on pest and disease control.

(d) increase farmers awareness of mosaic control and other improved cassava production technologies so as to improve productivity.

Strategies for implementing the project

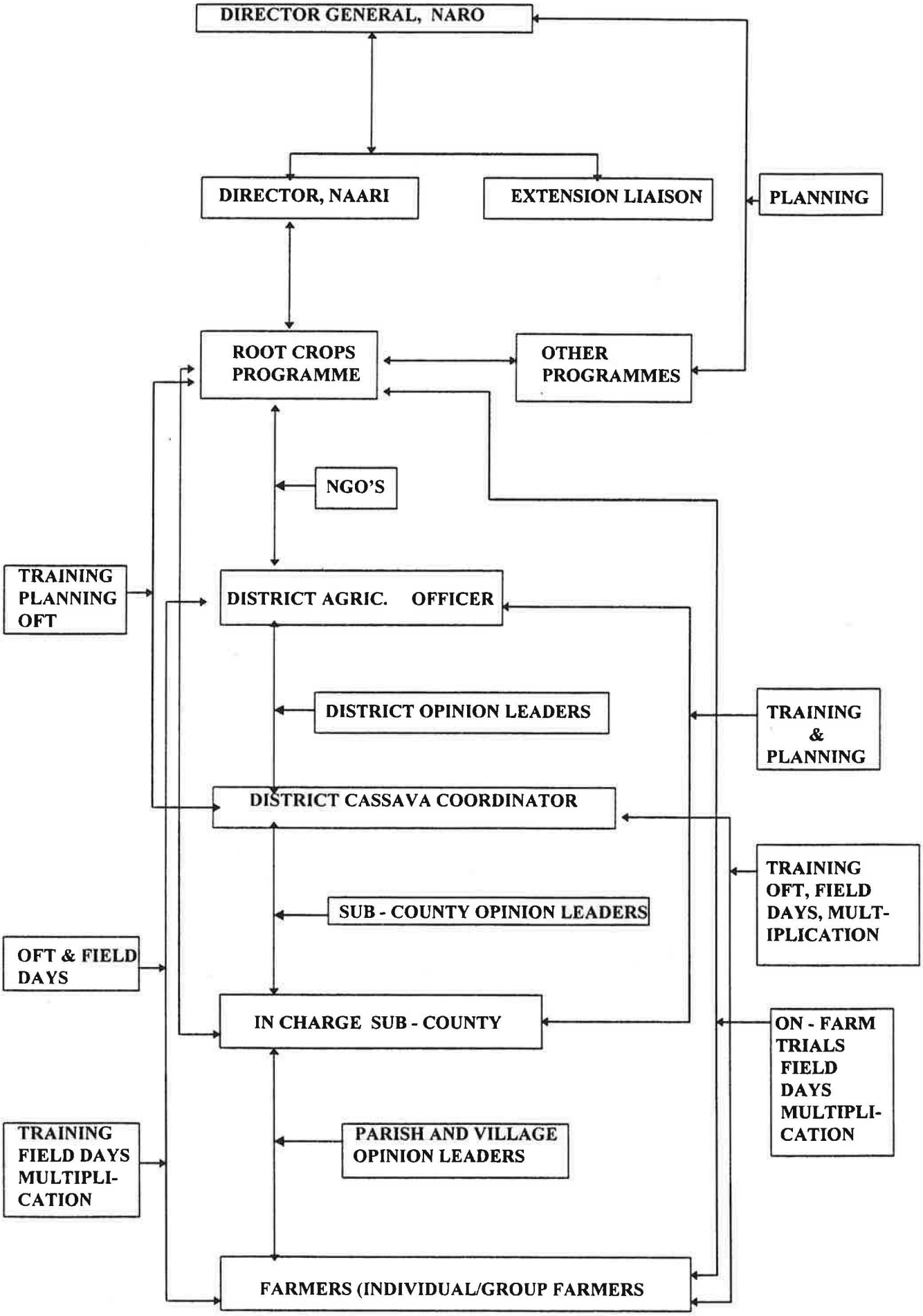
Establishment of a strong research-extension linkage through a national network of cassava workers (NANEC)

An efficient and effective research and extension linkage is necessary to achieve rapid technology transfer. Experience had indicated that a major constraint of the extension service was that district staff were ill-motivated and poorly equipped. They lacked transport and knowledge to perform their duties effectively and did not have the confidence to approach farmers. Tackling the issue of technology transfer, therefore, necessitated first addressing the problem of extension personnel in targeted areas. The agricultural officers in charge of districts, district plant protection officers, and subject matter specialists periodically participate in a 1-2 week training workshop on cassava. The workshops aim to sensitize the officers and instruct them on improved cassava production, pest and disease control methods and technologies for rapid multiplication of planting material of improved varieties.

A district cassava subject matter specialist (district coordinator), the cassava officers (sub-county coordinators) in charge of each of the four sub-counties per district, and the district agricultural officer (DAO) form the district team of the National Network of Cassava Workers (NANEC) Each team is responsible for training other extension staff, chiefs, opinion leaders and farmers in the district. They are also responsible for conducting OFTs and for multiplying and distributing planting material of the improved varieties preferred by farmers. Their activities are planned and closely supervised by scientists from the cassava programme. The team leader of the cassava programme provides the overall supervision and coordination. The Non-Governmental Organisations (NGOs) active on cassava in a district form a part of the team. Annual workshops organised in Kampala, for the district cassava coordinators review progress, plan for the next cropping season and update knowledge on improved technologies for cassava production and utilisation. A flow diagram for this network is shown (Fig. 5).

The network involves all components such as the national agricultural research system, cassava scientists, NGOs, extensionists and farmers required in technology generation, dissemination and adoption. They work in a multi-disciplinary manner and operate in a "balance-and-check" fashion. In his coordinating role, the Director General fosters close linkages with the Directors of research institutes such as Namulonge Agricultural and Animal Production Research Institute (NAARI) and the programmes within this institute. This linkage provides a forum for research planning in which technical and non-technical (policy) issues related to cassava and other commodities are prioritized

Fig. 5


DIRECTOR GENERAL, NARO
DIRECTOR, NAARI
EXTENSION LIAISON
PLANNING
ROOT CROPS PROGRAMME
OTHER PROGRAMMES
NGO'S
TRAINING PLANNING OFT
DISTRICT AGRIC. OFFICER
DISTRICT OPINION LEADERS
TRAINING & PLANNING
DISTRICT CASSAVA COORDINATOR
TRAINING OFT, FIELD DAYS, MULT-IPLICATION
SUB - COUNTY OPINION LEADERS
OFT & FIELD DAYS
IN CHARGE SUB - COUNTY
ON - FARM TRIALS FIELD DAYS MULTIPLI-CATION
TRAINING FIELD DAYS MULTIPLI-CATION
PARISH AND VILLAGE OPINION LEADERS
FARMERS (INDIVIDUAL/GROUP FARMERS

based on national interests and the resources available in the research system. The cassava programme promotes horizontal linkages with other commodity programmes and collaborates with extension staff and NGOs in planning, training and conducting OFTs and in multiplication of planting material and other relevant technologies.

The cassava staff train extension personnel and NGOs who in turn train other extension staff and farmers. Farmers are involved in OFTs to validate the technologies appropriate to their natural and socio-economic environments. Field days draw together all those involved to review the performance of the technologies tested and improvements and recommendations are made as necessary. Multiplication of the accepted cassava genotypes by the farmers is initiated here.

The network plays a key role in the dissemination of new information and technologies to clients and in providing feedback to scientists, administrators and policy makers. It stimulates and strengthens close linkages between policy makers, researchers, extensionists and farmers through planning and setting priorities for research, training of other extension staff and farmers and for developing and disseminating appropriate and sustainable technologies for ACMD control.

Integrated strategy for multiplication and distribution of planting material of improved varieties

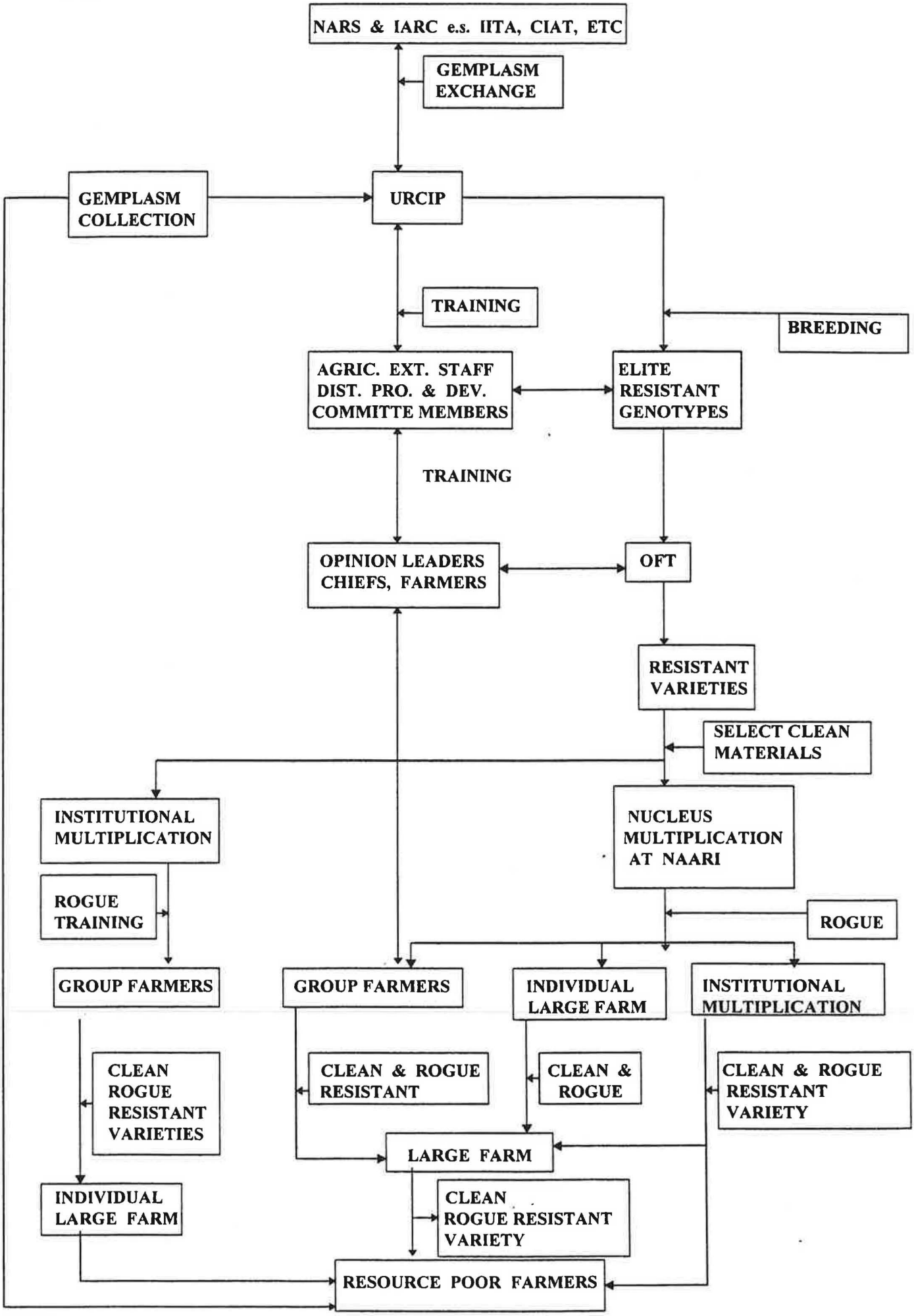
Another major constraint was lack of suitable planting material of the mosaic-resistant varieties that are acceptable to farmers. In order to address this problem, an integrated strategy for the multiplication and distribution of planting material of the improved varieties has been developed based on data obtained from biological and socio-economic studies conducted since 1990. The integrated multiplication strategy was designed to screen and generate "clean", mosaic-free material of mosaic- and pest-resistant cassava varieties. This involves a series of activities in which the cassava programme assembles germplasm from National Agricultural Research Systems, International Agricultural Research Centres and local sources (Fig. 6). This material is used in the breeding programme which aims to develop elite genotypes resistant to mosaic and other important pests and diseases. Further, the programme links with extension agents, local leaders and NGOs by way of training and conducting OFTs so as to perfect the performance of genotypes at farm level.

The cassava genotypes accepted by farmers enter the nucleus and institutional multiplication stages. At these stages the stocks are rogued to ensure that only clean planting material is distributed to farming groups (frequently womens groups) and to individual large-scale farmers. Training and roguing are conducted at all stages of multiplication so as to create awareness of the production of disease-free planting material for the resource-poor farmers who grow cassava in small areas. Roguing is adopted to complement the resistance of the genotypes to ACMD and other diseases.

Generally, in order to multiply and distribute 'clean' planting material, all key players in the development, transfer and adoption of cassava genotypes are well integrated. This offers a feed-back on the performance of each genotype at all stages of development and multiplication so as to determine the quantity of each genotype to be multiplied in a particular infection pressure area of the country.

Three approaches for the multiplication of planting material of improved varieties are used at institutional farms, by womens groups and by individual farmers. Experience gained indicates which approach is suitable for particular circumstances, as discussed by Otim-Nape *et al.* (1994).

Fig. 6


NARS & IARC e.s. IITA, CIAT, ETC
GEMPLASM EXCHANGE
GEMPLASM COLLECTION
URCIP
TRAINING
BREEDING
AGRIC. EXT. STAFF DIST. PRO. & DEV. COMMITTE MEMBERS
ELITE RESISTANT GENOTYPES
TRAINING
OPINION LEADERS CHIEFS, FARMERS
OFT
RESISTANT VARIETIES
SELECT CLEAN MATERIALS
INSTITUTIONAL MULTIPLICATION
NUCLEUS MULTIPLICATION AT NAARI
ROGUE TRAINING
ROGUE
GROUP FARMERS
GROUP FARMERS
INDIVIDUAL LARGE FARM
INSTITUTIONAL MULTIPLICATION
CLEAN ROGUE RESISTANT VARIETIES
CLEAN & ROGUE RESISTANT
CLEAN & ROGUE
CLEAN & ROGUE RESISTANT VARIETY
LARGE FARM
INDIVIDUAL LARGE FARM
CLEAN ROGUE RESISTANT VARIETY
RESOURCE POOR FARMERS

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We thank the staff of the cassava programme, particularly Messers J. Orone, J. Omara and the District Cassava Coordinators for their unstinting efforts. We are also grateful to the Government of Uganda, The International Development Research Centre (IDRC), Canada and the Gatsby Charitable Foundation, U.K. for financial support to the cassava programme.

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APPROACHES USED FOR CASSAVA MULTIPLICATION: THE SOROTI EXPERIENCE

Charles Aben
District Agricultural Officer, Soroti

Introduction

Cassava is the main stable food crop of the people of Teso (Soroti and Kumi districts). As a drought-resistant, famine reserve crop, it has become the most important commercial crop in the eastern region of Uganda. Cassava previously occupied *c.* 30,000 ha. per year which is a substantial proportion of the cropped area in Soroti district. However, figures from 1974 to date reveal a steady downward trend in the area of cassava which has decreased at a rate of nearly 4,000 ha. *per annum*. By 1990 cassava had been virtually eliminated by African cassava mosaic disease (ACMD). The spread of the disease was accelerated by several factors including the narrow genetic base of the varieties grown due to the strong preference for a single cassava variety (Ebwanateraka) which succumbed to ACMD. There was also civil strife which affected cassava production and marketing in physical terms; weak institutional linkages viz. by-laws, extension-research-farmer linkages, and weak perception of the gravity of the ACMD problem during the 1970s and early 1980s; apparent farmer ignorance about the existence of ACMD. Thus, interventions were necessary to develop cheap methods of multiplying planting material for distribution to farmers.

Various approaches in terms of groups, individuals, gender-base and religious affiliations were used with varying degrees of success (Table 1). However, the most successful approach has been through groups. A description of these approaches follows:

(a) Agricultural Development Project/World Bank Cassava Mosaic Sub- Project

72 centres in 8 counties of Soroti district were provided with a total of 700,000 stems obtained from disease-free plants selected in Apac district. By the end of the project 5,000 ha. were planted and this represented nearly 15% of the total cassava area required to meet the needs of the district. Extension was strengthened to enhance supervision.

Two sites in each of the 36 sub-counties were ploughed using hired tractors. The farmers groups used consisted of 15-60 members, who cleared the land, planted, weeded and maintained phyto-sanitary measures. Farmers were selected on the basis of the centrality of site and extension convenience and no further statistical or electoral methods were employed. The farmers benefited from the tuberous roots, which they were encouraged to harvest piecemeal to leave ratoon crops so as to produce additional stems for a second propagation cycle. Stems were distributed to parish multiplication centres (each 5 of 2 ha.) which were ploughed and prepared by the farmers themselves.

Experimental Multiplication

Demonstration plots of improved resistant varieties: TMS 30786, TMS 60141, TMS 4(2)1425, TMS 30572 (Migyera), TMS 60142 (Nase 1), TMS 30001 and TMS 60140

were established at a strategic site at Teso College near Soroti township, and later expanded to cover 6 ha. at Arapai Village.

Training

Courses were run for extension staff and farmers who updated their knowledge of cassava agronomy and pathology. Senior staff benefitted from National and International symposia.

Experiences

Methodological effectiveness

1. The initial incidence of ACMD was 5-10% at the multiplication centres and attributed mainly to the expression of symptoms by shoots produced by cuttings from latently infected plants. The incidence was greatest in plantings established by some NGOs and farmers who collected unselected material.

2. Goal ambiguity was noted from the conflicts between the politically motivated equity tendencies and the scientific and technical need for disease control. This could only work best through a group approach rather than everybody planting a few stems.

3. Much spread of ACMD occurred from farmers' old diseased crops to the newly established project plots. Almost half of the farmers were growing diseased cassava prior to the project and they were unwilling to remove this, even though control of extraneous sources of infection is vital to the successful multiplication of 'clean' cassava.

4. Groups were easy to supervise. However non-members envied and sometimes stole tuberous roots from groups. Delays in decision making delayed weeding in some cases.

Implementation Bottlenecks

1. Stems from some sites e.g. Kapelebyong and Kalaki dried out before they could be planted because farmers did not have the implements (hoes, axes etc.) to clear the sites in time.

2. Even if project crops became infected due to spread by whiteflies they still yielded much better than the farmers' crops. Farmers did not perceive crops as diseased if they still gave even a modest yield. This attitude impeded disease control.

3. An eight-fold increase in cassava prices during 1991 from U.sh 3,000 to 24,000 per sack led some farmers to abandon stem multiplication in favour of tuberous root production. Most ratoon stands were damaged as farmers harvested and sold the roots.

4. Seasonal constraints were a serious drawback. Late -ploughed plots could not be planted in time. With a rainfall duration of only 8 weeks, some land took 3 weeks to clear and the time between first and second ploughing was 3 weeks.

5. Ten of seventeen sampled sites had some disorder during the post-multiplication distribution. Some farmers were not willing to release stems without payment to compensate for their efforts during the multiplication process.

6. The use of long (30 cm) instead of short (15-30 cm) cuttings in some plots aggravated the shortage of planting material.

7. In an attempt to gain local popularity, some influential individuals distributed unproven local varieties from Tororo district that were susceptible to ACMD and in effect helped to sustain the epidemic.

8. The massive theft of tuberous roots because of the prevailing food shortages nearly disrupted the multiplication process. The use of police to curb theft was detested by politicians.

Gender Factors

Although women's groups appeared somewhat more receptive, there were no marked differences in performance between male and female groups. It seemed as if women's successes were linked more to supervision by their husbands than from their own initiatives.

(b) NURP Cassava Multiplication Programme

This was a continuation of the ADP/World Bank effort. Generally group and institutional approaches were used to establish variety demonstration centres. Thus:

- In 1994, 6 ha. of land were opened at Arapai Village. The management of the plots was left entirely to the group members and they were planted with TMS clonal selections including 30572 (Migyera), 30001 and 60140. Stems were distributed to groups for further multiplication on their own. Some were used to establish more demonstration centres in 1995.

- In 1995, seven variety demonstration sites were established under joint extension/farmer management. A total of 9 ha. were planted. Nase 1 and Nase 2, Migyera, Muguga, Bao, Alado, and SS4 were planted.

- In 1995, three large mother gardens of Nase 2 at Nakatunya (8 ha.), Kateta (4 ha.) and Soroti Prisons were established. The first two are institutional and the last is under farmers' management.

Experiences

- The NURP approach cultivates a strong sense of ownership

- Management in institutional farms was poor due to lack of financial resources

- Variety demonstrations are very popular. Farmers are able to appreciate differences between varieties in growth habit, disease resistance, and tuberous root quality.

(c) Cassava Action Research programme

74 ha. have been planted in 15 locations with Nase 1 and Nase 2 using the group approach. Ploughing and stems were provided by the project. Extension activities were strengthened through the provision of allowances and fuel for supervision. Weeding support is provided to farmers. Staff courses were conducted and farmer courses have been planned.

Experiences

- Improved field maintenance has been achieved due to weeding support and extension motivation.

- The group approach used has facilitated supervision and on-farm sensitisation.

- The high resistance of the varieties Nase 1 and Nase 2 to ACMD has boosted farmers' morale and their regard for these varieties.

(d) NGO Participation

Baptist Mission (1990)

Seven sub-counties viz. Wera, Abarilela, Kuju, Kapelebyong, Katine, Orungo, and Katakwi were involved in both the individual and group approaches to multiplication. Four of seven sites each had 5 ha. blocks and the other three had 12, 8, and 12 ha., respectively. Each farmer owned *c.* 0.5 ha. within a block. Some individual farmers were also supplied with stems. A total of 46 ha. were planted with Bao and Alado screened by technical staff from Apac.

Experience

- Supervision of individual farmers became impracticable, whereas it was relatively easy to supervise groups

- Planting material has diffused to other farmers but it is often diseased.

- Collaboration with extension became weak and disease control suffered

Presidential Commission For Teso

- 160 ha. were planted in 1994 and 141 ha. in 1995

- All sub-counties were covered and the variety used was Migyera

- The approach was mainly through individuals.

Problems

- Limited farmer education was achieved because technical staff were not officially committed
- Supervision by liaison officers who are non- technical, was too weak to be effective

Church of Uganda Cassava Programme

- A total of 20 ha. were planted at ten sites using the group approach
- Post-multiplication distribution planned for 1995 could not take place due to lack of funds.

Problems

- Poor staffing
- Poor monitoring of projects
- Lack of knowledge of technical aspects of cassava multiplication

Soroti Catholic Diocese Development Organisation (SOCADIDO)

Features

- Cassava multiplication was gender-biased in favour of women who provide more than 70 % of the household labour.
- Project preparation included seminars, group selection, surveys of sources of resistant planting material, block siting and bush clearance.
- Each block was 2 ha., four members share 0.5 ha. and each member received one hoe and one panga.
- The project met the cost of ploughing, whereas maintenance was through communal work. Termiticides were provided.
- Tuberous roots belonged to beneficiaries, but stems remained project property until after first ratooning.
- Each participant had to deliver a tin of dried cassava chips to SOCADIDO as a token of appreciation.

- After multiplication, group participants were to plant 0.4 ha. while neighbours were to plant 0.5 ha. Cuttings from ratoon crops were used later by participants to expand the areas grown.

Experiences

- Shortage of technical staff was further aggrevated by the retrenchment of Ministry staff upon whom the project relied heavily

- The excessive demand for cassava by farmers tended to create despair for those who were not group members.

- The low education among women folk means that supervision has to be really intensive.

Conclusions

1. Cassava multiplication in Soroti has generally been very successful. Farmer education becomes vital as Bao and Alado require an intensive phytosanitation effort and much roguing to maintain a satisfactory health status.

2. Cassava multiplication is a science, therefore NGOs and private operators, should be given adequate technical backing.

3. The speedy introduction of resistant varieties e.g. Nase 1 and Nase 2 is vital to the whole national multiplication programme.

4. The individual approach is applicable where variety resistance is assured, but otherwise should be avoided unless effective phytosanitation is adopted.

5. "Agro-Politics" is an important hazard in cassava multiplication, and can "derail" the whole process.

Table 1: Different approaches used in the various Cassava Multiplication projects in Soroti District

Projects	Year	Source of stems	Varieties	Training extension workers	Approach	Area planted (ha.)	Management of plots
1. ADP/World Bank	1992	Apac	Bao, Aladu	+	Women groups	5,000	Farmers
			TMS series	-	Demonstration plot	15	
2. NURP cassava multiplication	1994	NAARI SAARI	Migyera TMS 30001 TMS 60142 (Nase 1)	-	Demonstration groups Institutions	30	Group Project
	1995	SAARI NAARI	Migyera Nase 1 & 2	-	Institutions	52	Project
3. Cassava Action Research Programme	1995	SAARI	Nase 1 & 2	+	Group	185	Group
4. NGOs	1990	Apac	Bao Aladu	-	Group Individual	128	Farmers
(a) Baptist Mission							
(b) Presidential commision for Teso	1994	Serere (farmers)	Migyera	-	Individual	400	Individual farmers
	1995	Serere (farmers)	Migyera	-	Individual	353	Individual farmers
(c) Church of Uganda Cassava Programme	1994	Serere (farmers)	-	-	Group	50	Group
(d) Soroti Catholic Diocese Development Org. (SOCADIDO)	1992		Aladu Bao	-	Group	-	Group

APPROACHES ADOPTED FOR CASSAVA STEM MULTIPLICATION: THE KUMI EXPERIENCE

Odeke Valdo
District Agricultural Officer, Kumi

Introduction:

Cassava is a major staple and food reserve crop in 'Teso' region of Uganda (now Soroti and Kumi districts). The various positive attributes attached to the crop i.e. low production costs, long in-ground storage, as a food in both fresh and dried form, and its use in the local brewing industry make cassava an important food and cash crop in Kumi district with an enormous socio-economic contribution in the area.

Until 1987, cassava occupied most of the area used for annual crops in Kumi district and plantings averaged 35,000 ha. *per annum*. However, beginning in 1988, epidemics of African casssava mosaic disease (ACMD) hit the district and by 1992 the area under cassava was only *c.* 2,000 ha. This warranted emergency intervention by both governmental and non-governmental organisations (NGOs). A strategy for controlling ACMD was formulated involving phytosanitary control measures and the multiplication of mosaic-resistant/tolerant varieties within the district to replace the widely grown Ebwanateraka. This is a local variety which is highly susceptible to the disease. Most of the approaches used by the different agencies towards the revival of cassava production in the district were greatly influenced by these two cardinal points. The approaches used are shown in Table 3.

The Oxfam Cassava Mini-project

Oxfam, a British-based NGO, first operated by providing relief items including food to people who had been in detention camps in 1990. However, it was noted that this did not provide a solution to the famine in the district. A more permanent and reliable approach was required to revive cassava production. This necessitated the introduction of 'clean' (mosaic-free) resistant/tolerant varieties.

Methodology used

In 1991 Oxfam provided the funds for the purchase and transportation of cassava stems into Kumi from Apac district to the west. Oxfam, collaborated with National Root and Tuber Crops programme staff (NAARI) and the District Agricultural Office. Planting material of the varieties Bao and Aladu was purchased from farmers in Apac district and a team of researchers from NAARI identified 'clean' healthy stems from disease-free plants. The stems selected were cut and tied into bundles each of eight stems. A commercial company Magric (U) assisted in the collection and transportation of the stems used to provide cuttings. The initial individual approach used by Oxfam favoured only women as the beneficiaries. Other negative attributes of this approach were:-

(a) poor siting of plantings,
(b) planting by farmers amongst older diseased cassava,
(c) lack of roguing,
(d) inadequate supervision by extension workers.

Consequently, the department of Agriculture, Kumi, convinced Oxfam to open up land at Kumi Leprosy Centre and St. Mary's Teacher Training College for use as institutional multiplication centres

Supervision and education of the participants was done in groups. A total of 27,800 stems were delivered to Kumi Leprosy Centre but due to a dry spell, 13,000 stems dried up before planting. Nevertheless, at least 6 ha. were planted. Records for the plantings made at St. Mary's are not available as they were retained by Oxfam.

Shortcomings:-

(i) Political and subsequent military insecurity delayed the distribution of the stems to the intended beneficiaries. Many stems, therefore, dried up or sprouted whilst still at the distribution centres which affected their survival when planted.

(ii) Theft of stems whilst at the distribution points was rampant and they could not be traced as proper follow-up records were not available.

(iii) Only eight stems were distributed per farmer and the varieties distributed were often planted amongst stands of the local heavily infected Ebwanateraka.

(iv) The major administrative problem was that extension staff could not provide adequate education and supervision to farmers. This was attributed to the insecurity at the time which made most areas inaccessible.

(v) The individual approach used by Oxfam was not appropriate for the district at the time because so few stems were given out and they were grown amongst large numbers of diseased Ebwanateraka.

The Cassava Mosaic Sub-Project

Following the decline in cassava production due to ACMD, the Ministry deemed it necessary to re-activate cassava production to fight the food shortages which became common, hence the initiation of this project. Multiplication was done by SOCADIDO which is an NGO based in Soroti.

Implementation

A group approach was adopted in which blocks of 6 ha. each were opened in each sub-county. Land preparation was done by the Project but subsequent management was by farmers themselves. Some inputs including hoes, axes and termiticides were also provided.

Source of stems

Researchers had recommended the collection of the varieties Bao and Alado from Apac and Lira districts but adequate quantitites were no longer available because stems had already been collected from there in large quantities for distribution in Soroti. An alternative source was sought and Iganga was proposed. but this was opposed by researchers because of the susceptibility to infection of the varieties grown there. Unfortunately, the proposal went ahead despite the technical advice given. The identification of the stems in Iganga was done by extension staff and SOCADIDO.

Implementation bottlenecks:-

(i) Lack of farmer training

(ii) Inadequate supervision due to lack of transport i.e. motorcycles

(iii) Theft because of severe food shortages at the time. Many multiplication plots were harvested and destroyed before the stems had matured and become suitable for propagation.

Substantial coverage of the project areas was achieved, but the varieties used soon succumbed to ACMD and the overall situation in the district was not improved.

The Cassava Action Research and Development Project (CARDP) 1995

Despite the various approaches tried in the multiplication of cassava in the district, production in 1995 was till quite low and the incidence and severity of ACMD in the remaining crops of the district remained very high. Consequently, an additional project was initiated by NARO in 1995 with the main focus on:-

(i) Training of extension staff, farmers and opinion leaders, and

(ii) Multiplication of improved ACMD-resistant/tolerant varieties.

Training

Extension staff training was organized and conducted by research scientists from NAARI (Table 1). This training was to equip extension staff with the knowledge and skills of improved technologies of cassava production and to strengthen the links between research, extension and farmers. The extension staff later organized the training of farmers and opinion leaders.

Multiplication of Improved Cassava varieties

Sites for the multiplication of improved cassava varieties were selected by both extension staff and researchers. Coordinators both at district and county level were nominated and terms of reference provided. Fourteen farmer groups were selected as shown in Table 2. Multiplication and subsequent management of the blocks were done with assistance from NARO staff.

The Northern Uganda Reconstruction Programme (NURP) (Agricultural Component)

The objective of this programme was to multiply resistant cassava varieties, especially in the famine-stricken areas of Ongino, Malera and Kolir. However, the coverage was limited because of inadequate funds. The multiplication was undertaken at parish level. Two multiplication centres each of 0.2 ha. were planted in each parish.

Land preparation and field management were the responsibility of farmers themselves. The project only provided cassava cuttings.

Bottlenecks

(i) Lack of farmer education

(ii) Supervision was limited as funds were not allocated for operations

(iii) Coverage was inadequate.

Table 1: Number of farmers and extensionists trained inKumi district 1995.

Date	Category	Venue	No.
13-15 Feb, 1995	Extensionists	Tororo D.F.I.	5
30 July, 1995	Farmers	Kumi	30

Table 2: Farmer groups and areas of cassava planted in Kumi district, 1995.

Name of group	County	Sub-county	Village	Ha
Agu Farmers Group	Ngora	Ngora	Agu	6
Koting Group	Ngora	Kobwin	Kobwin	4
Katamakisi	Kumi	Ongino	Morupeded	4
Rapad	Ngora	Mukura	Aduli	4
Kaol Women & Youth Group	Kumi	Kanyum	Olumot	
Kumi Larytex Farmers Association	Kumi	Kumi	Olungia	4
Apopong Mixed Group	Kumi	Kumi	Kabata	4
Get-get	Kumi	Kumi	Omatenaga	6
Kapala	Bukedea	Bukedea	Kasoka	6
Kongui	Bukedea	Kolir	Apopong	4
Esodot's Group	Bukedea	Malera	Kachede	4
Kumi V.T.C.	Kumi	Kumi	Kumi	2
Kumi P.S.	Kumi	Kumi	Kumi	2
Okedi's Group	Bukedea	Kachumbala	Kachumbala	2
Total				52

A comparativc summary of thc various approachcs adoptcd to cassava rchabilitation in Kumi district is presented in the following table.

Table 3: Comparison of approaches adopted towards cassava rehabilitation in Kumi District

Approach	Source of stems	Varieties used	Training		Method used	Site selection	Ploughing	Weeding	Supervision	Provision of inputs
			Ext. staff	Farmers						
Oxfam (1991)	Apac	Bao Aladu	Nil	Nil	Individual	Farmers		Farmers	Nil	Nil
Cassava Mosaic Sub-project	Iganga	Local varieties	Nil	Nil	Block (group)	Ext. staff	Farmers	Farmers	Inadequate	Yes
Cassava Action Project (1995)	SAARI	Nase 1 Nase 2	Yes	Nil	Group	Researchers Extension Farmers	Project	Project	Researchers & Extensionists	Nil
NURP	Kumi	Migvera Nase 1	Nil	Nil	Group	Extension staff	Farmers	Farmers	Nil	Nil

PROGRESS IN CASSAVA TECHNOLOGY TRANSFER IN MASINDI DISTRICT

G. Nkuzaalwo
District Cassava Coordinator,
Masindi District

Introduction

Cassava is an important food crop in Masindi district and sustains the livelihood of a highly diverse society of 56 tribes. Production of the crop has been hampered by:-

1. the dominance of inherently low-yielding varieties;

2. the high incidence of African cassava mosaic disease (ACMD) which has devastated all the local cassava varieties,

3. the introduction of the cassava mealybug (*Phenacoccus manihoti*) to the district from neighbouring areas.

There was, therefore, an urgent need to solve these problems and in 1991 the cassava multiplication project was intiated under the guidance of the National Root Crops Programme. A three-point Action Programme was adopted with the broad objectives of improving the awareness of farmers and extension agents of the improved technologies, farmers participatory involvement in the evaluation and selection of these technologies and the multiplication and distribution of improved high-yielding ACMD-resistant varieties. These objectives were achieved through:-

(a) On-farm trials (OFTs) (Tables 1, 2).

(b) training of agricultural extension staff, farmers, policy makers and opinion leaders (Tables 5, 6)

(c) multiplication and distribution of farmer-accepted ACMD-resistant varieties (Tables 3, 4).

Multiplication methods adopted

Three methods of multiplication were adopted:-

a) By individual farmers (Table 3)

b) Institutional (Table 3)

   (i) Non-Governmental Organisations (NGOs)
   (ii) Government

(c) By groups of farmers

Table 1: On-farm trials in Masindi District

	Location			
Year	**County**	**Sub-county**	**No. of trials**	**Varieties tested**
1991/1992	Buruli	Karujubu Miirya Pakanyi	4 4 4	Nase 2 (TMS 30337) TMS 4(2)1425 TMS 30001 Nase 1 (TMS 60142) TMS 60140 TMS 30786 Migyera (TMS 30572) Bukalasa 11 Local Ebwanateraka
1992/1993	Buruli Kibanda Bujenje	Kimengo Nyayahya Kiryandongo Kigumba Bwijanga	4 2 2 6 6 4	Nase 2 (TMS 30337) TMS 4(2)1425 TMS 30001 Nase 1 (TMS 60142) TMS 60140 TMS 30786 Bukalasa 11 Local
1993/1994	Buruli Kabanda	Mirya Karujubu Nyangalya Kiryandongo Kigumba	5 4 3 6 6	Nase 1 (TMS 60142) Nase 2 (TMS 30337) TMS 4(2)1425 TMS 30786 TMS 60140
1994/1995	Buruli Kibanda	Mirya Pakanyi Kigumba Kiryandongo	4 3 3 6	Nase 1 (TMS 60142) Nase 2 (TMS 30337) TMS 4(2)1425 TMS 30786 TMS 60140
1995/1996	Buruli	Karujubu	6	Nase 1 (TMS 60142) 89/KKWE-29 89/30786-11 89/1988-2-UYT-PDB

Table 2: Farmers' Preferences: Data for on-farm trials

Variety	Yield	Period of maturity	Resistance/ tolerance to ACMD	Canopy cover	Taste when cooked	Total
TMS 30337	3	3	3	4	2	15
TMS 4(2)1425	3	3	3	3	3	15
TMS 30001	-	-	-	-	-	-
TMS 60142	3	2	4	2	3	14
TMS 60140	-	-	-	-	-	-
Local (Bao)	3	3	3	3	3	15
Ebwanateraka	3	2	2	2	3	12
TMS 30786	3	3	2	3	3	14
Bukalasa 11	-	-	-	-	-	-
TMS 30572	4	4	4	3	2	17
89/KKWE-29	NYH	NYH			NYH	
89/30786-11}	NYH	NYH			NYH	
89/1988-2-UYT-PDB }	NYH	NYH			NYH	

Values

4	=	High preference
3	=	Medium "
2	=	Low "
1	=	No preference indicated
NYH	=	Not yet harvested

Varieties

TMS 60142	=	Nase 1
TMS 30337	=	Nase 2
TMS 30572	=	Migyera

Table: 3: Area (Ha.) of improved cassava by variety in Masindi district, 1995

	Varieties						
Method	**County**	**Sub-county**	**Nase 1 (60142)**	**Nase 2 (30337)**	**Migyera (30572)**	**Total area**	**Target area**
NGO	Kibanda	Kiryandongo	3.0	7.5	-	10.5	105
Government	Buruli	Pakanyi	1.2	7.9	-	9.1	87
	Kibanda	Kigumba	3.6	4.0	-	7.6	77
Individual	Buliisa	Buliisa	-	-	83.0	83.0	526
		Biiso	-	-	24.3	24.3	283
	Kibanda	Kiryandongo	4.5	63.6	-	68.1	680
		Kigumba	0.2	14.6	-	14.8	148
	Buruli	Pakanyi	1.2	16.6	-	17.8	178
		Miirya	-	4.0	-	4.0	40
	Bujanja	Bwijanga	-	10.1	-	10.1	101
Total			13.7	128.3	107.3	249.3	2225

More plantings of Migyera are to be made in Buliisa county using material from Namulonge Research Institute

Table 4: Appraisal of methods of multiplication used in Masindi district

Method	Advantages	Disadvantages	Suggestions
Individual	Less expensive to the programme to establish	Limited number	Provide adequate transport
	On-the-spot advice easy	Farmers reluctant to release material to others	Encourage where possible as there is little loss of material
	Decision making easy	Expensive to monitor	
	Favoured varieties retained		
NGO	Financially sound	Normally selective in membership participation	Should be community based
	Not influenced by politicians	Limited coverage	
Government	Adequate staff for the work	Decision making slow	Donors should be asked to support extension staff and activities
	Financial support from government	Release of funds slow	
	Proper supervision of fields.	Interferences by politicians/chiefs	
		Facilitation usually inadequate	
Group	Easy diffusion of message	Decision making slow	Should be encouraged where appropriate
	Collective efforts and experiences are exploited	Sometimes lack of ownership	
Communal	Appropriate value; land ownership is communal		
	Inexpensive to supervise		

Table 5: Training 1991/92 - 1993/94*

Participants	Year		
	1991/92	1992/93	1993/94
Extensionists	15	336	47 + 1 MSc.
Farmers and opinion leaders	222	939	256

* Objectives:
1. Create awareness amongst farmers of the major pests/diseases attacking cassava i.e. mealybug, ACMD, bacterial blight and anthracnose.
2. Involve administrators for mobilization of the public.
3. Train extension staff to provide them with knowledge of ACMD so as to be able to provide technical advice to farmers.

Table 6: Training and awareness campaigns in Masindi district in 1994/1995

County	Sub-county	Category	No. of seminars	Attendance	Target		Achievement (%) *	Resolutions
					No. of seminars	No. of participants		
Buliisa	Buliisa	General farmers	8	725	10	1000	72	Planting material to be supplied
	Biiso	General farmers	2	118	4	400	30	Establish a multiplication centre but also encourage individual approach
Kibanda	Kiryandongo	Refugee camp	1	56	1	60	93	Have more training during dry season as most of the Kibanda roads are impassable during the wet seasons
		Extensicn staff						
		General farmers	6	320	10	1000	32	
	Kigumba	"	5	227	10	1000	23	
Bujanja	Budongo	General farmers	1	62	2	200	31	Have planting material supplied in time
	Bwijanja	General farmers	2	108	2	200	54	Increase supply of Nase varieties, especially in Budongo sub-county.
								Prevent the movement of mealybug to the rest of Masindi
Buruli	Masindi town	Agricultural and veterinary staff	1	62	1	80	78	Lack of reading material from researchers
	Miirya	General farmers	1	41	3	300	14	Have additional seminars from other researchers Identify their seminars Consider the different methods of utilizing cassava by-products Have more seminars in the dry season
Total			**27**	**1719**	**43**	**4240**	**40**	Intensify training Financial support from government should be timely

* Attendance as percentage of number targetted

Achievements of the Cassava Multiplication Project

1. Improved farmers awareness of ACMD as a threat to food security

2. New cassava varieties are being established and are replacing the local poor-yielding and ACMD-susceptible varieties e.g. in Buliisa. High yields are being recorded

3. 83% target achievement of the district for the area planted with new cassava varieties in 1994/1995.

Special Request through the Programme to Government and Donors

1. Provide more financial support to the Programme. Commendable work has been done but much is still required.

2. Improve the processing of cassava so as to commercialize the crop even at village level

3. Improve or introduce or educate farmers in the different methods of cassava production

4. Emphasise training.

Acknowledgements

Acknowledgements are due to Uganda staff and those of external organization including:-

1. Staff of Namulonge Research Institute for their tremendous work in the cassava programme whereby new cassava varieties have been introduced and utilized.

2. NARO administration which has enabled the researchers to operate efficiently

3. Government of Uganda for facilitating the above.

4. Gatsby assistance is greatly appreciated for financial support to the programme and whose contribution has been enormous, especially in training and multiplication and distribution of new varieties.

5. International Institute of Tropical Agriculture for their collaborative efforts with researchers in the cassava programmes of Uganda and other African countries.

6. District staff of Ministry of Agriculture, Animal Industry and Fisheries for their participation in the programme.

7. Local councils for supporting cassava activities in the district.

IMPACT OF CASSAVA TECHNOLOGY TRANSFER IN MASINDI DISTRICT

Peter Watanda
District Agricultural Officer, Masindi

Introduction

Cassava is a very important crop in Masindi district both as a food stuff and as a source of income to the rural people because:-

(a) it can be consumed in various forms, e.g. as bread made of cassava flour, and as the tender leaves which are a highly nutritive vegetable. Moreover, cassava can be eaten fresh and after fermentation can be distilled into spirit (enguli), etc.

(b) cassava can be stored for a long time when properly dried, thus making it a good famine reserve crop.

(c) compared to other crops, cassava has few storage pests and will continue to do fairly well even when plantings are infested with weeds. Moreover, cassava can grow well even on marginal soil where other crops cannot survive. It is drought-resistant and can stay for long in the soil, so it is a crop which can be harvested year-round. It is cheap to obtain planting material as in most places stems for use as cuttings are given away free by farmers.

The cassava project was started in Masindi district in September, 1991. The main emphasis of the project was on African cassava mosaic disease (ACMD) which was prevalent in the district at the time The objectives included:

(i) test promising ACMD-resistant genotypes of cassava under farmers conditions

(ii) train both farmers and extension agents on improved cassava production and to increase their awareness of the economic importance and control of ACMD

(iii) rapidly multiply and distribute ACMD-free planting material of both local and improved varieties proven to be resistant to the disease.

Observable Indicators of Project Impact by Component

(a) *Testing of resistant genotypes*

The main objective of this component was to evaluate on-farm some high-yielding genotypes of cassava that had exhibited resistance to ACMD. The evaluation of the varieties was done with respect to resistance to ACMD, suitability in the local farming system, tuberous root yields, raw and cooked taste, maturity period and in-ground storability, etc.

Moreover, during the process of on-farm testing, a deliberate effort was made to introduce a technology package to the 'contact' farmers and neighbours. The first technology introduced was the use of resistant varieties for the control of ACMD. During the second set of on-farm trials, the

technology of using "clean" ACMD-free planting material and roguing was introduced. The trials were also used as "learning centres" for both staff and farmers.

The observable indicators of the project impact of the on-farm trial (OFT) component would therefore include:-

(i) Number of varieties tested, evaluated, approved and released

(ii) Number of farmers who had OFTs on their farms. These farmers are referred to as 'contact' farmers

(iii) Total number of contact farmers who have adopted the technological package introduced during the testing of genotypes

(iv) Total number of extension workers involved in testing genotypes under farmers' conditions. The statistics on the above indicators are provided in Tables 1 and 2.

(b) *Training component*

The training was intended to cover extension staff, opinion leaders and farmers. Topics covered during the training included:-

(i) Cassava agronomy, processing, OFTs, pests and diseases with particular emphasis on ACMD, use of resistant planting material to control ACMD.

The observable indicators of the impact of the training component include:-

(ii) Number of people trained

(iii) Number of sensitization meetings.

The statistics on the above indicators are in Table 3.

The following have also been achieved as a result of the training programme:-

(i) The management of many cassava fields has improved

(ii) Processing has improved in communities where bitter cassava is consumed

(iii) There has been a marked decline in the incidence of ACMD, as in some parts of Buliisa county

(iv) Extension agents have acquired all the technical information regarding cassava production, thus putting them in a good position to advise farmers.

(v) Civil and political leaders have come to appreciate their complementary role in helping the extension workers to disseminate technical information to the farming community.

(c) *Cassava Multiplication Component*

After evaluation of the various varieties in the OFTs, proven genotypes have been multiplied and distributed to farmers. In Masindi three officially released varieties are currently being multiplied, namely, Nase 1 (TMS 60142), Nase 2 (TMS 30337) and Migyera (TMS 30572).

Individual farmers, Government and Non-Governmental Institutions and farmers groups are multiplying the proven varieties. Under this component, the observable indicators of impact include:-

(i) Area of cassava being used for multiplication

(ii) Quantity of improved planting material distributed to farmers

(iii) Area of improved cassava in relation to the total area of cassava in the district

Relevant statistics are provided in Table 4.

Conclusion

Since the inception of the project in Masindi, there has been an increase in the cultivation of improved cassava varieties which are resistant to ACMD. The management of cassava fields has also significantly improved. The overall area of cassava in the district has been steadily increasing. All the above have led to an increase in cassava production and thus enhanced food security in the district. The statistics are provided in Table 5.

Table 1: On-Farm Trials in Masindi District from 1992 to 1995

Year	No. of trials	No. of contact farmers	No. of different staff involved	No. of varieties tested	No. of varieties released
1991/92	12	12	25	10	0
1992/93	24	24	25	8	0
1993/94	24	24	25	5	3
1994/95	16	6	25	4	0
Total	76	66	25	27	3

Table 2: Adoption rate by contact members and neighbouring farmers in Masindi district

Total no. of contact farmers	Approximate no. of neighbouring contact farmers	Contact farmers with resistant varieties	Contact farmers using 'clean' material	Contact farmers roguing	Neighbouring farmers using resistant material	Neighbouring farmers using 'clean' planting material	Neighbouring farmers roguing
76	760	70	67	67	400	360	350

Table 3: Number of seminars and sensitization meetings and attendance: Masindi

Year	Seminars		Meetings	
	Number	Attendance	Number	Attendance
1992/93	53	1,980	73	5,789
1993/94	50	3,150	52	5,200
1994/95	27	1,846	43	3,827
Total	130	6,976	168	14,816

Table 4: Current area of resistant varieties in Masindi district

Variety	Current area (ha.)	Projected area (ha.)
Nase 1 (TMS 60142	4.6	7.5
Nase 2 (TMS 30337)	107.6	348.5
Migyera (TMS 30572)	106.0	343.3
Total	218.2	699.3

Table 5 Cassava production in Masindi district

Variety	Current Area (ha.)	Output (Tonnes)
1991	2,680	30,147
1992	5,188	58,365
1993	5,880	66,150
1994	6,606	74,318
1995	6,807	76,579

PROGRESS IN CASSAVA TECHNOLOGY TRANSFER IN LIRA DISTRICT

Samuel Ebonga
District Cassava Coordinator, Lira

Introduction

Since its introduction to the district, cassava spread rapidily and was adopted by farmers mainly because of its flexibility in the farming system, diverse use as food, ability to do well under declining soil fertility, income generating ability and as a reliable food reserve.

Despite the rapid spread and adoption of this crop, cassava production has been facing several important constraints:-

(i) Cassava green mite (*Mononychellus spp.*) since the 1970s

(ii) African cassava mosaic disease (ACMD), especially since the 1980s

(iii) Isolated infestations of cassava mealybug (*Phenacoccus manihoti*) since 1993.

These have caused food shortages, loss of planting material, changes in food cultivation and eating habits, reduced family income and general food insecurity at the household level.

To alleviate these, the Root Crops Programme of Namulonge Agricultural and Animal Production Research Institute (NAARI) and the Extension Department of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) of Lira District have collaborated to implement a technology transfer programme. This began in September 1991 with financial assistance from the U.K. Gatsby Charitable Foundation. The overall aim is to improve cassava production in the district with much emphasis on the control of ACMD whose effect is the most devastating of all the diseases and pests in the district.

To achieve these objectives, the project had the following specific aims:-

(a) to evaluate on-farm the performance of improved cassava genotypes when exposed to ACMD (Tables 1, 2, 3)

(b) to rapidly multiply and distribute farmers' selected genotypes

(c) to carry out effective and self-sustaining training programmes for district staff, farmers, local authorities and opinion leaders (Tables 5, 6, 7).

On-Farm Cassava Genotype Evaluation

Because of the need to consider seasonal and site differences, resistance to ACMD has been evaluated in four series of on-farm trials (OFTs) over the last 5 years (Tables 1, 2). The overall objective of the trials was to assess the stability of the cassava genotypes within the resource base of the farmer.

The assessments were mainly based on:-

(a) ACMD resistance
(b) Genotype suitability in the cropping system
(c) Yields
(d) Tuberous root quality i.e. raw and cooked taste and mealyness
(e) Maturity period
(f) In-ground storability

The numbers of trials conducted and the varieties tested are shown in Tables 1 and 2.

Table 1: Number of On-farm Trials in different counties of Lira district

Location	1991/92	1992/93	1993/94	1994/95	1995/96
Lira	2	4	2	-	2
Bar	1	4	2	-	-
Amac	4	4	2	-	3
Dokolo	2	4	2	-	-
Total	**9**	**16**	**8**	-	**5**

Table 2: Varieties Tested On-Farm

Year	Variety Tested	Variety selected	Remarks
1991/92	TMS 30337 (Nase 2) TMS 39572 TMS 30786 TMS 30001 TMS 60142 (Nase 1) TMS 60140 TMS 4(2(1425 TMS 63397	TMS 30337 (Nase 2 TMS 60142 (Nase 1)	-
1992/93	TMS 30001 TMS 60142 (Nase 1) TMS 60140 TMS 4(2)1425 TMS 63397 SS5 SS4 SS8 Ali Mutumba	TMS 60142 (Nase 1) TMS 30337 (Nase 2) SS4	-
1993/94	SS6 SS4 SS2 89/50207 89/91934-92 89/751-7	-	Evaluation was not done due to poor establishment
1995/96	89/1988-2-UYT-PDB 89/KKWE-29 Nase 1 (check)	-	Record taking still proceeding Final evaluation not yet done

In all trials, local checks were included except in 1995/96 when Nase 1 (TMS 60142) was used.

Table 3: Farmers' Variety Preferences

Variety	Yield	ACMD resistance	Weed smothering	Inter-cropping	Time of maturity	Taste	Mealyness
TMS 30001	3	1	3	1	1	1	1
TMS 30786	1	3	2	2	1	2	1
TMS 30337 (Nase 2)	2	3	1	3	2	2	2
TMS 30572 (Migyera)	1	1	2	2	1	3	1
TMS 4(2)1425	1	3	2	2	1	2	1
TMS 60140	3	2	3	1	2	1	2
TMS 60142 (Nase 1)	2	2	3	1	2	1	2
TMS 63397	3	3	2	1	2	3	2
SS4	1	1	1	2	1	2	1
SS5	1	3	2	2	1	2	1
SS8	2	3	1	2	1	2	1
Ali Mutumba	2	4	3	1	1	1	1
89/1988-2UYT-PDB	-	1	2	2	-	-	-
89/KKWE-29	-	4	2	2	-	-	-

- Not yet evaluated

Yield: 1 = High yielding, 2 = Moderate, and 3 = Low.
ACMV Resistance: 0 = Immune, 1 = Highly resistant, 2 = Resistant, 3 = Moderately resistant and 4 = Susceptible.
Canopy: Weed Smothering: 1 = high, 2 = moderate, and 3 = Low
Inter-cropping: 1 = Good, 2 = Average, and 3 = Bad
Time to maturity: 1 = Short term - (upto 12 months), 2 = Medium term - (12 - 18 months), and 3 = Long-term (more than 18 months).
Taste: 1 = Very good, 2 = Slightly bitter, 3 = Bitter.
Mealyness: 1 = Very mealy, 2 = Moderately mealy, 3 = Hard when cooked.

Major achievement of On-farm Trials

(i) New varieties have been released to farmers

(ii). Linkage has been fostered between Research, Extension and Farmer

(iii) Farmers' knowledge of ACMD control has been improved

Cassava Stem Multiplication

A number of varieties were selected by farmers during OFTs. Considering the low multiplication ratio of cassava and the limited quantity of planting material that was available an appropriate and sustainable approach had to be adopted in order to provide quality planting material.

The following approaches were adopted:-

(a) Institutional multiplication,
(b) Group multiplication
(c) Individual multiplication

Table 4: Area of the varieties Nase 1 and Nase 2 planted each year in hectares

Year	Nase 1	Nase 2	Total
1991/92	2	2	4
1992/93	49	13	62
1993/94	175	82	257
1994/95	627	196	823
Total	**853**	**293**	**1146**

Appraisal of the approaches:

1. Institutional

Strengths

(a) It is necessary initially to multiply the limited quantity of planting material and eventually to maintain a central supply unit to ensure continuity

(b) ACMD control is done effectively as the fields are maintained by technical staff hence resulting in high quality planting material

(c) Large areas are managed resulting in massive production of planting material.

Weakness

(a) Expensive in terms of field management

(b) Remote from farmers in terms of availability of planting material and knowledge

(c) Farmers do not participate in the evaluation of the varieties

(d) Animal damage and theft are rampant where security is relaxed because there is no sense of ownership by the surrounding farmers

2. Farmers' Groups

This approach has worked well with pre-existing groups which already had an agricultural background.

Strengths

(a) Labour bottlenecks are minimal since work is done by group members

(b) Distribution is easy as it is done among the members and their relatives

(c) Farmers participate directly in evaluating the available varieties

(d) Organizing training is easy since members of the group form the participants and this leads to high attendance.

Weakness

(a) Unless a group has strong leadership and proper internal organization, it can easily disintegrate resulting in poor field management

(b) ACMD control techniques may not be practised resulting in poor quality planting material

(c) Planting material may be distributed exclusively to members of the group so restricting diffusion and adoption.

3. Individual Farmer Approach

Strengths

(a) Proper field management because there is a sense of ownership

(b) ACMD control techniques may be followed as training and planting material are provided

Weakness

(a) A tendency for farmers to sell the stems to other farmers to recoup production costs

(b) High capital investment needed which individual farmers may be unable to afford

(c) Some farmers who do not understand the effects of ACMD may not adopt control measures

Training and Farmer awareness

The poor knowledge of farmers on techniques for controlling ACMD is one of the factors that has led to the spread of the disease and hence the present problem. Consequently training and farmers awareness campaigns play a very important role in controlling this disease.

A number of trainings were carried out during the last five years (Tables 5, 6, 7).

Table 5: Number of participants trained during Awareness Compaigns in Lira district 1991/92

County	Chiefs	Agricultural staff	Other Dept. Staff	Farmers	Total
Rrute	107	13	2	71	193
Moroto	33	17	19	91	160
Dokolo	31	13	-	41	85
Kioga	52	11	12	185	259
Otuke	22	9	8	20	59
Total	245	63	41	408	756

Table 6: Number of Participants during Farmer Training

Sub-County	1992/93	1993/94	1994/95	1995/96*	Total
Bar	320	364	281	121	1086
Amac	352	358	311	115	1136
Lira	176	189	106	133	604
Dokolo	271	316	279	104	970
Total	1119	1227	977	473	3796

* In 1995/96, the number of participants indicated is for training between September and December 1995. Training continues.

Table 7: Categories of people trained.

Category	Objective
(a) District level authorities i.e. R.D.C., CAO, DLC and Heads of Departments	To create awareness and seek their support in mobilising the lower cadres of local authorities to assist in the creation of awareness at farmer level
(b) Agricultural Field Extension Staff	To train extension staff in basic aspects of cassava production and disease and pest identification, with much emphasis on ACMD so that they incorporate ACMD control techniques in their production recommendations
(c) Local authorities i.e. chiefs	To impart technical knowledge and seek their support in mobilising farmers to control the disease
(d) Farmers	To impart knowledge on ACMD control so that they treat it as part of their cultural practices for growing cassava To plan with the farmers the most effective means of multiplying and distributing the limited quantity of planting material available

Resolutions and Recommendations

The following proposals were made during the training organized during the last 5 years:-

1. Teams of local leaders and agricultural extension staff should be formed at sub-county level to create awareness.

2. Cassava and ACMD to be treated as important subjects in schools because school children can easily change the attitude of their parents.

3. The disease situation to be publicised as far as possible by use of all media available.

4. By-laws should be used as little as possible as such measures are not sustainable.

5. The group approach was recommended initially for stem multiplication with subsequent emphasis on the individual farmer approach.

Recommendation

1. A number of varieties have been tested On-Farm, but the ones that are acceptable are still few and so OFTs should be conducted with new introductions every year so that eventually there will be a wider range of cassava varieties acceptable to farmers.

2. There is need for a vigorous multiplication programme to cover the whole district. This can be achieved by establishing nuclear multiplication centres in each sub-county.

PROGRESS IN TECHNOLOGY TRANSFER IN MPIGI DISTRICT

John Lubega
District Cassava Coordinator, Mpigi

Introduction

Mpigi district in the central part of Uganda has a population of over 915,400, the majority of whom are engaged in full-time agriculture. The market potential for most agricultural produce including cassava is very high.

Cassava is a major food crop ranking second to bananas in the district. Over the past 5 years or so, there have been increasing trends in area harvested, total production and utilization. Moreover, the current trend in deterioration of soils and the increasing pest/disease problems associated with banana production indicate that cassava, may soon rank first in importance both as a food and cash crop.

Cassava Projects

A cassava multiplication project was initiated in Mpigi district in 1991 with support from the Gatsby Charitable Foundation. The objective was to alleviate the major production constraints including African cassava mosaic disease (ACMD) and to replace low-yielding varieties. The main components were research, training and the multiplication and distribution of improved cassava planting material.

Research:

The research component of the project involved varietal evaluation in on-farm trials (OFTs). The objective has been to involve farmers in the selection of suitable new technologies and to strengthen Research-Extension-Farmer linkages Selection of the best varieties to be adopted by the farmers was based on the following criteria among others:-

(i) Farmers' assessment of resistance to ACMD
(ii) Suitability in the cropping and food systems
(iii) Yield
(iv) Palatability of tuberous roots i.e. raw taste, cooked taste and mealyness.

OFTs were initiated in 1991 using four sites in each of four sub-counties. By the end of 1992, up to 39 OFTs had been set up throughout the district and by December 1995 there were 63 OFTs, of which only six await final yield evaluation. Resistance to ACMV, high yield and suitability in the cropping system were the most important attributes used by farmers as criteria for selecting new varieties. The varieties tested and those released are listed in Table 3.

Cassava multiplication and distribution activities

The objective of cassava multiplication and distribution activities is to ensure that 'clean' disease-free planting material is made available to most farmers in the shortest time possible and on a sustainable basis. Since the inception of the project in the district, farmers have been encouraged to

obtain material directly from Namulonge Agricultural and Animal Production Research Institute which is located within the district.

Furthermore, a distribution and multiplication strategy has been adopted with the aim of making the district self-sustaining in terms of supplying cassava material to the farmers. Thus, contact farmers were selected and multiplication blocks planted so as to produce enough material for further multiplication through block/group farms, schools and/or institution/Government farms.

Table 1: Cassava multiplication in Mpigi district: 1992 - 1995

Year	Sub-County	Parish	Area (Ha.)
1992	Busukuma	Busukuma	14
		Kikooko	8
	Total		**22**
1993	Busukuma	Kikooko	23
	Kikooko	Kiwenda	18
	Nangabo	Kiteesi	12
		Kiteesi	9
	Kiira	Kamuki	11
	Total		**73**
1994	Mpigi Prison Farm	Zone D	16
	Kakiiri	Kikubapanga	6
	Nabweru	Kawanda	13
	Mpigi Prison Farm	Zone D	9
	Mutumba 1	Bumozi	18
	Muduma	Nakyesanja	9
	Busukuma	Kiwenda	28
	Katabi	Kitala Prison	11
	Nangabo	Kiteezi	3
	Total		**113**
1995	Kiira	Bulindo	11
	Muduma	Nakyesanja	14
	Muduma	Busanyi	3
	Mpigi Prison Farm	Zone D	29
	Kakiiri	Kakiiri	31
	Masulita	Masulita	8
	Total		**96**

Objectives of training

The training component aims to improve cassava production with regard to agronomic practices, pest and disease control and the introduction of rapid multiplication technologies for increasing the availability of planting material of 'clean' cassava in mosaic-affected areas. This is consistent with the national policy of maintaining sustainable food security. Consequently, 23 training sessions attended by many extensionists, chiefs and farmers have been organized since 1991 (Table 2).

Achievements

(i) Farmers and local authorities have become aware of the importance of ACMD through training courses
(ii) Multiplication activities have expanded from four sub-counties to nine
(iii) The district authorities support cassava multiplication campaigns
(iv) Good resistant varieties have been selected by farmers and multiplied through OFT
(v) Extension field workers have been mobilised to support cassava-related activities

Constraints

(a) Many farmers are still ignorant on ACMD
(b) Inadequate availability of 'clean' planting material
(c) Lack of transport for field staff to mobilize and supervise farmers, particularly at 'grass roots' level
(d) Climatic factors e.g. prolonged drought.

Table 2: Training of Agricultural Extensionists and Farmers, in Mpigi District

Year	Chiefs, RCs, Farmers	Agric. Extension Staff
1991	113	53
1992	43	12
1993	243	33
1994	251	66
1995	365	18
Total	**1,015**	All extension staff

Table 3: Varieties Tested and Selected by Farmers

Year	Variety tested	Varieties selected	Remarks
1991/92	TMS 60140 TMS 60142 (Nase 1) TMS 30337 (Nase 2) TMS 4(2)1425 TMS 30572 (Migyera) TMS 30001 Ebwanateraka Bukalasa (B11) TMS 30786 Local varieties	TMS 60142 TMS 60140 TMS 30337	The three selections were based on resistance to ACMD, high yield and early maturity
1992/93	TMS 60142 (Nase 1) TMS 30786 TMS 4(2)1425 Bao TMS 30337 (Nase 2)	TMS 60142 TMS 30337	The selected varieties behaved consistently Resistant/tolerant to ACMD and high yielding
1995/96	89/1988-2-UYT/PDB Yelow R/B-35 Nase 2 (check) TMS 30337 Clonal Ev. 98 Clonal Ev. 85		Await final evaluation on maturity in March, 1996

Schedule of Work, Mpigi District 1996

Activity	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Farmer awareness	*	*			*	*		*	*	*		*
OFT site selection	*	*										
Multiplication site selection	*											
Field Preparation: OFT		*				*						
Field multiplication		*				*	*					
Planting OFT			*									
Planting multiplication			*	*				*	*			
Record OFT				*	*	*	*	*	*	*		
Weeding	*				*	*		*	*	*	*	
Harvest OFT				*								*
Harvesting multiplication				*								
Quarterly Report			*	*								
Mid-year Report						*						
Annual report	*										*	*
Field day						*					*	

PROGRESS IN CASSAVA TECHNOLOGY TRANSFER IN LUWERO DISTRICT

Ssenyonga Wilson
District Cassava Coordinator, Luwero

Introduction

Luwero district has a total land area of 8,665 sq. km. The total population is *c.* 500,000 people whose major staple is cassava, hence the need to revive cassava production.

Cassava is consumed in different forms such as fresh, boiled or steamed tuberous roots or sliced tubers that are sun-dried and then ground into flour which can be mixed with sorghum or millet flour.

Production

Cassava production decreased between 1989 and 1991, mainly due to the damage caused by African cassava mosaic disease (ACMD). In 1992, farmers responded to the low yield by increasing the area in production. In 1993, due to increased ACMD pressure, most farmers ceased growing cassava and resorted to other crops including sweet potato. The declining trend in cassava production was reversed by 1994 as a result of intervention measures by the Ugandan Root Crops Improvement Programme (URCIP) and the Gatsby Charitable Foundation. The strategies adopted to achieve this were multiplication of ACMD-resistant varieties, On-Farm Trials (OFTs) and training in ways of handling ACMD.

Objectives of the Cassava Multiplication Project

The project was conceived after a diagnostic survey of the ACMD situation in Uganda. The project began in 1988 with the following objectives:-

(i) To test the resistance of different cassava varieties to ACMD
(ii) To provide farmers with planting material of varieties resistant to ACMD
(iii) To create awareness of ACMD amongst staff, opinion leaders and farmers.
(iv) To study the whitefly vector populations and variation in the district
(v) To train farmers and opinion leaders on ACMD control measures.

On-Farm Trials

OFTs were initiated in 1989 with seven introduced varieties (Table 1). Two varieties were selected in Luwero district namely, TMS 60142 (Nase 1) and TMS 30337 (Nase 2). A few farmers took up TMS 30572 (Migyera) because of its high yields and resistance to ACMD. However, its frequent bitterness necessitates adequate processing before consumption.

In 1993, seven varieties were introduced for OFTs. These included URCIP selections SS2, SS4, SS8, SS7, SS10, 89/01438-13 and 89/91934-92; Nase 1 was used as a check. SS4 has been selected and it is hoped that it will soon be officially released.

During 1995, two other URCIP varieties were introduced for OFTs:- 89/1988-2-UYT-PDB and 89/UNKNOWN-Z. Details are in Table 1.

During 1995, two other URCIP varieties were introduced for OFTs:- 89/1988-2-UYT-PDB and 89/UNKNOWN-Z. Details are in Table 1.

Training and Awareness Campaigns

Training was initiated in 1991, particularly in the mandated counties as detailed in Table 2.

Resolutions and recommendations

1. Training to be continued up to village level
2. Resistant varieties be provided for further multiplication
3. By-laws to be formulated and implemented to control the spread of ACMD
4. Financial assistance to boost multiplication of planting material of resistant varieties should be enhanced and continued until the problem is solved.
5. Multiplication by individuals to be encouraged.

Multiplication of Resistant Cassava Varieties (Table 3)

Selection of varieties for multiplication is based on results from OFTs and farmers preferences. Three varieties have been selected and multiplied and they are being distributed:- Nase 1, Nase 2 and SS4. The first two have been released officially for multiplication and distribution to farmers. Other varieties including Bao and Migyera have also been adopted by some farmers. The major selection criteria adopted by farmers are yield and taste.

Methods of multiplication

Two approaches to cassava multiplication have been used in Luwero: institutional and individual.

Institutional multiplication. This approach has been useful, particularly in the establishment of nuclear multiplication blocks, especially in new operational areas. Eventually individual farmers receive planting material for further multiplication. Institutional multiplication is particularly advantageous at the early stages as there is full control over the availability of cassava stems and ease of distribution to farmers.

Individual multiplication. This method is the best if cassava stems are to reach most farmers. In Luwero, it is employed to further multiply the planting material grown originally in institutional blocks. Management tends to be good because farmers have a sense of ownership. The disadvantage is that other farmers may steal cuttings, or tuberous roots.

Constraints have been the lack of sufficient planting material of resistant varieties and continued cultivation of local varieties. For details of multiplication sites, locations, varieties, and areas see Table 3.

OFTs, training and awareness campaigns and multiplication of resistant varieties will continue.

On-Farm Trials

The Root Crops Programme based at NAARI identifies new and better varieties of cassava. OFTs are to be established to test such varieties before they can be released for multiplication. Interphase trials will be established in eight sub-counties for final evaluation of new varieties:- 89/1988-2-UYT-PDB and 89/UNKNOWN-Z.

Training

Farmer training is fundamental for the control of ACMD and it will continue in the 150 parishes of the district. It is expected that during 1996 there will be at least one seminar for 80 farmers and opinion leaders per parish. In all 12,000 participants are targeted for the year.

Multiplication of resistant varieties

Since 1991, the strategy has been to involve four additional sub-counties each successive year until the whole district is covered. This does not include OFTs. By December, 1995, there were cassava project activities in 8 of the 22 sub-counties in the district. During 1996, it is intended to expand by another four sub-counties bringing the total number to 12. Each of these new sub-counties is to open 4 ha. at institutions.

Conclusion

Observations show that the incidence and spread of ACMD have greatly reduced in the project operation areas. Much success has been achieved in selecting for resistance to ACMD. A more vigorous institutional multiplication and distribution system needs to be established. The multiplication project should also continue to support the URCIP since the availability of planting material of resistant varieties is still a limiting factor.

Acknowledgement

The people of Luwero wish to express their gratitude to The Gatsby Charitable Foundation based in U.K. for the financial support to Luwero district. It is the hope of Luwero that this project will continue until normal cassava production is fully restored. Sincere thanks go to URCIP for guidance and the new technologies introduced.

Table 1: Number of On-Farm Trials in Luwero District 1990-1995

Year	County	Sub-county	No. of Trials	No. of varieties	Varieties
1990	Buruli	Nabiswera	10	7	Nase 1, Nase 2, Migyera, Bao, Bukalasa 11, TMS 30786, Local (Ssenyonjo)
		Nakitoma	10	7	
		Wabinyonyi	10	7	
		Lwampanga	10	7	
		Total	**40**	**28**	
1991	Buruli	Nabiswera	2	6	Nase 1, Nase 2, Migyera, Bukalasa 11, Bao, TMS 30786
		Nakitoma	2	6	
		Wabinyonyi	2	6	
		Lwampanga	2	6	
		Total	**8**	**24**	
1992	Buruli	Nabiswera	2	5	Nase 1, Nase 2, Migyera, Bukalasa 11, Bao, TMS 30786
		Nakitoma	2	5	
		Wabinyonyi	2	5	
		Lwampanga	2	5	
		Total	**8**	**20**	
1993	Buruli	Wabinyonyi	4	8	SS4, SS2, SS7, SS8, SS10, 89/01438-13, 89/91934- 92
		Nakitoma	2	8	
		Nabiswera	1	8	
		Total	**7**	**24**	
1994	Nakaseke	Wakyato	4	3	SS4
		Nakaseke	4	3	
	Katikamu	Katikamu	4	3	TMS 4(2) 1425, Nase 1
		Butuntumula	4	3	
	Buruli	Wabinyonyi	2	5	SS4, SS8, SS7, 89/91934-92, Nase 1 (control)
		Nabiswera	1	5	
		Nakitoma	1	5	
		Total	**20**	**27**	
1995	Buruli	Wabinyonyi	6	3	89/1988-2-UYT-PDB, 89/UNKNOWN - Z, Nase 1 (control)
		Total	**6**	**3**	
1990-1995		**Total**	**89**	**126**	

Table 2: Training and Awareness Campaigns on African cassava mosaic disease in Luwero District: 1992-1995.

Location	Year	Category of people trained	Attendance	Target	Achievements (%)
Bukalasa	1992	Agricultural staff	26	70	37
Nakitoma	1992	Farmers	55	60	92
Wampiti	1992	Farmers & Opinion leaders	44	60	73
Wajjala	1992	Farmers & Opinion leaders	30	60	50
Wabinyonyi	1992	Farmers & Opinion leaders	51	60	85
Kisaalizi	1992	Farmers	49	60	82
Nakasongola	1992	Opinion leaders	31	60	52
Nabiswera	1992	Farmers & Opinion leaders	42	60	70
Total	**1992**		**328**	**490**	**67**
Nakitoma	1993	Farmers & Opinion leaders	47	70	67
Nabiswera	1993	Farmers & Opinion leaders	70	70	100
Kakooge	1993	Farmers & Opinion leaders	120	70	171
Kalungi	1993	Farmers & Opinion leaders	120	70	171
Total	**1993**		**357**	**280**	**127**
Butuntumula	1994	Farmers & Opinion leaders	62	70	89
Katikamu	1994	Farmers & Opinion leaders	70	70	100
Nyimbula	1994	Farmers & Opinion leaders	27	70	38
Kikyusa	1994	Farmers & Opinion leaders	96	70	137
Kalabala	1994	Farmers & Opinion leaders	120	70	171
Bamunanika	1994	Farmers & Opinion leaders	65	70	93
Zirobwe	1994	Farmers & Opinion leaders	26	70	37
Nakaseke	1994	Farmers & Opinion leaders	0	70	0
Wakyato	1994	Farmers & Opinion leaders	0	70	0
Ngoma	1994	Farmers & Opinion leaders	25	70	36
Kapeeka	1994	Farmers & Opinion leaders	41	70	59
Semuto	1994	Farmers & Opinion leaders	52	70	74
Luwero	1994	Farmers & Opinion leaders	107	70	153
Kikamuto	1994	Farmers & Opinion leaders	31	70	44
Kamira	1994	Farmers & Opinion leaders	89	70	127
Wabinyonyi	1994	Farmers & Opinion leaders	70	70	100
Lwampanga	1994	Farmers & Opinion leaders	80	70	114
Total	**1994**		**961**	**1190**	**81**
Luwero	1995	Agricultural, Veterinary and Fisheries staff	77	98	79
Luwero	1995	Opinion leaders at district level and staff from production departments.	107	132	81
Total	**1995**		**184**	**230**	**80**
Grand Total	**1992-5**		**1830**	**2190**	**84**

Table 3: Multiplication plots (ha.) of Resistant Cassava Varieties in Luwero District.

Location	Variety	1993	1994	1995
Wabinyonyi	Nase 1	17	45	85
	Nase 2	15	33	70
	SS4	-	1	3
	Migyera	3	3	9
	TMS 30786	3	2	2
	Bao	4	7	10
Nakitoma	Nase 1	17	60	103
	Nase 2	13	19	27
	SS4	-	1	3
	Migyera	2	7	7
	TMS 30786	3	2	-
	Bao	4	7	11
Kalungi	Nase 1	7	3	9
	Nase 1	3	2	5
	SS4	-	-	1
Kakooge	Nase 1	5	7	15
	Nase 2	5	6	11
Butuntumula	Nase 1	-	1	12
	Nase 2	-	1	7
	SS4	-	1	2
Nabiswera	Nase 1	5	19	44
	Nase 2	3	10	41
	SS4	-	0.5	1
	Migyera	1	1	2
	Bao	2	3	4
	TMS 30786	3	2	-
Kamila	Nase 1	-	-	7
	Nase 2	-	-	3
Lwampanga	Nase 1	7	10	11
	Nase 2	3	4	8
	Migyera	1	2	1
	TMS 30786	1	1	-
Katikamu	Nase 1	-	4	10
	Nase 2	-	1	4
	SS4	-	0.5	3
Wakyato	Nase 1	-	-	8
	Nase 2	-	-	4
Nakaseke	Nase 1	-	1	7
	Nase 2	-	-	2
	SS4	-	0.5	2
Total		**127**	**267.5**	**554**

PROGRESS IN CASSAVA TECHNOLOGY TRANSFER IN KIBAALE DISTRICT

Eric Karara
District Cassava Coordinator, Kibaale

Introduction

Cassava multiplication project activities in Kibaale district started mid-1992, under the Uganda Root Crops Programme based at Namulonge Agricultural and Animal Production Research Institute (NAARI). Project actitivities in the district were justified by the high incidence of African cassava mosaic disease (ACMD) that had devasted the crop. A step-wise active participatory approach was adopted. There have been three main activities: on-farm trials (OFTs), training and stem multiplication. While undertaking these activities, the farmers have been to the fore and linkages amongst all those involved have been devised and made functional. This paper presents highlights of the three activities.

On-Farm Trials

When OFTs started in Kibaale, the district had only just been formed as a separate administrative unit. The trials marked the beginning of agriculturally oriented and in particular research/extension-related projects in the district. The mission statement was communicated, discussed and modalities for implementation scheduled.

Provisional site selection (i.e. county/sub-county) was done at the district headquarters and later agreed in the field based on farmers' inputs. Criteria adopted for farmer/site selection included:- accessibility, farmers' willingness, prevalance of ACMD, and the social acceptability of the farmer in the community. At the time of farmer/site selection, the various roles were defined and discussions led to joint planning and to the identification of constraints to implementation.

The number of OFTs conducted is presented in Table 1. The number decreased in successive years because of the increased understanding gained of the differences between the various sites. It was recognised that adequate information could be obtained from fewer sites. Information collected on these trials could be broadly grouped into two categories:- researcher-oriented (i.e. disease and pest damage/distribution, crop growth, yield components and capturing of farmers' perceptions on general performance through monthly monitoring visits). Secondly, farmers' verdicts based on their own criteria. Farmers' judgement in most cases is consistent with that of researchers on very obvious research-focused aspects, but in a few cases the responses seemed surprising, although logical. The assessment process as described enabled a thorough understanding and refinement of the outcoming technologies.

Of all varieties tested, 62 and 40% were selected by farmers in 1992/93 and 1993/94, respectively (Table 2). Farmers considered resistance to ACMD, high yield and early maturity as most important. Table 3 presents farmers' preferences, of the varieties tested. During the first evaluation, the average preference response was consistent with the selected varieties. In contrast, in 1993/94 the varieties that were eventually selected and adopted differed from the average response. It demonstrated our limited understanding of farmers' adoption criteria and further affirmed the need to involve farmers in the evaluation process prior to release of any new technologies.

Training

The training component for both farmers and extensionists started in 1995. Farmers have been instructed in disease/pest identification, cassava production practices and on the processing of bitter varieties. The field extensionists were also trained and more farmers are expected to be trained through a "spill-over" effect. To date, two training courses have been conducted and the number of persons trained is presented in Table 4. At the end of the training, the following resolutions were made:-

(i) regular training courses should be arranged because of the crucial need for knowledge in the control of major cassava diseases/pests.

(ii) cassava multiplication activities should be extended to other parts of the district.

(iii) links between researchers, extensionists and farmers should be strengthened and fostered to enhance the abilities of the new district staff and to improve the quality of the project outputs.

(iv) new promising cassava varieties should be evaluated to increase the choice/diversity of varieties available to farmers.

(v) there should be informal training of all appropriate persons and fora such as monthly village council meetings, clan and family meetings were suggested.

Stem Multiplication

Multiplication of farmers' selected varieties started in 1993/94. To date, three approaches have been adopted i.e. institutional, non-governmental and individual farmers. The advantages and disadvantages of each approach are presented in Table 5.

Stem multiplication plots total 39 ha. in Kibaale district (Table 6). Multiplication started in Bugangaizi county in 1993/94 with 2 ha. of institutional multiplication and 11 ha. of improved material with farmers. In 1994/95, multiplication under institutional management comprised 77% of the total multiplication. It is projected that <30% of the multiplication in 1995/96 will be managed institutionally. This is to ensure that the results of the project reach the target group in addition to their contribution towards low-cost multiplication.

Major constraints and future plans

The quantity of improved planting material is still inadequate to meet farmers' demand. There is an opportunity to increase the scale of multiplication but funds are limiting. Moreover, the distribution of stems throughout the district is likely to be expensive because of the poor road network. Thus, the need for more multiplication centres in the district requires consideration. Furthermore, individual approach to multiplication should be put in place and be adequately facilitated e.g. provision of transport facilities to the coordinator and in-charge support staff. Finally, there is need for the operational budget to match with the local monetary value for meaningful project support to the district.

Emphasis on OFTs and farmers' training should continue. Most importantly, however, farmers' active participation should be encouraged and become paramount. During 1996, multiplication of SS4 should be started and a total of 12 ha. will be established. Overall, it is targeted to establish 64 ha. in three counties, i.e. Bugangaizi (24 ha.), Buyanja (18 ha.) and Buyaga (22 ha.). Finally, due to the increasing devastation caused by ACMD, all components of the project should continue.

Acknowledgements

The people of Kibaale are grateful to the Cassava Multiplication project for all the support and interest in cassava production in the district.

Table 1: Number of On-Farm Trials in Kibaale, 1992/93 to 95/96

Year	Location		No. of trials	No. of different varieties tested
	County	Sub-county		
1992/93	Bugangaizi	Bwanswa	4	8
	Bugangaizi	Kakindo	4	8
	Buyanja	Mugarama	4	8
	Buyanja	Bwamiramira	4	8
	Buyaga	Kagadi	4	8
	Buyaga	Mabaale	4	8
		Total	**24**	**8**
1993/94	Bugangaizi	Bwanswa	3	5
	Bugangaizi	Kakindo	3	5
	Buyaga	Kagadi	3	5
	Buyaga	Mabaale	3	5
		Total	**12**	**5**
1995/96	Bugangaizi	Kakindo	1	5
	Bugangaizi	Nalweyo	1	5
	Buyaga	Kagadi	2	5
	Buyaga	Mabaale	2	5
		Total	**6**	**5**
All Years		**Total**	**42**	**13**

Table 2: Varieties tested, and selected by farmers in Kibaale, 1992-1996

Year	Varieties tested	Varieties selected	Remarks
1992/1993	Ebwanateraka Bao Bukalasa 11 TMS 4(2)1425 TMS 30337 (Nase 2) TMS 30786 TMS 60142 (Nase 1)	TMS 4(2)1425 TMS 30337 (Nase 2) TMS 30786 TMS 60142 (Nase 1)	The four selected were based on: resistance to ACMD, high yield, and early maturity.
1993/1994	Bao Bukalasa 11 TMS 4(2)1425 TMS 30337 (Nase 2) TMS 30786 TMS 60142 (Nase 1)	TMS 60142 (Nase 1) TMS 30337 (Nase 2)	The selected varieties showed consistent, resistance/tolerance to ACMD and high yield.
1995/1996	UYT/PDB 89/1988-2 Clonal Ev. 95 Yellow R/B 35 Clonal Ev. 98 Nase 2 (check)	-	Await final evaluation in March/April 1996

Table 3: Farmers' Preferences of Varieties Tested in Kibaale, 1992-1994

Year	Preference							
	Variety	Yield	Maturity preference	Resistance to ACMV	Canopy formation	Cooked taste	Total response	Average response
1992/93	Ebwanateraka	3	3	2	2	3	13	2.6
	Bao	4	3	2	3	3	15	3.0
	Bukalasa 11	2	3	3	2	4	14	2.8
	Locals	2	1	2	2	2	9	1.8
	TMS 4(2)1425	4	4	3	4	2	17	3.4
	TMS 30337	4	4	4	4	3	19	3.8
	TMS 30786	3	3	3	4	1	14	2.8
	TMS 60142	3	2	4	2	2	13	2.6
1993/94	Bao	4	3	2	3	3	15	3.0
	TMS 4(2)1425	4	4	3	4	2	17	3.4
	TMS 30337	4	4	4	4	2	18	3.6
	TMS 30786	3	3	3	4	1	14	2.8
	TMS 60142	3	2	4	2	2	13	2.6

Value

4 = High preference
3 = Medium preference
2 = Low preference
1 = No preference indicated.

Varieties

TMS 60142 = Nase 1
TMS 30337 = Nase 2

Table 4: Field extension staff and Farmers' Trained in Kibaale District

Year	Location	Category of participants	No. trained	Target	Achievement (%)
1995	District headquarters	Field extension workers (FEW's)	29	36	81
	Kagadi URDT [a] headquarters	Members of farmer groups	25	40	62
	Total		**54**	**76**	**71**

KEY

[a] URDP refers to Uganda Rural Development and Training Programme: an NGO based at Kagadi and working with rural farmers' groups.

Table 5: Approaches adopted for stem multiplication in Kibaale District

INSTITUTIONAL APPROACH	
Advantages	**Disadvantages**
- Ease of supervision by extension staff	- Capital intensive
- Stem distribution easy	- Not sustainable
NON-GOVERNMENTAL (NGO) APPROACH	
Advantages	**Disadvantages**
- Supervision of activities by the cassava coordinator simplified	- Distribution of benefits depends on the interests of the NGO
- Rate of multiplication may depend on the approach adopted	
- Training of farmers simplified	
INDIVIDUAL FARMER'S APPROACH	
Advantages	**Disadvantages**
- Fields well managed leading to good planting material	- Rate of multiplication is slow due to dependency on family labour and small areas

Table 6: Areas of Cassava Stem Multiplication in Kibaale District 1993/94 - 1994/95

County	Sub-county	Variety	1993/94	1994/95	1995/96	Total
Bugangaizi	Kakindo	Bao	12.5	9.8	9.5	31.8
	Nalweyo	TMS	N/A	N/A	N/A	N/A
	Kiisita	4(2)1425 Nase 1 and Nase 2	N/A	N/A	N/A	N/A
Buyanga	Kyanaisoke	Nase1, Nase 2 and Bao	-	3.0	4.6	7.6
Total (ha.)		All	12.5	12.8	14.1	39.4

Data not yet available for Nalweyo and Kiisita

PROGRESS IN CASSAVA TECHNOLOGY TRANSFER IN APAC DISTRICT

O.G. Michael Edule
District Cassava Coordinator, Apac

Introduction

Apac district has long been a major cassava producing area. In 1991, there were serious epidemics of African cassava mosaic disease (ACMD) in Soroti and Kumi districts and 'clean' disease-free planting material of the varieties Bao and Aladu was obtained from Apac for distribution in the affected districts. This period, however, coincided with an upsurge of ACMD in Apac which created an acute shortage of 'clean' planting material. Following a survey in 1992, it was found necessary to initiate cassava project activities in Apac to combat the high disease incidence and the decreasing trend in cassava production.

On-Farm Trials

Trials were first established in four sub-counties of Kole and Kwania counties in 1992 (Table 1). To date 15 varieties have been evaluated and three of these were selected by farmers (i.e. Nase 1 (TMS 60142) and Nase 2 (TMS 30337)). Farmers' preferences were based on various characteristics including resistance to ACMD, high tuberous root yield, good cooked taste, early maturity, good canopy formation and fast sprouting. Based on these criteria, farmers selected 7 (47%) of the varieties tested during the two years of trials (Table 2).

Comments

The levels of achievement have been very good considering the intensity of community interactions and mobilisation.

Training (Tables 4, 5) has also been successful since additional means were established for effective dissemination of information to farmers at the "grass roots" level.

General resolutions made during training

(i) Additional training should be given to farmers

(ii) Farmers should be encouraged to adopt individual multiplication rather than institutional

Major contributions of training to participants

(i) Participants were taught cassava production constraints and measures to be taken to overcome these locally through joint efforts

(ii) Participants have been able to greatly improve the yield and area of cassava including the local varieties, through stem selection, use of 4 - 6 node cuttings for propagation, appropriate spacing, roguing and gap-filling

Table 1: Number of On-Farm Trials (OFTs) in Apac, 1992/93 and 1993/94

Year	County	Sub-county	No. of trials	No. of different varieties tested
1992/93	Kole Kole Kwania Kwania	Bala Akalo Aduku Nambieso	4 4 4 4	9 9 9 9
Total			**16**	**9**
1993/94	Kole Kole Kwania	Bala Akalo Aduku Nambieso	3 3 3 3	5 5 5 5
Total			**12**	**5**

Table 2: Farmers' selection efficiency of the tested varieties *

Year	**No. of varieties tested**	**No. of tested varieties preferred**	**Farmers' selection efficiency (%)**
1992/93	9	4	44
1993/94	5	3	60
Total	**15**	**7**	**47**

* The criteria adopted are discussed in the main text.

Table 3: Cassava stem multiplication in Apac District 1992/93 - 1995/96 in hectares

County	1992/93		1994/95			1994/95			1995/96			Total ha.
	Nase 1	Nase 2	Nase 1	Nase 2	SS4	Nase 1	Nase 2	SS4	Nase 1	Nase 2	SS4	
Kole	1	3	3	2	-	13	4	-	22	4	-	52
Kwania	-	-				3	1	< 1	7	-	-	11
Maruzi	-	-				1	2		20	27	2	52
Oyam	-	-				2	-		4	4	-	10
Total	1	3	3	2	-	19	7	< 1	53	35	2	125

Table 4: Training in Apac District

Year	List of courses	Venue	Categories of participants	No. of attendants	Targeted no.	Achievements %
Aug. - Sept. 1994	Practical skills in controlling ACMD.	Kole County (Balla Sub-county)	Farmers' representatives	200	400	50
Oct - Dec. 1994	Cassava production and its constraints in Apac	Oyam county (Loro sub-county Head-quarters)	(i) Farmers' representatives (ii) AEP staff (iii) RCs (iv) Local Leaders	60 30 30 20	400 80 50 50	15 37 60 40
Jan. 1995	Roles of RCs, Chiefs and AEP staff in promoting cassava multiplication projects and strategies adopted	Maruzi county (Apac District Headquarters)	(i) RCs (ii) Chiefs (iii) UNFA Representatives from Gombololas/Farmers	5 15 2	30 30 4	17 50 50
Feb. 1995	Practical skills in controlling ACMD in Apac	Maruzi county (Apac District Headquarters)	(i) AEP staff (ii) Farmers' representatives (iii) RCs & local leaders	0 0 10	80 400 20	0 0 50
April 1995	Socio-economic benefits of cassava in the farming system and modern production techniques	Kole and Kwania (Aduku, Akalo and Bala Headquarters)	(i) AEP staff (ii) Chiefs (iii) RCs (iv) Farmers' representatives	63 5 10 200	80 150 50 400	79 3 20 50
Total				**650**	**2224**	**29**

Table 5: **Summary of Training Achievement levels (%)**

	Number of courses conducted				
Categories of participants	**1st**	**2nd**	**3rd**	**4th**	**Total**
RCs	60	17	25	20	122
Chiefs	40	50	25	3	118
AEP staff	37	-	-	79	116
Farmers' Representatives	15	50	-	50	115
Farmers	-	29	-	50	79
UNFA Representatives	-	50	-	-	50
Opinion Leaders	-	-	25	-	25
Total	**152**	**196**	**75**	**202**	**625**

(iii) They have learnt the importance of Research-Extension-Farmer linkages in facilitating control of various diseases and pests notably ACMD and mealybug.

General Analysis

Food security as far as cassava is concerned has been greatly improved through the training given to farmers, RCs, Chiefs, AEP staff and local leaders, although total production remains low.

The cassava multiplication project continues on an upward trend (Table 3), although not all parts of the district have been covered since 1993 due to a shortage of planting material.

The strategies being adopted from 1996 will be to distribute the varieties Nase 1 and Nase 2 to individuals, groups, progressive farmers and institutions who will manage the field operations. The project will multiply SS4 institutionally to speed up the expansion of this variety, if possible by using rapid multiplication techniques.

Conclusion

The Cassava Multiplication Project was begun in Apac when farmers and local leaders were desperate to obtain planting material to sustain food security. There has been considerable improvement in production of cassava through vigorous training and sensitization of the people in the basic skills required to control ACMD.

Acknowledgements

Sincere acknowledgement are due to external donors, especially the Gatsby Charitable Foundation based in U.K., for their timely financial support.

We also appeal for further collaboration particularly in training by Researchers from NARO, MAAIF Officials, the National Cassava Task Force, and the District Cassava Task Force.

THE APPROACHES ADOPTED AND IMPACT OF CASSAVA MULTIPLICATION IN UGANDA

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Introduction

Cassava, since its introduction to Uganda in the 19th century has continued to spread in all parts of the country where it contributes up to 60% of the basic food requirement. The increased importance of cassava is attributed mainly to its relatively high productivity per unit of labour and land compared to many other crops. It serves to bridge the food gap between growing seasons and improves the internal economy of most resource-poor farmers.

However, in recent years the major constraint to cassava production in many parts of Uganda has been African cassava mosaic disease (ACMD). In some areas of the country, the crop is no longer available as a food reserve crop. Because of this declining productivity, there have been acute food shortages.

The need to bridge the food gap attracted the attention of the Government of Uganda and various developmental organizations within and outside the country. Hence a participatory paradigm was developed and implemented by Oxfam, CARE, Vision Terudo, the Agricultural Development Programme (ADP) and the Uganda Root Crops Improvement Programme under the auspices of the World Bank and the U.K. Gatsby Charitable Foundation. The participatory approach adopted by all the developmental and scientific institutions ensured that the benefits of development are equitably distributed and rural community participation is regarded as a viable approach to social development. This is based on the premise that the poor should be encouraged to participate in decision making for social and economic development at the "grass roots" level. This underlies the concept on which the cassava multiplication and distribution project was designed, institutionalized and implemented.

Aware of the central role cassava plays in the diet of the rural poor and considering the declining productivity of the crop due to ACMD and the grave implications of the declining trend in food supplies in major cassava growing districts, the different institutions sought to eliminate the soaring problems of food shortages and famine.

This paper considers the physical impacts achieved, the adoption of improved cassava varieties and the different multiplication and distribution approaches employed by the National Root Crops Programme and Non-Governmental Organisations (NGOs) in selected districts of Uganda.

Materials and methods

Oxfam, and ADP approaches in Kumi and Soroti districts

Disease-free planting material for use in Kumi and Soroti districts was sought in Apac district by visual inspection. Selected/certified disease-free stems were marked with blue paint. Prior to stem selection, the procedure was to:-

- select villages where average ACMD incidence did not exceed 1%
- identify individual fields that were away from known sources of infection. Fields were then selected where disease incidence was <5%
- select fields that were sufficiently large and upwind of any older diseased cassava fields nearby
- mark only stems with leaves which were totally free of disease symptoms
- transport the marked stems to the buying and/or loading sites with all their leaves intact. This provided an opportunity for a double check by the inspectors. The disease-free planting material was then transported to Kumi and Soroti districts for distribution to farmers.

In the Oxfam approach, cassava stems were distributed mainly to adult women in Kumi district many of whom insisted on planting their own individual plots despite the advice to plant in groups. There was some planting at institutions where block multiplication was implemented. By comparison, the ADP approach in Kumi and Soroti districts involved group multiplication. The groups were mainly specially organized for the project and there were few pre-existing ones. On maturity, stems were collected and a further ratoon crop was taken for distribution to individual group members, non-members and project-organised and existing groups within and outside the parish. The distribution was supervised by the extension staff who also trained farmers. Generally, the multiplication blocks were managed by the group members who either divided the blocks into smaller conveniently sized plots which were managed individually or the members worked together collectively on agreed days each week.

Uganda Root Crops Programme/Gatsby Approach

This approach entails on-farm trials (OFTs), training, multiplication and distribution in six selected districts:- Lira, Apac, Masindi, Mpigi, Luwero and Kibaale.

On-farm trials (OFTs) have been conducted in all six Gatsby districts. In each district four farmers were selected in each of four sub-counties. The improved cassava genotypes and the farmer's common local varieties were planted in fields prepared by the farmers. Subsequent management of the trials was conducted by the farmers using standard practices at the different stages of growth and at harvest. Farmers used their own selection criteria to assess the performance of each genotype, mainly in relation to ACMD, yield, suitability in the cropping system, raw and cooked taste and mealyness. Other variables including maturity period and in-ground storability were relatively minor criteria used at the time. These features are likely to emerge later as important

attributes when it becomes necessary to consider land as a scarce resource and the commercial value of cassava increases. Meanwhile, farmers were encouraged to multiply the preferred genotypes. The data recorded on the performance of the genotypes and farmers' assessments were used in deciding the most appropriate varieties for use by farmers.

Training: At the outset, it was considered that the extension staff did not have adequate knowledge on the most appropriate package of practices to recommend. Hence, the District Agricultural Officers, District Plant Protection officers and the two extension staff per targetted district were trained for 1-2 weeks on improved methods of cassava production, ACMD control and technologies for rapidly multiplying planting material of resistant varieties (Otim-Nape *et al.*, 1995). The trained senior extension staff were in turn responsible for training other extension staff, chiefs, opinion leaders and farmers in their district.

Multiplication and Distribution of improved varieties: The Foundation stocks of 'clean', disease-free planting material were established at Namulonge Agricultural and Animal Production Research Institute near Kampala. At maturity, the stocks were distributed to institutions, existing groups and individual farmers in the targeted districts. The subsequent ratoon crops were harvested until the plants were no longer suitable to provide planting material. Several multiplication sites were established in each district so as to reduce distribution costs and to increase the economy of scale by reducing bureaucracy.

Institutional multiplication involved borrowing or hiring land from the Ministry of Agriculture, Prison Department and/or schools. The management and distribution of the stems in this arrangement was undertaken jointly by the cassava scientists and district extensionists.

For the group multiplication approach, existing groups were selected which had an agricultural focus. The management and distribution of the crop was the responsibility of the individual groups. The district cassava team provided technical supervision and facilities at the time of planting. In contrast, the individual multiplication approach required that individual farmers should be the decision makers on the management and distribution of stems and the scientists merely provided planting material and technical backstopping.

Vision Terudo Approach

The Uganda NGO Vision Terudo has adopted both the institutional and community approaches. Institutional multiplication was conducted at colleges and was fully managed by the project. Individuals and groups participated in the community approach. Individual participation within the community was based on religious affiliation and confined mainly to Ngora county and to some extent Kumi county. The communities comprised 40-80 households from which farmers' representatives were given the opportunity to plant the initial material. The farmer representatives were trained by the field staff, who in turn trained their community members.

The group method involved pre-existing groups and also groups specially organised by the project. In this system, cassava was planted in multiplication blocks but sub-divided into plots which were managed by individual members. The members of the newly formed groups were selected on the basis of willingness and capability.

Members were first given priority at the time planting material was allocated in all categories of communities. Ratooning was practised and at least two ratoon crops were taken by the institution and communities.

CARE Approach

The basic units used by the NGO CARE International were 'farmer communities' comprising 40 - 150 households from which farmer extension representatives (FERs) were selected by the farmers. Demonstration plots were planted by each FER. Other interested farmers were supplied with 100 mini-sets of planting material. Plots 9m x 9m were used to plant Migyera (TMS 30572) and a variety of the farmer's own choice. Field management and maintenance of the demonstration plots were the farmer's responsibility.

Farmers evaluated the elite variety *vis-a-vis* the check (local) for acceptability based on desirable attributes i.e. suitability in cropping system, yield, resistance to ACMD, mealyness, maturity period, cooked taste and flour quality.

Additionally, CARE provided technical advice to the farmers through the Field Extension Officers (FEOs) directly employed by CARE and agricultural extension staff of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF).

Results and Discussion

The agricultural and rural development projects are evaluated on their effectiveness in increasing production. The assessments are quantified in terms of area and yield increases for specified crops or varieties. Oehuike *et al.,* (1992) noted that research impact is usually recognised where varieties and new agronomic methods with the potential to increase yield are adopted by farmers and result in increased production and/or lower costs. Furthermore, most rural development projects include diffusion of knowledge and use of services within the community as a desirable strategy. The pattern of cassava production and multiplication in Uganda pertains to this notion and it demonstrates to farmers thorough collective action and institutions.

Cassava Production:

Yields: On average, all the improved cassava varieties outyielded the local ones (Fig 1). The performance of the new Uganda selection SS4 was outstanding among the improved varieties and gave a four-fold yield advantage over the local. The results indicate that other cassava genotypes are suitable at farm level for further recommendation in addition to Nase 1 (TMS 60142), Nase 2 (TMS 30337), and Migyera (TMS 30572). Figure 2 shows the consistently superior performance (yield gap) of improved compared to local varieties. This gap is attributed to socio-economic and technological constraints in the adoption of improved cassava varieties. The Gatsby approach, that involves assessing the performance of the improved varieties at farm level and subsequent multiplication of the appropriate ones overcomes these adoption constraints and "adds value" to such generated technologies. This is consistent with the increased percentage yield gap between the improved and the local cassava varieties over successive years in all districts (Table 1). The yield gaps are mainly a consequence of the ACMD infection pressure encountered in the different locations.

Fig. 1

Figure 1: Yield of improved and local cassava varieties in six selected districts in 1995.

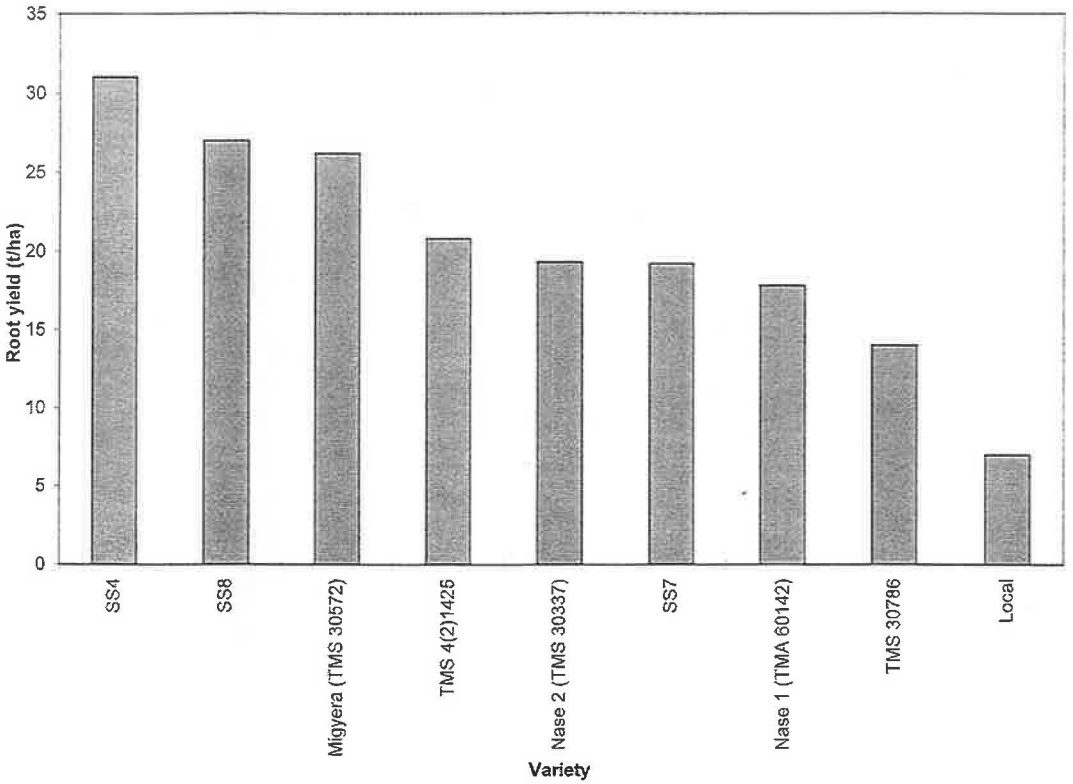


Fig. 2

Figure 2: Yield of the improved and local varieties, 1995

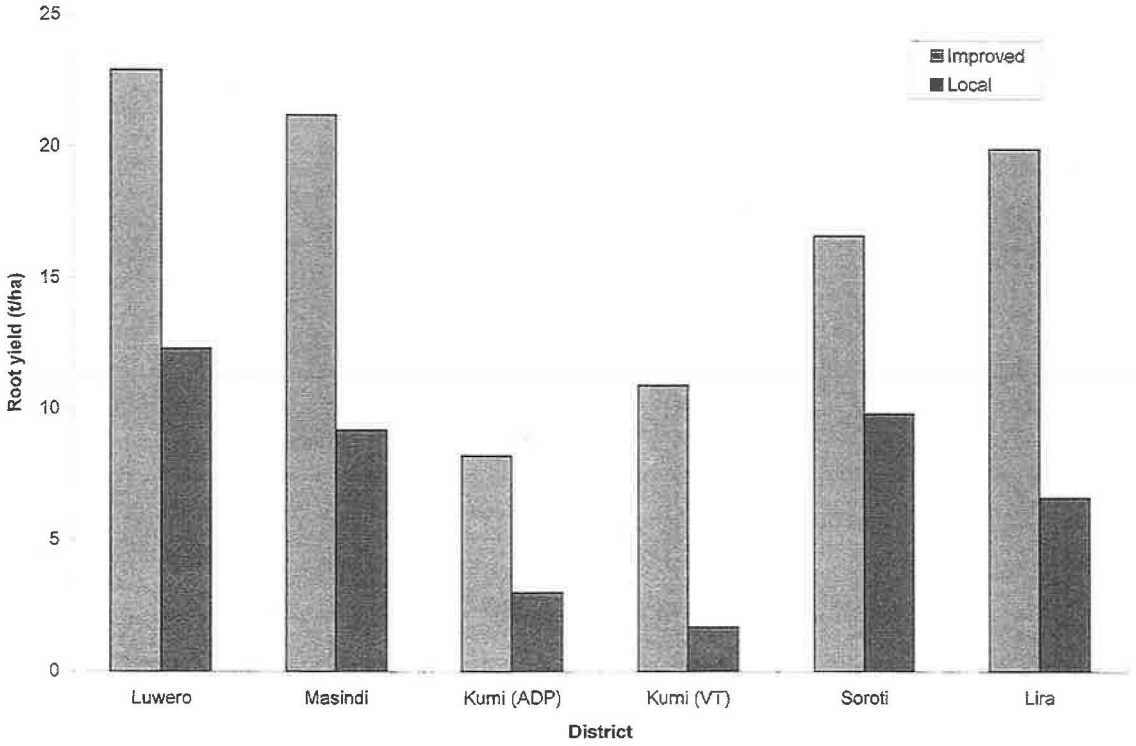


Table 1: **Tuberous root yields of improved and local cassava varieties in five selected districts of Uganda, 1993 - 1995.**

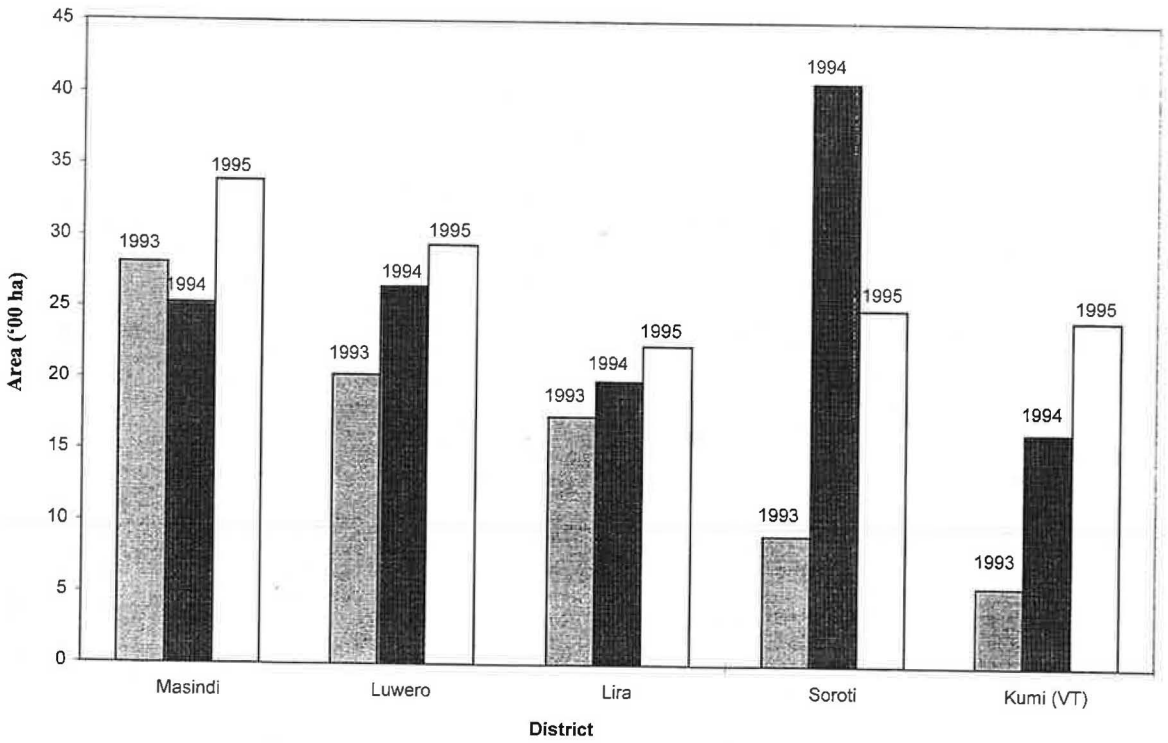
Year	1993				1994				1995			
District	Yield of improved varieties (t/ha.)	Yield of local varieties (t/ha.)	Yield gap (t/ha.)	Yield gap (%)	Improved (t/ha.)	Local (t/ha.)	Yield gap (t/ha.)	Yield gap (%)	Improved (t/ha.)	Local (t/ha.)	Yield gap (t/ha.)	Yield gap (%)
Luwero	12.2	6.4	5.8	91	12.9	6.9	6.0	87	22.9	12.3	10.6	86
Masindi	8.5	3.3	5.2	158	7.2	3.1	4.1	132	21.2	9.2	12.0	130
Kumi (ADP)	-	6.0	-	-	-	8.1	-	-	-	-	-	-
Kumi (VT)	12.9	4.3	8.6	200	11.4	3.9	7.5	192	8.2	3.0	5.2	173
Soroti	-	11.7	-	-	23.1	11.4	11.7	103	10.9	1.7	9.2	541
Lira	19.0	8.0	11.0	137	22.7	7.3	15.4	211	19.9	6.6	13.3	201

Area: The area under cassava production increased in three of the five districts during the three years 1993 to 1995 (Figure 3). However, in Masindi district, there was a decline in 1994 because of the increased campaign and incentive to maize production by the Uganda Seed Project. This 'substitution effect' and the competition by maize for the scarce labour resource is a possible reason for the decline in the area under cassava.

The big increase in area of cassava in Soroti in 1994 was due to increased activities by NGOs that introduced mostly 'clean' disease-free material of local varieties from other parts of the country. However, the local varieties readily succumbed to ACMD and their generally poor performance is reflected by the subsequent decline in area during 1995 (Figure 3).

Generally, the progressive increase in the area under cassava in three of the five districts indicates the impact of the improved varieties generated under the Gatsby and Farming Systems Support Programmes. There was a notably big increase in area under cassava in the Vision Terudo project area of Kumi due to the high concentration of planting material achieved at the limited number of selected sites. This narrow coverage may cause economic and social imbalances between communities in the short/medium term, but because of "spillover" effects and the social obligations of participants to others this gap may eventually be bridged. The Gatsby approach, in contrast, ensures wide coverage and equitable distribution of cassava stems in a medium to long-term period.

Figure 3: Area under cassava in five selected districts of Uganda, 1993-1995.



Adoption

All farmer categories: The initial increase in adoption levels showed clearly that cassava farmers appreciated the improved varieties (Figure 4a). In Luwero, Masindi and Lira districts of the Gatsby project and in Kumi supported by Vision Terudo and CARE, resistant varieties were accepted from the outset and the adoption rate was higher each successive year (Figure 4a). This was because the improved varieties address farmers' major production constraints which indicates that the strategy adopted by Gatsby, CARE, and Vision Terudo is effective, because farmers were offered appropriate technology suited to their socio-economic and natural environments. However, in the Kumi-ADP and Soroti projects where local varieties were used, there was less adoption due to the inadequate quantity of resistant material available (Figures 4a, 4b).

Meanwhile, it is apparent from Figure 4a that the adoption level in the limited Vision Terudo area of Kumi district is accelerated by the specific focus of the farmer categories covered by the project. Indeed, *c.* 95% of the farmers were using the improved varieties by 1995. This concentration of resources in a small area by Vision Terudo may in the short term, make those in the project area benefit more and become more affluent than those in the surrounding areas. Hence, an economic and social inequality could develop.

Adoption by non-participants: A measure of the diffusion of improved varieties to non-participants is vital in assessing the impact of each project. Figure 4b shows the adoption of improved cassava varieties by non-participants and reveals the substantial improvement in adoption due to the projects being operated in selected districts. The increase in the adoption level of improved varieties by the non-participants indicates the "horizontal" diffusion of new varieties within the farming communities.

Propagation plot of an improved virus-resistant variety in Luwero district, 1996

Figure 4a: Adoption level by farmers of improved varieties in the six selected districts, 1993-1995.

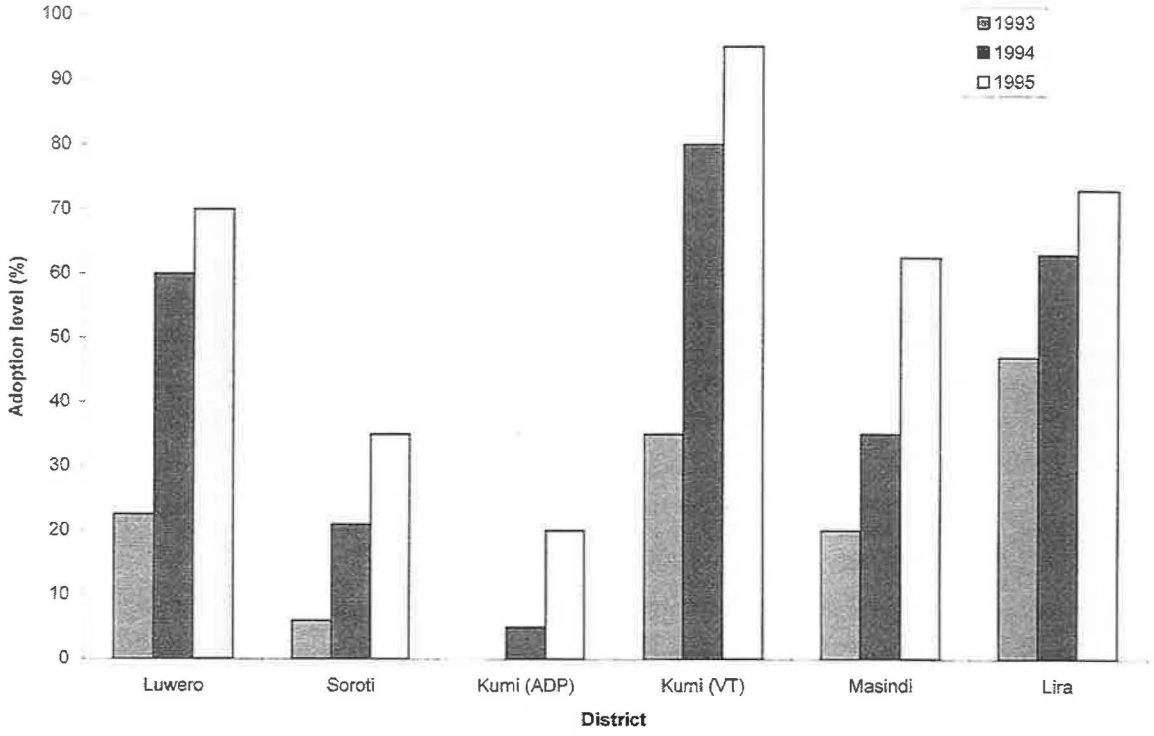
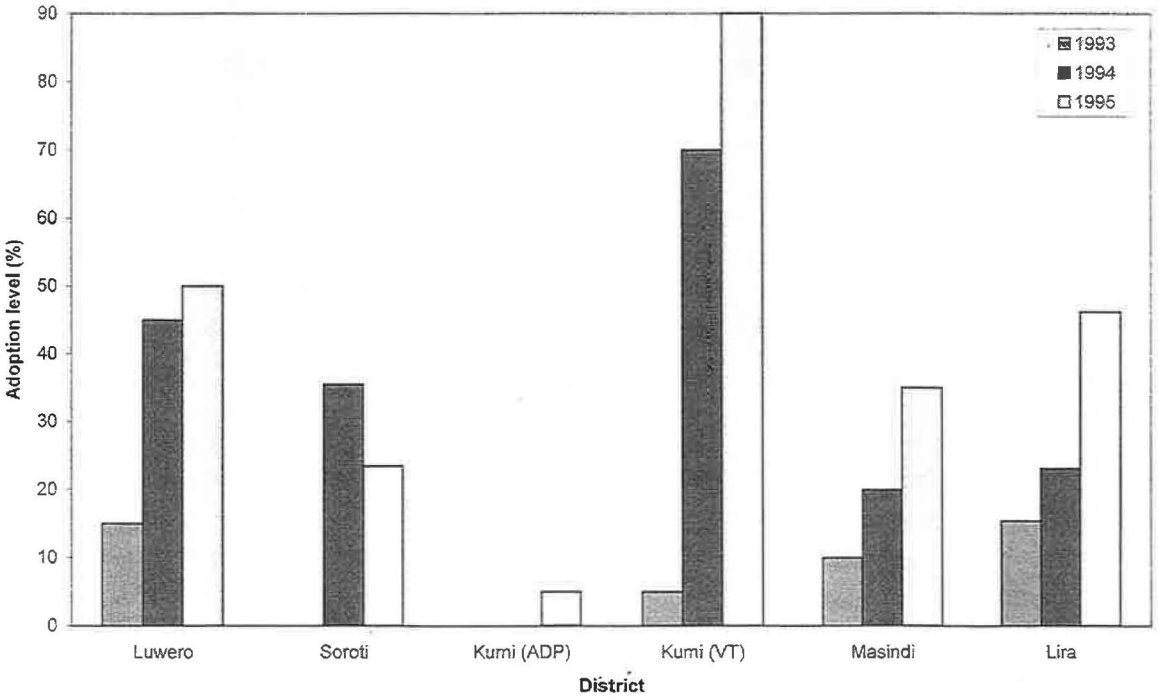


Figure 4b: Adoption level by non-participating farmers of improved varieties in the six selected districts, 1993-1995



However, there are differences in the adoption levels between districts (Figure 4b). This is due mainly to the type of varieties used, the level of awareness among farmers and the size of the project area. There was a steady increase in the adoption levels in the Gatsby districts of Lira, Luwero and Masindi due to efficient training programmes, the release of appropriate varieties and the wide coverage of the areas under the project. Meanwhile the Kumi and to some extent the Soroti ADP-supported projects experienced a decline in adoption by non-participants due to the deteriorating performance of the local varieties used which included susceptible varieties from Iganga in Kumi and only moderately tolerant varieties (Aladu and Bao) from Apac for use in Soroti district. In contrast, the Kumi Vision Terudo Project achieved high adoption levels because of the mainly small area covered by the project and use of improved varieties generated under the Gatsby and FSSP-supported OFTs. Overall, Gatsby approaches have, in the long run, made enormous achievements and proved to be a sustainable approach in the transfer of appropriate technologies to Ugandan resource-poor farmers.

Training

These are visible indicators of an increase in the level of advice provided and in farmers' knowledge as a result of contact with research and extension agents (Figures 5a-c). By 1995, there was greater awareness among the extension agents, opinion leaders and farmers of the ways in which ACMD spreads and on its control than before the inception of the Gatsby project. Figures 5a-c emphasize the collaboration of the local staff, NGOs and research as a training component of the cassava multiplication and distribution strategy. This has resulted in training of most of the extension agents in each of the project districts between 1992 and1995 (Figure 5a). However, extensive training of farmers and opinion leaders especially in the districts of Mpigi, Apac and Kibaale is desirable so as to bridge the "knowledge gap" and increase awareness of ACMD spread and control in the districts.

Comparison and implications of different approaches

Table 2 summarises the wide range of cassava multiplication and distribution schemes employed by government, NGOs and other development institutions. The pertinent feature common to all the approaches was the participatory strategy adopted. This was done with the explicit notion that farmers should be encouraged to participate in decision-making to achieve social and economic development at the "grassroot" level. Indeed, Midgley (1986) asserts that social progress is accelerated by involving rural resource-poor farmers in the development process. The view is held by many promotors of community participation that poor farmers have an inherent capacity for participation and that they are not only able to organize themselves but already do so.

Table 2 shows the differences in the type of community chosen by each project. While most projects provided resource-poor farmers with an equal opportunity to participate, Vision Terudo tended to concentrate on those of a particular religious denomination. Perhaps this explains the apparently rapid diffusion of the improved cassava varieties achieved quickly. By comparison the Gatsby and FSSP approaches entailed and emphasised at the outset on-farm experimentation besides other components common to all (Table 2).

This recognised that the success of all these projects could be achieved through the use of improved varieties which are suitable to the socio-economic and biophysical environments of farmers. It empowers the sustainability and cost effectiveness that characterised the Gatsby approach in technology generation and transfer. In contrast, both Oxfam and Kumi ADP used local varieties

Figure 5a: Number of extensionists trained in the six Gatsby supported districts, 1992-1995

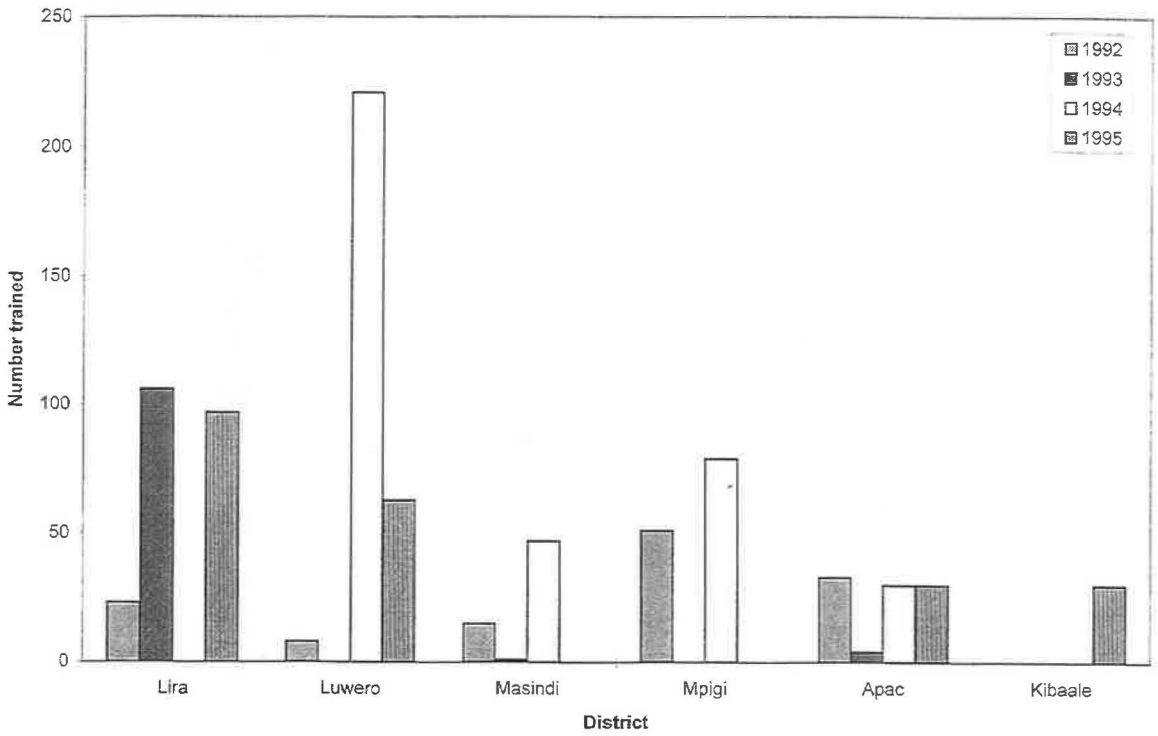


Figure 5b: Number of farmers trained in the six Gatsby supported districts, 1992-1995

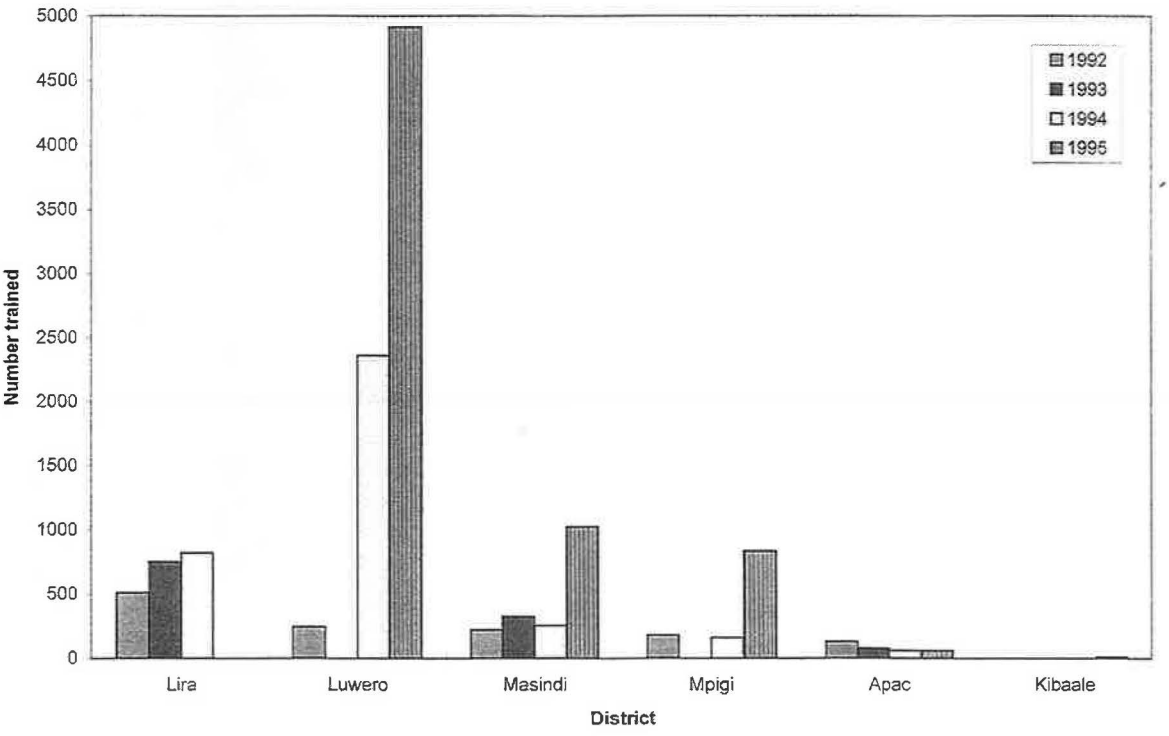
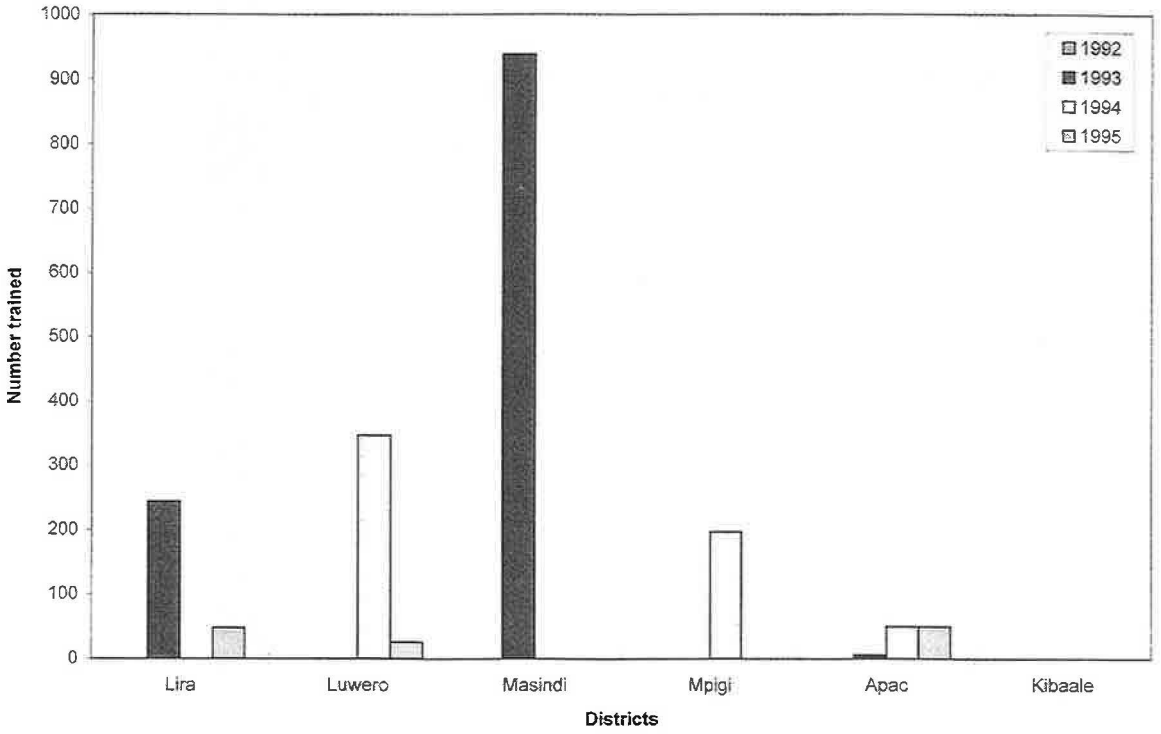


Figure 5c: Number of opinion leaders trained in the six Gatsby supported districts, 1992-1995



that could not withstand the high disease pressure prevailing at the time, and achieved little. This failure was aggravated by weak linkages between research, extension and farmers for technical support (Table 2).

Meanwhile, the FSSP project suffered from lack of continuity to the extent that the local people were left with an incomplete and unfulfilled project. Hence, government must formulate national policies and design programmes that are implemented with full state intervention such that the programmes are sustained effectively even after all external support has been withdrawn. This implies that reliance on such arrangement without government commitment may not necessarily solve long-term problems. There is a need to strengthen state-society relationships and for consensus in the design and implementation of rural-oriented programmes. Midgley (1986) affirms the need for a more realistic and appropriate concept of community participation to enhance state and community involvement in social development.

Table 2: Comparison of the various approaches to cassava multiplication used by different Institutions and NGOs

NGO/Institution	Training	OFTs	Material used for multiplication	Multiplication approaches	Distribution method	Remarks
Uganda Root Crops Programme (Gatsby)	- Researchers - Extension workers - District Heads of Department - Opinion Leaders - Farmers	Conducted	Improved cassava varieties by the farmers	Mixture of individual, existing farmer groups and institutions	Farmer to farmer Institution to farmer Institution to groups Group to Group members Group to groups Group to non-group members	Strengthens and consolidates linkages between stake holders Sustainable and suitable for medium to long-term strategies Cost effective and increases income. Group cohesiveness strengthened Clear success because of farmer involvement in the selection of appropriate varieties Covers wide area, hence flexible
Vision Terudo	Farmers- Community agricultural workers	None	Improved varieties recommended by researchers	Mainly community. Few institutions and individuals	Community to community Community to community members Community to other individuals Individual to individual Institution to individual Institution to community	Strengthen linkages between communities and community agricultural workers Strong research-NGO-farmer linkages Farmer-to-farmer linkages increased Group cohesiveness maintained Sustainable and suitable for short and medium tem strategies Covers specific project area and it is rigid. Success depends on availability of appropriate improved varieties No NGO-Research-Extension linkages Creates income inequity between participants and non-participants
CARE	FERs FEOs (Pre-Season Workshop)	Demonstration plots	Improved varieties recommended by researchers	Mainly community and some individual instititions (Abi VTCs)	Farmer-to-farmer NGO-to-farmers	- Ratooning not practised therefore rate of spread minimal - Sustainable and suitable when improved varieties are available - Good linkage between research and NGO. - Weak linkage between research-extension & farmers
ADP/Soroti	Farmers	None	Improved and local (Bao & Alado) selected by researchers	Farmer groups organized by the project	Farmer groups to Individuals Group members	- Sustainable only where ACMD pressure is low - Increased rate of spread of material - Stimulates linkages between extension and farmers - Strict sanitation being practised
ADP Kumi	Farmers	None	Local varieties selected by Extension staff	Farmer groups organized by the project	Within group members Farmer groups to Individuals	- Most varieties highly susceptible hence not sustainable. - Not cost-effective - No linkage between Research-Extension or farmers - Successful where ACMD pressure is low
FSSP		Conducted	Farmer selected varieties.	Individual farmers	Farmer to farmer	- Incomplete planning - Unpredictable success - Very slow
Oxfam	Farmers	None	Locals selected by researchers	Mainly individual women	Farmer to farmer	- Rate of diffusion poor because most varieties were susceptible - Not cost-effective & sustainable - Very weak linkage between Research-Extension & farmers - Successful in emergency situation and where mosaic pressure islow - Sustainable if highly resistant variety is used - Ensures access to planting material by the social-economic disadvantaged.

Conclusions and Recommendations

Conclusions: The various cassava multiplication projects in Uganda have had different degrees of success as related to the particular paradigm adopted and the level of community organization and participation (Table 2). Experience gained from the study indicates that the socio-economic determinants and the ACMD infection pressure encountered influence the choice of the most appropriate multiplication and distribution system. It was clear that these factors had been important in the adoption and production levels achieved in most districts, except in the Oxfam and Kumi ADP in the medium to long-term due to project implementation. This implies that new technologies can make enormous achievements which are sustainable and promote an equitable pattern of development, as notably achieved in the Gatsby project districts and eventually in the CARE, Vision Terudo and Soroti districts.

Generally, there is a wide adoption of improved cassava varieties, because such varieties meet most of the attributes of interest to farmers, especially resistance to ACMD and high yields. It is also possible that the wide adoption is due to extensive training of extension staff, opinion leaders and farmers, especially in Gatsby districts and the contribution by private institutions and NGOs. It is apparent that access to reliable information facilities adoption of improved technologies. Hence, a widespread adoption of the improved varieties is relevant to a rural society's cohesion and 'parity of esteem' so that all classes can advance together towards higher levels of income and technology (Casley and Kumar, 1990).

Recommendation: Many socio-economic and biophysical factors influence the extent and the value of the technology transferred by research and/or development organisations. The efforts to transfer such technologies to farmers should address and concentrate on the main limiting factors influencing production. It is noteworthy that farmers' involvement in the design and implementation of the projects achieves significant changes in social and economic conditions at the "grass roots" level.

Meanwhile the breeding of cassava varieties for high levels of resistance to ACMD (e.g. SS4) to reduce the risk of infection and facilitate control can accelerate the adoption of such varieties by farmers and encourage extension advice for resource-poor farmers. Farmer-friendly institutions (e.g. NGOs) must improve their technical capacity and expand their coverage without adversely affecting their flexibility, social cohesiveness and concern for farmer participation. The partial solution is to promote coordination among NGOs and between NGOs and research and extension institutions, as in the Gatsby approach.

Government organisations should institutionalize the facts of bargaining, trade-offs and exchange of ideas and experiences with local communities and NGOs rather than operate independently of these key players in community programmes.

Generally, a mixture of approaches and methods should be adopted to enable Ugandan farmers to share, enhance and analyse their knowledge of life and conditions to plan, act and adopt different cassava recommendation packages. However, it is not usually possible in agricultural and development projects to establish with any precision the rate of production change within a limited time. Hence, it is recommended that the evaluation of agricultural and rural development falls within the confines of what is possible and that the evaluators have a role to define these and offer the available evaluation options. For instance, the appropriate time-frame for a programme with crop such as cassava should extend to 5-10 years.

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THE UPTAKE OF IMPROVED VARIETIES IN THE SIX GATSBY PROJECT DISTRICTS

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Introduction

By the 1980s cassava was one of the most important food crops in Uganda. It ranked second to banana in terms of area occupied, total production and *per capita* consumption. Besides being a major subsistence crop for the majority of rural peasants, it was grown for cash oriented purposes. The crop was also important as a famine reserve. The poor marketing system and unattractive prices of the traditional cash crops such as coffee, cotton and tobacco greatly contributed to increased cassava production.

Despite the positive attributes mentioned above, the productivity of cassava in Uganda (8t ha^{-1}) is considerably lower than the world average (11t ha^{-1}). This has been attributed to the use of inferior low-yielding varieties, lack of good quality planting material, poor price incentives, labour bottlenecks and poor agronomic practices. Pests and diseases, however, are the biggest constraints to cassava production. African cassava mosaic disease (ACMD) is the major disease and in recent years it has caused serious losses, food shortages and famine in many areas.

Various interventions have been made to control ACMD, including the release of high-yielding cassava varieties (notably Nase 1, Nase 2 and Migyera) which are acceptable to farmers and have good levels of resistance to ACMD. These varieties were released by the National Root Crops programme and have contributed significantly to national food security.

The multiplication and distribution of resistant, virus-free planting material has followed different approaches involving individuals, groups, community and institutional participation through NGOs and the Ugandan Root Crops Programme. The most successful has been the Gatsby project begun in 1991 and operating in the six districts of Apac, Kibaale, Lira, Luwero, Masindi and Mpigi.

This paper reports the results of a pilot survey to assess the uptake of the new varieties in the six Gatsby districts and the extent to which they are being grown within and outside the project areas.

Methodology

In each Gatsby district, the main cassava growing counties were identified. Of these, up to three were selected at random and sampled. Within the selected counties, twenty farmers were sampled at random and interviewed. Information was obtained on the total area cultivated, the total area under cassava and the total area under improved cassava varieties.

Results

Substantial areas were being cultivated in each of the 42 sub-counties assessed. The areas ranged from 12.1 ha to 127.1 ha in each of the 23 sub-counties participating in the Gatsby project (mean 30.2) and from 8.9 ha to 116.2 ha in the 19 sub-counties not participating (mean 31.9).

Cassava was being cultivated extensively in each of the sub-counties. The areas ranged from 3.2 ha to 46.6 ha in each of the participating counties (mean 14.5) and from 3.2 ha to 24.3 ha in those not participating (mean 12.1). The proportion of cultivated land that was planted to cassava was up to 87% in the participating sub-counties (mean 66%) and up to 81% elsewhere (mean 48%). Substantial areas of cassava had been planted with improved varieties in the participating sub-counties, where the areas ranged from 0.8 ha to 30.8 ha (mean per sub-county 8.2). The improved varieties were less widely grown in the non-participating areas and they were not recorded in two of the sub-counties assessed. Up to 7.3 ha were recorded elsewhere and the overall mean was 2.4 ha.

The proportion of the cassava area planted with improved varieties ranged from 18 to 78% in the participating sub-counties (mean 57%) and from 0 to 40% elsewhere (mean 20%). The use of improved varieties was greatest in the participating sub-counties of Luwero (69%) and Apac (62%) and least in those of Lira (36%) and Mpigi (42%).

Considerable 'spill-over' was apparent in five of the six districts from the extent to which the improved varieties were being grown in sub-counties where the Gatsby project has not been active. Uptake was greatest in the non-participating areas of Luwero (33%) and Masindi (24%) and least in Mpigi, where improved varieties were not recorded in the one sub-county assessed, and Kibaale (8%).

Apac District (Table 1). There has been considerable progress in all four participating sub-counties that were assessed and overall improved varieties accounted for 62% of all the cassava being grown. There was also a spill-over effect to two of the three non-participating sub-counties assessed and overall improved varieties accounted for 16% of the total area of cassava being grown outside the project areas.

Kibaale District (Table 2). Substantial spread of improved cassava has been achieved since the initiation of the cassava multiplication project in the district in 1994, especially in the Gatsby project areas. However, there are big differences in the extent of adoption between sub-counties and these are associated with the proximity and accessibility of the multiplication sites and the level of awareness among farmers.

Lira District (Table 3). There is a considerable area of improved cassava in the district, especially in the Gatsby project areas. However, the improved material is thinly diffused and planted in small plots. Nevertheless, a considerable proportion of the farming community has access to improved material. The diffuse pattern of cassava production in the district resulted from the intervention of various institutions and organisations, but the Gatsby-supported sub-counties are the main source of planting material. All participating organisations need to integrate their activities so as to reduce the incidence of infection and the loss of planting material being experienced due to dry season harvesting, goats and sale into other districts.

Luwero District (Table 4). Cassava plays an important role in the farming, food and commercial system of the district. This has provided the impetus for the widespread uptake of the improved varieties in the project areas and to a lesser extent elsewhere. Overall, Luwero district has performed better than other districts which is associated with long-term activities of the Gatsby project which has operated in the district since 1991.

Masindi District (Table 5). There has been substantial progress in the district, within and outside the project areas. Furthermore, there has been limited substitution of cassava by other crops so that cassava has retained its importance in the food system and increased in commercial value. The degeneration and loss of planting material may have been limited because of the moderate infection pressure exerted by ACMD. However, there is need to diversify the cassava varieties being grown in the district to ensure sustainability of cassava production and to stimulate the cultivation of appropriate varietal mixtures.

Mpigi District Table 6). The cassava multiplication and distribution effort has encountered a problem due to initial emphasis on Bao and Ebwanateraka which are susceptible to ACMD and were largely wiped out as the disease moved into the area over the last two years. There is a need to expedite the propagation of suitably resistant varieties for which there is now a great demand. Nevertheless, the release of Bao and Ebwanateraka in Mpigi served to bridge the food gap that existed at the time. Hence their contribution to development in the district should be recognized, even though they later succumbed to ACMD and are being replaced by more resistant varieties.

Overall Project Scope

The variation in the adoption rates between different districts can be attributed to differences in the infection pressure experienced, the extent of the interventions by the various organisations concerned with cassava rehabilitation, the type of varieties transferred, the methods adopted for propagation and distribution and by other socio-economic and biophysical factors. This implies the need to understand the factors that determine sustainable cassava multiplication and distribution systems if there is to be meaningful implementation of the project.

Generally, socio-economic factors and the infection pressure imposed by ACMD were important in influencing the dissemination of cassava in all districts. This implies that improved varieties can eventually make enormous achievements in improving food supplies and eventually the economic status of the farming community in Uganda.

Meanwhile, the breeding of cassava varieties for resistance to major pests and diseases, particularly ACMD and cassava mealybug, needs to be emphasised and suitably resistant varieties should be multiplied vigorously and distributed within the country. The roles of government and non-governmental organisations should be streamlined and strengthened. These collective strategies will encourage the sustainable production of improved cassava varieties in Uganda.

Table 1: Survey data (ha.) for seven selected sub-counties of Kwania (Ka), Kole (Ke) and Maruzi (M) counties of Apac district: 1996

Sub-County	Cultivated area sampled	Sampled area under cassava	Sampled area under improved cassava	Area under cassava as % of cultivated area	Area under improved cassava as % total cultivated area	Area under improved cassava as % total cassava area
Participating (4):						
Bala* (Ke)	27.9	13.8	10.1	49	36	73
Akalu* (Ke)	37.2	18.6	10.1	50	27	54
Atopi* (M)	127.1	46.6	30.8	37	24	66
Aduku/Inomo* (Ka)	27.1	16.6	8.5	61	31	51
Sub-total	*219.3*	*95.6*	*59.5*			
Mean per sub-county	*54.8*	*23.9*	*14.9*	*44*	*27*	*62*
Non-participating (3):						
Chegere (M)	31.2	12.1	0	39	0	0
Ayer (Ke)	29.6	14.2	0.8	48	3	6
Aboke (Ke)	36.0	20.6	6.9	57	19	33
Sub-total	*96.8*	*46.9*	*7.7*			
Mean per sub-county	*32.3*	*15.6*	*2.6*	*48*	*8*	*16*
Total (Mean)	**316.1**	**142.5**	**67.2**	**(45)**	**(21)**	**(47)**

* Sub-counties which participated in the Gatsby project

Table 2: Survey data (ha.) for five selected sub-counties of Bugangaizi (Bi) and Buyaga (Ba) counties of Kibaale district: 1996

Sub-County	Cultivated area sampled	Sampled area under cassava	Sampled area under improved cassava	Area under cassava as % of cultivated area	Area under improved cassava as % total cultivated area	Area under improved cassava as % total cassava area
Participating (3):						
Nalweyo* (Bi)	20.2	4.5	2.4	22	12	53
Kakindo* (Bi)	20.2	5.7	1.2	28	6	21
Mabaale* (Ba)	21.9	5.3	4.0	24	18	75
Sub-total	*62.3*	*15.5*	*7.6*			
Mean per sub-county	*20.8*	*5.2*	*2.5*	*25*	*12*	*49*
Non-participating (2):						
Kagadi (Ba)	21.5	4.9	0.4	23	2	8
Muhorro (Ba)	28.3	5.7	0.4	20	1	7
Sub-total	*49.8*	*10.6*	*0.8*			
Mean per sub-county	*24.9*	*5.3*	*0.4*	*21*	*2*	*8*
Total (Mean)	**112.1**	**26.1**	**8.4**	**(23)**	**(7)**	**(32)**

* Sub-counties which participated in the Gatsby project

Table 3: Survey data (ha.) for ten selected sub-counties of Erute (E) and Dokolo (D) counties of Lira district: 1996

Sub-County	Cultivated area sampled	Sampled area under cassava	Sampled area under improved cassava	Area under cassava as % of cultivated area	Area under improved cassava as % total cultivated area	Area under improved cassava as % total cassava area
Participating (4):						
Adekokwok* (E)	19.0	10.9	3.6	57	19	33
Amac* (E)	30.0	10.5	5.3	35	18	50
Dokolo* (D)	13.0	3.2	0.8	25	6	25
Bar* (E)	13.0	5.7	1.2	44	9	21
Sub-total	*75.0*	*30.3*	*10.9*			
Mean per sub-county	*18.7*	*7.6*	*2.7*	*40*	*15*	*36*
Non-participating (6):						
Aromo (E)	31.2	11.3	0.8	36	3	7
Ogur (E)	17.0	6.9	1.2	41	7	17
Agwata (D)	27.1	12.6	0.8	46	3	6
Bata (D)	18.6	7.7	0.8	41	4	10
Kangai (D)	18.2	7.7	0.8	42	4	10
Kwera (D)	21.4	13.0	1.6	61	7	12
Sub-total	*133.5*	*59.2*	*6.0*			
Mean per sub-county	*22.2*	*9.9*	*1.0*	*44*	*4*	*10*
Total (Mean)	**208.5**	**89.5**	**16.9**	**(43)**	**(8)**	**(19)**

* Sub-counties which participated in the Gatsby project

Table 4: Survey data (ha.) for nine selected sub-counties of Buruli (B) and Katikamu (K) counties of Luwero district: 1996

Sub-County	Cultivated area sampled	Sampled area under cassava	Sampled area under improved cassava	Area under cassava as % of cultivated area	Area under improved cassava as % total cultivated area	Area under improved cassava as % total cassava area
Participating (5):						
Lwampanga* (B)	25.9	13.4	10.1	52	39	75
Wabinyonyi* (B)	23.5	10.1	7.7	43	33	76
Nabiswera/ Kadobo* (B)	31.2	15.4	6.9	49	22	45
Nabiswera/ Namakukulu* (B)	24.3	12.6	9.3	52	38	74
Wajjala* (B)	53.8	30.4	22.7	57	42	75
Sub-total	*158.7*	*81.9*	*56.7*			
Mean per sub-county	*31.7*	*16.4*	*11.3*	*52*	*38*	*69*
Non-participating (4):						
Kalungi (B)	41.3	17.0	4.5	41	11	26
Kamira (B)	35.2	7.7	2.0	22	6	26
Kakooge (B)	39.7	18.2	7.3	46	18	40
Katikamu (K)	24.7	6.1	2.4	25	10	39
Sub-total	*140.9*	*49.0*	*16.2*			
Mean per sub-county	*35.2*	*12.2*	*4.0*	*35*	*11*	*33*
Total (Mean)	**299.6**	**130.9**	**72.9**	**(44)**	**(24)**	**(56)**

* Sub-counties which participated in the Gatsby project.

Table 5: Survey data (ha.) for seven selected sub-counties of Bullisa (Ba), Kibanda (K) and Buruli (Bi) counties of Masindi district: 1996

Sub-County	Cultivated area sampled	Sampled area under cassava	Sampled area under improved cassava	Area under cassava as % of cultivated area	Area under improved cassava as % total cultivated area	Area under improved cassava as % total cassava area
Participating (4):						
Buliisa* (Ba)	37.7	32.8	17.4	87	46	53
Kigumba* (K)	32.8	23.9	18.6	73	57	78
Miirya* (Bi)	30.0	10.9	2.0	36	7	18
Pakanyi* (Bi)	31.6	20.2	7.7	64	24	38
Sub-total	*132.1*	*87.8*	*45.7*			
Mean per sub-county	*33.0*	*21.9*	*11.4*	*66*	*35*	*52*
Non-participating (3):						
Biiso (Ba)	25.5	20.6	5.7	81	22	28
Budongo (Bi)	33.6	15.4	2.4	46	7	16
Bwijanga (Bi)	116.2	24.3	6.1	21	5	25
Sub-total	*175.3*	*60.3*	*14.2*			
Mean per sub-county	*58.4*	*20.1*	*4.7*	*34*	*8*	*24*
Total (Mean)	**307.4**	**148.1**	**59.9**	**(48)**	**(19)**	**(40)**

* Sub-counties which participated in the Gatsby project

Table 6: Survey data (ha.) for four selected sub-counties of Kayadondo county in Mpigi district: 1996

Sub-County	Cultivated area sampled	Sampled area under cassava	Sampled area under improved cassava	Area under cassava as % of cultivated area	Area under improved cassava as % total cultivated area	Area under improved cassava as % total cassava area
Participating (3):						
Busukuma*	12.1	4.9	2.0	40	17	41
Nangabo*	19.0	8.5	5.3	45	28	62
Kiira*	16.6	8.5	2.0	51	12	24
Sub-total	*47.7*	*21.9*	*9.3*			
Mean per sub-county	*15.9*	*7.3*	*3.1*	*46*	*19*	*42*
Non-participating (1):						
Gombe	8.9	3.2	0	36	0	0
Sub-total	*8.9*	*3.2*	*0*			
Mean per sub-county	*8.9*	*3.2*	*0*	*36*	*0*	*0*
Total (Mean)	**56.6**	**25.1**	**9.3**	**(44)**	**(16)**	**(37)**

* Sub-counties which participated in the Gatsby project

Table 7: Survey data (ha.) for 23 participating and 19 non-participating sub-counties in the six Gatsby districts: 1996

District	Cultivated area sampled	Sampled area under cassava	Sampled area under improved cassava	Area under cassava as % of cultivated area	Area under improved cassava as % total cultivated area	Area under improved cassava as % total cassava area
Participating sub-counties of:-						
Mpigi (3)	47.7	21.9	9.3	46	19	42
Luweru (5)	158.7	81.9	56.7	52	38	69
Masindi (4)	132.1	87.8	45.7	66	35	52
Lira (4)	75.0	30.3	10.9	40	15	36
Apac (4)	219.3	95.6	59.5	44	27	62
Kibaale (3)	63.2	15.5	7.6	25	12	49
Sub-total (23)	*695.1*	*333.0*	*189.7*			
Mean per sub-county	*30.2*	*14.5*	*8.2*	*48*	*27*	*57*
Non-participating sub-counties of:-						
Mpigi (1)	8.9	3.2	0	36	0	0
Luweru (4)	140.9	49.0	16.2	35	11	33
Masindi (3)	175.3	60.3	14.2	34	8	24
Lira (6)	133.5	59.2	6.0	44	4	10
Apac (3)	96.8	46.9	7.7	48	8	16
Kibaale (2)	49.8	10.6	0.8	21	2	8
Sub-total (19)	*605.2*	*229.2*	*44.9*			
Mean per sub-county	*31.9*	*12.1*	*2.4*	*38*	*7*	*20*
Total (42) (Mean)	**1,300.3**	**562.2**	**234.6**	**(43)**	**(18)**	**(42)**

QUESTIONS AND COMMENTS ON THE PAPERS PRESENTED

Questions/Comments on paper presented by Dr G.W. Otim-Nape: - Head of Programme - Cassava.

L. Cockcroft: What is the basis of the figure of 150,000 ha. loss of production?

Reply: This is based on the total cassava area destroyed in different districts of Uganda.

L. Cockcroft: Does Gatsby Phase 2 include all counties in each district or just target sub-counties?

Reply: Initially four sub-counties per district but later we added additional ones according to the size of the district.

B. Mubiru: Which districts were/are in the pilot and main phases of the multiplication programme?

Reply: Pilot phase: Lira, Masindi and Mpigi. Phase 2: Lira, Mpigi, Masindi, Luwero, Apac and Kibaale.

Questions/Comments on paper presented by Samuel Ebonga: DCC, Lira

J.M. Thresh: On the point of presenting results on the suitability of varieties, there is a need for uniformity. One speaker used a ranking where "1" is best, whereas a previous speaker used a score of "1" as least satisfactory i.e the exact opposite. This is confusing and inappropriate

Response (audience):
Agreed.

A. Bua: (comment):
Districts should be encouraged to use schools as training sites so as to ensure quick flow of information to the farming community.

Response: Training at schools will start this year by training teachers of post-primary schools in the district.

A. Bua (comment):
District coordinators should salvage OFT genotypes being used in the districts to assess their impact and for possible release.

Response: Stocktaking of OFT genotypes will be done and lists will be forwarded to NAARI in due course.

J.M. Thresh: When farmers judge varieties according to the yield of Bao, do they have in mind healthy Bao or infected?

Response: They still dream of the Bao of the early 1980s which was not infected and they feel that any new variety that is introduced should out-yield uninfected Bao.

G.W. Otim-Nape:
The area being multiplied is not increasing by a factor of 5-10 as was expected. Why?

Response: Some stems are stolen from the propagation sites and cannot be traced. What has been presented is what is on record and being managed by the project.

G.W. Otim-Nape:
TMS 30001 and SS4 are being grown in the district. You need to take account of this.

Response: Efforts will be made to do this.

L. Cockcroft: Explain the declining trend in the number of trainees.

Response: Training was a pre-requisite of acquiring clean planting material through the project. So there was a high demand for stems initially, but subsequently training was limited by the amount of planting material available.

G.W. Otim-Nape (additional comment):
The declining trend in Lira training is partly because there was already much awareness in some parts of the district. Therefore, we had to direct training to areas of greater need.

J.H. Elem (additional comment):
When the ACMD epidemic struck, it was of great concern to everybody in the district. This explains why initially the number trained in 1992/93 was high. The number trained reduced because it was important to follow up training with the introduction of improved varieties. Material of these improved varieties was scarce.

B. Mubiru (supplement):
Besides the training provided and recorded by the cassava programme, there is normal training that goes on regularly through the extension service.

Questions/Comments on paper presented by Peter Watanda: DCC, Masindi

J.M. Thresh: How does the area of improved varieties relate to the total area of cassava quoted by Dr. Otim-Nape in his earlier paper?

Response: What can easily be traced represents 3%, but actually the amount of improved material being grown is greater. The problem is actual assessment in the field because of the few staff available in relation to the large area to be covered..

A. Bua (comment):
The percentage would give a different trend. However, there is a need to improve on the area if there are weaknesses in the field of training.

L. Cockcroft: The table suggests that only 3% of the potential cassava area has been planted to new varieties. Is this correct?

Response (G.W. Otim-Nape):
When stems go down to the "grass roots", it is difficult to monitor individual fields. Thus coordinators report only the areas they manage. Can we find a way of estimating total area under cultivation?

L. Cockcroft: What does the targetted area for new varieties represent as a percentage of the total area planted to cassava in 1994?

Response: Targetted area = 220 ha. (600 ac.)
Distribution hectarage planted = 6000 (av.) = 220/6000 x 100 = 2.6%

F.A. Ojacor: Has the district received copies of the brochure on utilisation of cassava? More copies can be collected from NAARI.

Response: Not received; only lecture notes were available during seminars.

Questions/Comments on paper presented by Michael Edule: DCC, Apac

J.M. Thresh: How has the area of cassava changed over recent years and following the ACMD epidemic? What is the current rate of spread of ACMD in the area?

Response: The production of cassava in Apac is still low in terms of area and yield due to:

(i) continued use of local varieties infected with ACMD.

(ii) the three recommended varieties (Nase 1, Nase 2 and SS4) are still limited to mainly institutional multiplication.

(iii) infected local planting material is causing high inoculum pressure of the virus to the three new varieties which are being expanded rapidly.

G.N. Ssemakula:

The term "farmers' selection efficiency" is not used appropriately when it refers to the number of varieties selected as a percentage of the total number tested on-farm.

Response: Farmers' selection preference should be used not selection efficicency.

A. Bua: How is the interaction between the two adjacent districts of Lira and Apac concerning the multiplication and sharing of stems? How do you monitor spill-over effects?

Response: It has been difficult to obtain data on the material of the new varieties going out of the district from the few farmers involved because of the conditions put down by the District Cassava Task Force (DCTF). Apac has been getting the new material from NAARI since 1993 and since 1995 from Ngetta experimental farm, Lira. In 1995, Apac supplied two lorry loads of Nase 1 to Gulu through NURP from individual farmers.

J. Elem: Planting material from Lira district has been given to farmers in Kitgum, Gulu and Apac and two lorry loads were given to Moyo.

G.W. Otim-Nape:

I am impressed with the work done in Apac. This has been mainly through institutional multiplication which gives very high rates of propagation compared to individual multiplication.

Questions/Comments on paper presented by Eric Karara: DCC, Kibaale

J.M. Thresh: If Ebwanateraka is not sufficiently resistant for use in Kibaale, why is Bao being propagated as this variety is also susceptible?

Response: Bao is susceptible much like Ebwanateraka, but through rigorous selection and roguing it can still be grown successfully in Kibaale. But with time when more resistant varieties are available in sufficient quantity it can be phased out from the area.

F.A. Ojacor: Why should you be concerned about lack of "transparency" by NGOs if they provide funds for multiplying the material and you agree with them on how to distribute and utilise the material?

Response: The "transparency" is not only in relation to funds but also some NGOs may not clearly state their objectives and strategies in order to establish the collaboration between you and them. You may start off well but in the end, they may want to divert you in their direction and ways of operation.

G.N. Ssemakula (comment):

Lack of transparency is not with regard to funds but is in the terms of operation and what eventually happens to the cassava material.

G.W. Otim-Nape (comment):

Some NGOs are not transparent. A case in point was an NGO in central region who did not give material to other farmers except to members of their own denomination.

Questions/Comments on paper presented by Ssenyonga Wilson: DCC, Luwero

L. Cockcroft: When farmers reduce the area of cassava, do they grow other crops; if so, which?

Response: Due to awareness created by 1992, farmers realised the importance of not planting diseased cassava cuttings. This caused some of them to shift to other crops. Others abandoned local cassava varieties expecting resistant ones. Crops adopted were sweet potato and maize.

J. Elem (comment):

There has been no substantial drop in cassava area in Lira district as farmers maintained the poor and heavily infected varieties in desperation and despite their poor yield. Inevitably, the output declined significantly. This situation differed from that in Luwero where the cassava area declined.

G.W. Otim-Nape (comment):

I think we need to let farmers know the consequences of the decisions they make in growing infected material.

Question/Comments on paper presented by John Lubega: DCC, Mpigi

J.M. Thresh: What is the recent history of ACMD in Mpigi?

G.W. Otim-Nape:

Until recently Mpigi has been in the low spread area of Uganda and we were testing possible technologies for controlling ACMD in such situations. We introduced a lot of high-yielding but not necessarily resistant varieties (including Bao and Ebwanateraka) to areas where the mosaic epidemic had not yet reached and the varieties have spread and made an impressive impact.

Questions/Comments on paper presented by Charles Aben: DAO, Soroti

J.M. Thresh: I congratulate the speaker on his excellent paper. Can I ask for clarification of his statement that:

(a) much of the cassava was wiped out.

(b) over 50% of farmers still had infected material of local varieties which acted as sources of infection.

G.W. Otim-Nape (comment):

(a) Various projects on cassava multiplication had different degrees of success depending on the level of extension and scientist involvement. We should therefore work-out a mechanism of ensuring that NGOs and others who go into multiplication receive technical support.

(b) Can the DAO provide us with the latest cassava production figures, preferably by varieties and counties?

Question to Drs. G.W. Otim-Nape and J.M. Thresh: Virologists

A. Bua: What was ACMD affecting before cassava was introduced to Africa from South America?

Response (J.M. Thresh):

ACMD and many of the most important pest/disease problems in the world are due to what the distinguished American scientist Ivan Buddenhagen refers to as "new encounter " situations: eg: A crop is introduced to a new area where it "meets" new problems, or a pest or pathogen is introduced to a new area where it encounters a crop in which it has had no co-evolutionary history. Cassava in Africa is a 'new' introduction that encountered viruses already established in indigenous vegetation. Such wild/weed hosts of ACMD have been identified but epidemiologically they seem to be unimportant and *not* major sources of infection.

G.W. Otim-Nape:

We feel that mosaic in wild plants does not pose any serious threat by facilitating spread of ACMD to cassava.

DISCUSSION POINTS : GROUP 1

The main conclusions were presented under several broad headings:-

1. Evaluation and Impact Studies

Such studies should be done to:-

- Gauge progress and achievement
- Assess value in relation to investment
- Justify funding
- Streamline the focus and direction of the project

Issues to be considered should include:-

(i) Physical Indicators including:-

- Area of production
- Yield improvement
- Number of farmers growing cassava
- Amount produced
- Spill-over effects beyond the project area
- Number of people trained
- Crop status
- Number of improved varieties established

(ii) Economic Indicators including:-

- Production costs
- Marketing costs
- Storage costs
- Farm gate prices
- Rural retail prices
- Urban wholesale prices
- Urban retail prices

A preliminary evaluation should be done after 3 years and a detailed impact assessment after 5 years. They should involve a judicious mixture of both internal and external evaluators and the use of primary and secondary data.

The mosaic-susceptible varieties Bao, Aladu and Ebwanateraka were disseminated in Mpigi and other areas in the south before they were affected by the epidemic. These varieties were grown successfully for several years and Aladu proved to be more tolerant of infection than Bao or Ebwanateraka. The varieties brought initial benefits because they:-

- Helped to bridge the "food gap"
- Set the standard for productivity
- Were accepted by farmers
- Provided income to farmers

The methods used to assess the areas established with new varieties should include:-

- Crop returns
- Intensive coverage by coordinators to separate clearly between areas under improved cassava varieties and substitute crops
- Estimation of yield
- Imputed farmer recall
- Field sample survey

Movement of material between districts should be considered because it may influence impact within the district. Moreover, it should be appreciated that the organized movement between districts is a politically and socially sensitive issue that is highly contentious.

2. Multiplication and Distribution Strategies

These should provide a sustainable system by:-

- Creating a sense of ownership among farmers
- Training farmers on ACMD control
- Use of appropriate varieties
- Sensitizing farmers to the commercial value of stems
- Implementing a policy of selling stems by institutions
- Introducing a "Royalty" charge so that a percentage of sales can be ploughed back to research.
- Sensitizing administrators on the value of multiplication and distribution through DDC
- Promoting ACMD control measures through educational, religious and political fora.

3. The impact of the epidemic in different areas:-

This differed between areas and some of the factors thought to be responsible were:-

- The number of varieties being grown
- The amount of knowledge on ACMD
- Disease pressure
- Environment e.g. drought
- Availability of alternative crops and differences in food habits
- Differences in food habits and preferences
- Cassava cropping intensity
- Varietal diversity

4. Attitude to roguing in respect to stem multiplication

Roguing was:-

- considered appropriate at all stages at institutional farms
- recommended for use by farmers at the early stages of crop growth, together with stem selection to be done at harvest
- not recommended where disease severity and rates of spread are high
- influenced by the variety grown.

DISCUSSION POINTS: GROUP 2

The main topics addressed were:-

1. Experiences and Future Strategies for Cassava Multiplication

- The different forms of multiplication which have been adopted to date. Is a consolidation of approach now appropriate in the light of current knowledge and experience?
- The relationship between researchers, extensionists and farmers in relation to the diffusion of planting material.
- The experience gained that can be used to improve future approaches and their cost effectiveness.
- How can the supervision of multiplication and distribution of planting material be improved?
- Means of boosting rates of propagation and minimising the loss of cassava stems.
- The remaining research requirements.

2. The effectiveness of Different Forms of Multiplication

Three main forms of multiplication have been adopted to date as summarized in Table 1:-

- Individual farmers
- Farmer groups (women/youths/men/mixed)
- Institutions (private, prison or government farms, schools and colleges)

Planting material has been distributed by:-

(a) Government e.g. Extension, Research, Teso Presidential Commission.
(b) NGOs e.g. CARE, Vision Terudo, SOCADIDO.
(c) Individuals.

The Individual Approach

The distribution of stems in small quantities to individual farmers as used in Kumi, Lira and Masindi districts has proved to be largely ineffective, mainly because farmers interplanted the new material amongst or alongside existing diseased stands and rapid spread occurred. Moreover, monitoring and follow-up was difficult because of the many farmers and the numerous scattered fields.

Medium scale of production (0.1 - 0.2 ha.) is effective if several neighbouring farmers benefit. Otherwise it becomes ineffective due to theft and envy.

Large scale (>0.4 ha.) production is an effective means of multiplication, but is often ineffective in achieving diffusion because the farmers claim ownership and require payment before releasing planting material.

The Group Approach

- *Women's Groups:* Considered effective due to high degree of loyalty

- *Men's Groups:* Rarely used. When used tend to be ineffective due to lack of seriousness and conflicting interests.

- *Mixed Groups:* Effective where women outnumber men. Used in Lira and Apac.

- *Youth Groups:* Rarely used. Effectiveness difficult to determine.

The Institutional Approach

- *Prison Farms:* Effective but depends greatly on the officer-in-charge and the availability of inmates. Consequently, sustainability uncertain because of lack of continuity.

- *Government Farms:* Effective where adequate resources are available. Otherwise very costly.

- *Schools and Colleges:* Generally effective but depends on relationship with school administration and availability of pupils for labour. Sustainability uncertain.

- *Private Farms:* Effectiveness depends on the commitment and interest of the farmers involved. Sustainability is uncertain. Used in Migyera and Apac.

Overall it was concluded that the effectiveness of the different approaches varies between districts, depending on circumstances, as summarized in Table 1.

Some of the main findings were:-

- Based on experience from different districts, womens groups performed very well and should be encouraged.
- Distribution of stems by distributing agents should cover at least 0.4 ha and the release of only few stems to farmers should be discouraged.
- Institutional multiplication should be used, with emphasis on government and prison farms where adequate resources are available and there is a need to build up initial multiplication stock,.

3. Relationship between researchers, extensionists and farmers in diffusion of planting material and the role of the various 'actors'

The main activities were considered to be:-

Researchers

- Develop high-yielding, disease and pest-resistant varieties
- Generate production recommendations
- Design and participate in on-farm research and joint surveys
- Train Extension Staff
- Disseminate research results
- Provide nucleus material for multiplication
- Participate jointly with extension in technology transfer
- Monitor, evaluate and advise on the technologies
- Provide technical back-stopping to NGOs, extension staff etc.

Extension Service

- Participate in joint surveys and on-farm research
- Provide feed-back to researchers and farmers
- Participate in "seed" multiplication activities
- Pursue and encourage distribution of cuttings and exchange of material
- Train and sensitize farmers and others involved and provide technical advice to NGOs
- Participate in research planning and review committee meetings
- Produce regular reports and provide statistical information on the different varieties under multiplication and production figures
- Participate in monitoring and evaluation of results, jointly with research
- Transfer new technologies from research to farmers and provide advisory service.

Farmers

- Participate in on-farm research
- Multiply new cassava varieties
- Provide feed-back to extension
- Participate in distribution, demonstration and education of neighbours, friends and relatives

NGOs

- Provide financial and logistical support to cover training, procurement and distribution, including maintenance of material
- Produce periodic reports on the status and performance of the introduced varieties, and provide details of participating farmers and areas planted
- Work under close guidance with research and extension

Civil Leaders

- Mobilise and sensitize farmers on new cassava technologies
- Provide political, administrative, and financial support to district extension staff to facilitate multiplication of cassava material in their districts

The overall conclusion was that the NANEC strategy is the best and should be adopted.

4. Lessons learned, improvement in future approaches, and cost-effectiveness of on-farm research

It was considered that there is no advantage in having many on-farm trials (OFTs) in a district or region. Instead the number of OFTs should be selected judiciously to cover the different agro-ecologies and farming systems within a district. Similarly, there may be no need to conduct OFTs in all districts with similar ecologies, farming and food systems

It is therefore recommended that the number of OFTs in each district with a uniform farming and food system should not exceed five. For districts with similar ecological conditions, farming and food systems, one district should suffice to represent them all.

OFTs should be sited such that they give a broad representation of agro-ecological zones, farming and food systems in the country.

5. Recommendations for Improving the Supervision of Multiplication and Distribution of Planting Material

- District Agricultural Officers should closely supervise the District Cassava staff and ensure smooth implementation of the programme in their district.

- (a) A District Cassava Task Force (DCTF) should be formed where none exists and should be activated where one has not yet operated effectively.

- (b) The DCTF should oversee the DAO and his staff, and ensure that cassava multiplication activities are progressing well.

Research staff should monitor cassava multiplication activities at district level and ensure they are progressing as planned.

6. Boosting Rates of Propagation

Factors leading to low multiplication rates were identified as:-

- Poor establishment
- Poor weather
- Termites
- Farmers harvest stems during the dry season
- Cuttings used are too long
- Some farmer may be selfish and do not share with others
- Bruising of stems during transportation and delays in transportation lead to drying of stems and poor sprouting
- Poor roads.
- Premature harvesting of stems
- Destruction by goats and vermin.

Recommendations:-

- Research should investigate the poor establishment of Nase 1 and provide solutions
- Proper planning and timely provision of logistics and planting material required
- Where termites are a problem, farmers should be assisted to procure appropriate pesticides
- Farmers should be trained not to harvest cassava during the dry season and to tether goats to prevent them causing damage.
- Encourage piece-meal harvesting
- Encourage farmers to use stems of optimum length, to share planting material and to avoid premature harvesting of stems
- Multiplication of planting material should be intensified at district level to minimise need for long distance transportation which leads to bruises and increased loss of material.
- District authorities should be encouraged to improve feeder roads.

Table 1: Approaches used by government organisations and various NGOs in the distribution and multiplication of planting material

Project	Location/ district	Year initiated	Varieties	Source of varieties	Method used	Involvement of research	Involvement of extension	- Remarks
Oxfam	Kumi	1991/92	Bao, Aladu	Apac	Individual women.	Identified source of cassava stems used.	Minimal.	Inadequate supervision by extension workers. Most varieties susceptible. Little input sought from research.
Agricultural Development Project/World Bank (ADP/WB)	Soroti	1992	Bao Aladu TMS series	Apac	Womens group. Demonstration plots.	Supply of stems. Technical support.	Farmer awareness campaigns.	Farmer awareness enhanced in some areas.
	Kumi	1992	5 local varieties	Iganga	Block (group).	None.	Site selection. Farmer training on phyto-sanitary measures.	Most of these varieties are highly susceptible but varieties remained 'clean' in areas where control measures were followed.
Northern Uganda Reconstruction Programme (NURP)	Soroti	1994	Migyera Nase 1 Nase 2	NAARI SAARI	Demonstration plots. Farmers groups. Institutional.	None.	Farmer selection. Supervision.	No linkage between research - extension - farmers. Limited scope.
	Kumi	1995	Migyera Nase 1	NAARI SAARI	Group.	None.	Site selection. Monitoring and supervision.	No linkage between research - extension - farmers. Limited scope.
Presidential Commission for Teso	Soroti	1994	Migyera	Serere (farmers)	Individuals.	None.	None.	Supervision by non-technical staff was too weak to have tangible results.
Baptist Mission	Soroti	1990	Bao Aladu	Apac	Groups. Individuals/	None.	Minimal	Material has diffused to other farmers but not much disease.
Vision Terudo	Kumi	1991	Migyera Nase 1 Nase 2 TMS 4(2)425	NAARI SAARI Serere (farmers)	Selected communities. Groups. Institutions.	Provision of planting material. Technical support.	None.	Rate of diffusion of improved varieties has been very high.
Soroti Catholic Diocese Development (SOCADIDO)	Soroti	1992	Bao Aladu	Soroti	Group	None	Minimal	Poor linkage between research - extension - farmers.
Church of Uganda Cassava Programme	Soroti	1994	Migyera	Serer e (farmers)	Group	None	None	(Poor monitoring. Lack of funds led to discontinuation of project).
Cassava Action Research and Development Programme (ARDP)	Soroti Pallisa Kapchwora Mbale	All 1995	Nase 1 Nase 2	SAARI	Group	Site selection. Monitoring. Supply of stems. Training of extensionists.	Selection of farmers. Farmer training. Monitoring. Supervision.	High ACMD resistance of improved varieties has boosted farmers' morale. Considerble success in all districts.

Table 1: Approaches used by government organisations and various NGOs in the distribution and multiplication of planting material (cont'd)

Project	Location/ district	Year initiated	Varieties	Source of varieties	Method used	Involvement of research	Involvement of extension	Remarks
Gatsby I	Masindi Lira Mpigi	1991	Migyera Nase 1 Nase 2	NAARI	Group/ Individual/ Institutional.	Supply of stems. Training of extensionists. Monitoring. Technical support.	Farmer selection. Farmer training. Phyto-sanitary activities.	Increased volume of improved varieties. Management of fields has significantly improved. Cassava production enhanced.
Gatsby II	Masindi Apac Kibaale Luwero Apac Kibale	1994	Nase 1 Nase 2 TMS4(2) 1425 Migyera SS4	NAARI	Individual Institutional. Group	Training. Supply of stems. Routine supervision.	Farmer selection. Training. Phyto-sanitary activities.	Extension staff supported:- allowances, transport and training.
ACCORD	Moyo Gulu	1992	Nase 2 Migyera	NAARI	Individual	Provision of planting material.		Impact not known.
CARE International	Arua Nebbi	1993	Migyera	NAARI	Communities, Institutional	Provision of stems.	None.	Rate of diffusion of new varieties slow, since ratooning was not practised.
World Vision	Luwero	1994	Nase 1 Nase 2 Migyera	NAARI	Individual. Institutional/	Minimal	Farmer awareness.	Inadequate extension facilitation.
VEDCO	Luwero	1995	Nase 1 Nase 2	NAARI	Indsitutional.	Supply of stems.	Routine phyto-sanitary activities.	

RESOLUTIONS AND RECOMMENDATIONS OF THE PARTICIPANTS AT THE NATIONAL WORKSHOP ON CASSAVA TECHNOLOGY TRANSFER

We, participants in the National Workshop on Cassava Technology Transfer meeting at Masindi Hotel 9 - 12 January 1996 to review the progress made, have noted the commendable achievement of the project funded by the Gatsby Charitable Foundation (U.K.) and the extent of the technical capacity developed in districts.

Recognizing the importance of cassava stems in propagation, we resolve that:-

1. Cassava stems be recognized as seed and be given the same status as the true seed of other crops

2. The District Authorities should give maximum administrative and financial support to cassava multiplication and should extend multiplication activities to all sub-counties and parishes. Each parish should have at least one hectare of improved varieties under multiplication and managed by local communities.

3. The Ministry of Agriculture, Animal Industries and Fisheries and the National Agricultural Research Organisation should as a matter of urgency develop a donor-funded project on cassava development in order to restore cassava production.

Recommendations

It is further recommended that:-

1. There is need for continuous evaluation and detailed impact assessment.

2. The contribution of Bao, Aladu and Ebwanateraka to food security over the years should be recognized.

3. Varieties should be developed that are similar to Bao, Aladu and Ebwanateraka but more resistant to ACMD.

4. A standard methodology should be developed to provide valid assessments of the area of cassava and production in districts.

5. "Spill-over" effects of the released planting material into other districts should be recognized and quantified.

6. Farmers should have a sense of ownership of the planting material from the outset.

7. Farmers should be trained in ACMD control so that they can continue effectively even if the project is discontinued.

8. A policy should be put in place to allow the sale of cassava stems multiplied at institutions to provide funds for further activities.

9. A fee should be levied on the stems supplied to NGOs and farmers as "royalty".

10. Varietal diversification should be promoted.

11. Multiplication Approach

    (a) Use of existing womens groups should be encouraged.
    (b) Institutional multiplication should be used, with emphasis on government and prison farms, where there is need to build-up initial multiplication stock and adequate resources are available.
    (c) The number of stems issued by distributing agents should suffice for at least 0.4 ha. and the practice of giving only few stems to farmers should be discouraged.

12. Multiplication of planting material should be intensified at district level to minimise the need to transport stems over long distances and to accelerate the release of planting material to farmers.

13. Sensitization of district political and civic leaders should be intensified.

14. Cassava Task Forces should be formed in districts and sub-counties.

15. The National Network of Cassava (NANEC) workers is the best linkage strategy and should be adopted.

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We express our deep appreciation to the Gatsby Charitable Foundation (U.K) for financing the Cassava Multiplication Project; the International Development Research Centre (IDRC), Canada, for supporting research on cassava through the Uganda Root Crops Project (Phases 1 and 2); the International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria, and the Natural Resources Institute (UK) for technical assistance. We also thank the Government of Uganda through the National Agricultural Research Organisation (NARO) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) for both financial and logistical support and for providing adequate capacity and a conducive environment for conducting the work.

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NATIONAL WORKSHOP ON CASSAVA TECHNOLOGY TRANSFER 9-12 JANUARY, 1996.

WORKSHOP EVALUATION

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Introduction

Cassava is one of the most important food security crops in Uganda. Following the outbreak of the current epidemic of African cassava mosaic disease (ACMD), there was a serious decline in production. Hence the National Rootcrops Programme generated resistant/tolerant varieties as a control strategy for the disease.

The role cassava plays as a food security crop necessitated intervention by both the local and international community to accelerate the multiplication of these varieties. Thus the Gatsby Charitable Foundation, CARE International, Vision Terudo (VT), ACCORD and others came to participate effectively in the multiplication and distribution of stems.

Against this background, the national programme called for a workshop to review progress in cassava technology transfer in Uganda. All the approaches used by the various actors in the different districts in the multiplication and distribution of stems and their impact were considered during the workshop.

Workshop evaluation

The workshop was evaluated by 15 of the participants and they all indicated that the multiplication project was worth continuing.

Regarding the general workshop organisation, 47% indicated that it was excellent and the other 53% indicated that it was good.

Seven percent referred to time-keeping as excellent, whereas 27%, 60% and 7% referred to it as good, fair and poor, respectively. [Note: The latitude in time-keeping was to allow the District Cassava Coordinators to complete their reports.]

Twenty-seven percent indicated that transport was excellently arranged, whereas 60% and 13% indicated that transport arrangements were good and fair, respectively.

Forty percent indicated that the presentations were excellent and the other 60% considered them good.

Eighty-seven percent, referred to accommodation as being good, whereas 7% regarded it as excellent; 73% indicated that the meals were good whereas 20% and 7% indicated the meals were fair and excellent, respectively.

Thirty-three percent of the participants referred to the entertainment provided as being excellent, whereas the remaining 47% referred to it as being good and 20% as fair.

Majority of the participants (73%) indicated that the field tour was excellent, whereas the other 27% indicated that it was good.

Finally, 80% of the participants indicated that the workshop duration was appropriate, whereas the other 20% indicated that it was too short. 73% indicated that the workshop objectives had been achieved fully.

In conclusion, the majority of participants felt that the Workshop was well organised, of appropriate duration and format and that it achieved its objectives.

As regards whether the project was on the right lines and making an impact, 93% indicated that it was. However, the need was recognised for supervision and proper assessment to establish the extent of the impact. Participants were of the view that the multiplication project was worth continuing and the following reasons were given:-

- Suitable tolerant/resistant varieties are still inadequate in number and quantity.
- ACMD is still a problem in many local varieties.
- Cassava is still needed/used in many districts of Uganda.
- The project makes a significant contribution to combating ACMD.
- To ensure wide coverage and equity.

Although the multipication project has had considerable impact, participants were of the opinion that improvements in multiplication could and should be made and therefore suggested:-

- More funding to cover all other cassava-growing regions of the country.
- That the group approach be encouraged.
- Local leaders and politicians be involved at all stages right from sensitization.
- Farmers multiplying improved varieties be assisted, especially with weeding.
- More training/sensitization of farmers on ACMD.
- Rapid multiplication, especially of the newly released variety SS4.
- Logistical and financial support should be timely and a close follow-up should always be made.
- Decentralisation of multiplication sites and locations.
- Cost-effective methods be adopted in each district.
- Materials be distributed at the onset of rains to avoid loss of material.
- An accelerated method of multiplication and distribution be introduced.

All participants indicated that they benefited from the workshop. The following benefits were listed:-

- Exposure to activities and organisation of the multiplication project in other districts.
- Gained and shared experiences from other districts in their cassava multiplication efforts.
- Interaction with farmers, scientists (researchers) and cassava coordinators (extensionists).
- A complete picture was obtained on the coverage and impact of the programme.

- A clear picture of the status of cassava in the Uganda food system and the situation and prospects of multiplication activities and how to make the best of the situation.
- Exposure to some additional subjects e.g. impact studies.
- Yardstick on one's performance.

When asked to give any other comments regarding the workshop, the following were emphasized:-

- Participation should cover more areas than that represented.
- Training of both farmers and staff needs to be done regularly.
- Coordinators need to be facilitated in their work.
- Periodic workshops and fora are required as these provide a chance to review his/her performance.
- The workshops should be annual and arranged at the end of each year of the project. This makes annual report writing easier and effective.
- For subsequent workshops, a longer period would be more appropriate i.e. about five days.
- Project reviews should be done every two years.
- A field tour should be arranged to West Nile.

A summary of the workshop evaluation is provided in Table 1.

Table 1: Workshop evaluation by participants (n=15)

General Organisation	Response	% Response
Good	8	53
Excellent	7	47
Accommodation		
Good	13	87
Excellent	1	7
Fair	1	7
Entertainment		
Good	7	47
Excellent	5	33
Fair	3	20
Meals		
Good	11	73
Fair	3	20
Excellent	1	7
Transport arrangements		
Good	9	60
Excellent	4	27
Fair	2	13
Field tour		
Excellent	11	73
Good	4	27
Time keeping		
Fair	9	60
Good	4	27
Excellent	1	7
Poor	1	7
Presentations		
Good	9	60
Excellent	6	40
Workshop duration		
Just enough	12	80
Short	3	20

Appendix 1: TECHNOLOGY TRANSFER IN UGANDA:- INFORMATION AND STATISTICS

Table 1: Improved varieties of cassava tested and selected for use in Uganda

Variety	Maturity period (months)	Typical yield (tonnes/ha.)	ACMD status
Released varieties			
Bao	10 - 12	30	Susceptible
Ebwanateraka	10 - 12	30	Susceptible
Nase 1 (TMS 60142)	12 - 14	25	Resistant/Tolerant
Nase 2 (TMS 30337)	12 - 15	40	Moderately resistant
Migyera (TMS 30572)	10 - 12	45	Resistant/Tolerant
Awaiting release			
SS4 (as Nase 4)	12 - 14	55	Resistant/Tolerant
TMS 4(2)1425 (as Nase 5)	10 - 12	35	Moderately resistant
89/1988-2 UYT/PDB (as Nase 6)	10 - 12	30	Resistant/Tolerant
Migyera 81 (as Nase 7)	10 - 12	25	Resistant/Tolerant
Migyera 16 (as Nase 8)	10 - 12	30	Resistant/Tolerant

Table 2: Number of On-Farm Trials on cassava conducted by The National Root Crops Programme in the six Gatsby and nine other districts of Uganda during the cropping years 1990/1991 to 1996/1997

District	1990/1991	1991/1992	1992/1993	1993/1994	1994/1995	1995/1996	1996/1997	Total
Gatsby								
Apac	-	-	16	12	-	-	-	28
Kibaale	-	-	24	12	8	6	4	54
Lira	-	9	16	6	-	5	5	41
Luwero	16	12	24	16	8	6	4	86
Masindi	-	12	24	24	16	6	4	86
Mpigi	-	12	24	16	16	6	5	79
Sub-total	**16**	**45**	**128**	**86**	**48**	**29**	**22**	**374**
Other								
Arua	-	-	12	8	-	-	-	20
Hoima	-	-	12	8	-	-	-	20
Iganga	-	-	12	8	-	-	-	20
Kasese	-	-	12	8	-	-	-	20
Masaka	-	-	12	8	-	-	-	20
Mubende		-	12	8	-	-	-	20
Mukono	-	-	12	8	-	-	-	20
Pallisa	-	-	-	-	-	6	5	11
Soroti	-	-	-	-	-	6	5	11
Sub-total	**0**	**0**	**84**	**56**	**0**	**12**	**10**	**162**
TOTAL	**16**	**45**	**212**	**142**	**48**	**41**	**32**	**536**

Table 3: Number of Extension Staff, Opinion Leaders and Farmers trained in the six Gatsby (G) and three other districts of Uganda 1991-1996

Trainees	Lira (G)	Luwero (G)	Masindi (G)	Mpigi (G)	Apac (G)	Kibaale (G)	All Gatsby	Kumi	Soroti	Pallisa	Grand Total
Extension											
1991/92	106	26	14	53	8	?	**>207**	?	?	?	**>207**
1992/93	23	8	15	51	33	?	**>130**	?	?	?	**>130**
1993/94	106	48	1MSc	33	4	?	**>192**	?	?	?	**>192**
1994/95	97	221	47	79	30	?	**>474**	?	?	?	**>474**
1995/96	30	77	2	18	30	29	**186**	65	50	47	**348**
Total	**362**	**380**	**79**	**234**	**105**	**29**	**>1,189**	**>65**	**>50**	**>47**	**>1,351**
Opinion leaders											
1992	?	42	?	?	?	?	**>42**	?	?	?	**>42**
1993	?	?	400	?	6	?	**>406**	?	?	?	**>406**
1994	50	347	539	87	50	?	**>1,073**	?	?	?	**>1,073**
1995	48	26	?	110	50	?	**>234**	?	?	?	**>234**
1996	32	107	?	?	?	?	**>139**	20	?	?	**>159**
Total	**>130**	**>522**	**>939**	**>197**	**>106**	**?**	**>1,894**	**>20**	**?**	**?**	**>1,914**
Farmers											
1991/92	756	303	708	113	?	?	**>1,880**	?	?	?	**>1,880**
1992/93	1,119	245	1,622	179	128	?	**>3,293**	?	?	?	**>3,293**
1993/94	1,227	357	326	243	78	?	**>2,231**	?	?	?	**>2,231**
1994/95	977	2,361	256	162	60	28	**3,844**	283	131	?	**>4,258**
1995/96	473	1,267	1,023	835	60	25	**3,683**	30	611	289	**4,613**
Total	**4,552**	**4,532**	**3,935**	**1,532**	**>326**	**>53**	**>14,931**	**>313**	**>742**	**>289**	**>16,275**

Table 4: Estimated number of stems (in thousands) of virus-resistant and other improved cassava varieties distributed in six Gatsby and seventeen other districts of Uganda between 1991/92 and 1995/96

Districts	1991/92	1992/93	1993/94	1994/95	1995/96
Gatsby					
Apac	0	6	122	634	3,808
Lira	8	14	304	1,902	11,424
Kibaale	0	<1	3	16	98
Luwero	0	9	318	1,876	10,130
Masindi	9	4	349	3,094	18,572
Mpigi	15	114	730	4,356	26,150
Sub-total	**32**	**148**	**1,826**	**11,878**	**70,182**
Other					
Arua	27	120	1,292	3,618	9,769
Gulu	4	31	165	989	5,856
Iganga	0	0	4	21	132
Jinja	0	1	5	29	176
Kamuli	0	0	1	4	22
Kiboga	<1	2	17	102	609
Kitgum	1	6	39	232	1,389
Kumi	24	150	916	2,570	6,940
Masaka	0	3	24	143	867
Mbale	0	<1	1	8	50
Moyo	8	50	44	1,825	10,949
Mukono	1	3	18	89	658
Nebbi	0	<1	2	10	60
Pallisa	0	4	35	229	1,372
Rukungiri	0	6	36	216	1,296
Soroti	1	44	275	1,653	9,920
Tororo	0	0	2	24	125
Sub-total	**66**	**420**	**2,876**	**11,762**	**50,190**
Total	**98**	**568**	**4,702**	**23,640**	**120,372**

Estimates made by District Co-ordinators.
Six to eight cuttings (25-30cm long) can be obtained from one stem depending on variety.

Table 5: Estimated areas of virus-resistant and other improved cassava varieties (ha.) established in the six Gatsby and seventeen other districts of Uganda between 1991/92 and 1995/96

Districts	1991/92	1992/93	1993/94	1994/95	1995/96
Gatsby (6)					
Apac	0	3	41	194	944
Lira	4	39	213	1,327	8,195
Kibaale	0	<1	1	9	59
Luwero	0	2	194	1,126	6,078
Masindi	8	50	305	1,857	11,143
Mpigi	9	69	438	2,614	14,690
Sub-total	**22**	**163**	**1,192**	**7,127**	**41,109**
Other (17)					
Arua	16	129	775	2,171	5,861
Gulu	2	19	99	593	3,471
Iganga	0	0	2	13	79
Jinja	0	<1	3	18	106
Kamuli	0	0	<1	2	13
Kiboga	<1	1	10	61	365
Kitgum	1	4	23	139	167
Kumi	5	90	550	1,542	4,164
Masaka	0	2	14	86	521
Mbale	0	<1	1	5	30
Moyo	5	31	182	1,095	6,575
Mukono	<1	2	11	65	394
Nebbi	0	<1	<1	6	36
Pallisa	0	2	21	137	823
Rukungiri	0	4	22	130	778
Soroti	1	27	165	789	5,952
Tororo	0	0	1	15	75
Sub-total	**30**	**311**	**1,879**	**6,867**	**29,410**
Total (23)	**52**	**474**	**3,071**	**13,994**	**70,519**

Notes:

1. All figures rounded off to nearest whole number.
2. See Tables 6 and 7 for detailed breakdown by variety.
3. Areas presented indicate total area (ha) under improved varieties ie project controlled and self-diffused material.

Table 6: Estimated areas of virus-resistant and other improved cassava varieties established (ha.) in the six Gatsby Project districts of Uganda 1991-1992 to 1995-1996

District	Variety	1991/92	1992/93	1993/94	1994/95	1995/96
Apac	Nase 1	-	1	6	34	122
	Nase 2	-	2	11	64	242
	SS4	-	-	-	-	4
	Others*	-	-	24	96	576
	All vars.	-	**4**	**41**	**194**	**944**
Lira	Nase 1	<1	2	12	77	544
	Nase 2	-	7	45	270	1,765
	SS4	-	-	-	-	4
	Others*	4	30	155	980	5,882
	All vars.	**4**	**39**	**213**	**1,327**	**8,195**
Kibaale	Nase 1	-	-	<1	2	15
	Nase 2	-	-	1	4	26
	SS4	-	-	-	-	2
	Others*	-	<1	<1	3	16
	All vars.	-	**<1**	**1**	**9**	**59**
Luwero	Nase 1	-	<1	44	238	1,285
	Nase 2	-	<1	15	89	481
	SS4	-	-	-	-	11
	Others*	-	2	135	799	4,301
	All vars.	-	**2**	**194**	**1,126**	**6,087**
Masindi	Nase 1	-	<1	<1	2	15
	Nase 2	-	<1	<1	2	13
	Migyera	3	18	110	690	4,137
	SS4	-	-	-	-	4
	Others*	5	32	194	1,162	6,974
	All vars.	**8**	**50**	**305**	**1,857**	**11,143**
Mpigi	Nase 1	-	<1	<1	8	56
	Nase 2	-	<1	<1	2	11
	SS4	-	-	3	-	-
	Others*	9	68	434	2,604	14,623
	All vars.	**9**	**69**	**438**	**2,614**	**14,690**
Total	Nase 1	<1	3	64	362	2,037
	Nase 2	-	10	72	432	2,539
	Migyera	3	18	110	690	4,137
	SS4	-	-	3	-	25
	Others*	18	132	943	5,644	32,372
	All vars.	**21**	**163**	**1,192**	**7,128**	**41,110**

* 'Others' includes TMS 4(2)1425, TMS 30786, TMS 30001 and the Ugandan varieties Bao, Ebwanateraka and Aladu.

Table 7: Estimated areas of virus-resistant and other improved varieties established (ha.) outside the six Gatsby districts of Uganda between 1991/1992 and 1995/1996

District	Variety	1991/92	1992/93	1993/94	1994/95	1995/96
Arua	Migyera	13	111	667	1,868	5,044
	Others*	3	18	108	303	817
	Total	**16**	**129**	**775**	**2,171**	**5,861**
Gulu	Nase 1	-	2	1	9	52
	Nase 2	<1	3	21	127	672
	Others*	2	13	76	458	2,747
	Total	**2**	**19**	**99**	**593**	**3,471**
Iganga	Nase 1	-	-	1	7	42
	Nase 2	-	-	1	5	31
	SS4	-	-	-	-	<1
	Others*	-	-	<1	1	5
	Total	-	-	**2**	**13**	**79**
Jinja	Nase 1	-	-	<1	<1	1
	Nase 2	-	-	<1	<1	<1
	SS4	-	-	-	-	<1
	Others*	-	<1	3	17	104
	Total	-	**<1**	**3**	**18**	**106**
Kamuli	Others*	-	-	<1	2	13
	Total	-	-	**<1**	**2**	**13**
Kiboga	Nase 1	-	-	4	26	155
	Nase 2	<1	<1	<1	3	16
	Others*	-	1	5	32	194
	Total	**<1**	**1**	**10**	**61**	**365**
Kitgum	Nase 1	<1	<1	1	9	54
	Nase 2	<1	<1	1	6	39
	Others*	1	3	21	123	74
	Total	**1**	**4**	**23**	**139**	**167**
Kumi	Nase 1	-	2	14	83	462
	Nase 2	2	68	409	698	1,674
	SS4	-	-	-	-	<1
	Migyera	3	20	127	761	2,027
	Total	**5**	**90**	**550**	**1,542**	**4,164**
Masaka	Nase 1	-	-	<1	<1	5
	Nase 2	-	-	<1	<1	<1
	Others*	-	2	14	86	515
	Total	-	**2**	**14**	**86**	**521**

Table 7 (cont'd)

District	Variety	1991/92	1992/93	1993/94	1994/95	1995/96
Mbale	Others*	-	<1	7	5	30
	Total	-	**<1**	**1**	**5**	**30**
Moyo	Nase 1	-	1	7	42	253
	Nase 2	-	<1	1	5	32
	Migyera	5	29	174	1,042	6,258
	Others*	-	<1	1	5	32
	Total	**5**	**31**	**182**	**1,095**	**6,575**
Mukono	Nase 1	<1	<1	2	13	80
	Nase 2	<1	1	9	52	311
	SS4	-	-	-	-	4
	Total	**<1**	**2**	**11**	**65**	**394**
Nebbi	Migyera	-	<1	<1	6	36
	Total	-	**<1**	**<1**	**6**	**36**
Pallisa	Nase 1	-	2	15	101	607
	Nase 2	-	-	5	32	194
	SS4	-	-	-	-	<1
	Others*	-	-	<1	4	22
	Total	-	**2**	**21**	**137**	**823**
Rukungiri	Others*	-	4	22	130	778
	Total	-	**4**	**22**	**130**	**778**
Soroti	Nase 1	-	6	41	246	1,495
	Nase 2	<1	6	41	49	1,495
	SS4	-	-	-	-	<1
	Others*	1	14	82	494	2,962
	Total	**1**	**27**	**165**	**789**	**5,952**
Tororo	Nase 1	-	-	<1	2	-
	Nase 2	-	-	1	12	75
	Others*	-	-	-	-	-
	Total	-	-	**1**	**15**	**75**
Total	Nase 1	<1	15	88	539	3,208
	Nase 2	2	80	489	990	4,540
	Migyera	21	160	968	3,677	13,365
	SS4	-	-	-	<1	5
	Others*	7	56	334	1,661	8,293
	Total	**30**	**311**	**1,879**	**6,867**	**29,411**

* 'Others' includes TMS 4(2)1425, TMS 30786, TMS 30001 and the Ugandan varieties Bao, Ebwanateraka and Aladu.

Table 8: Estimated areas of virus-resistant or other improved cassava variety established in the six Gatsby and seventeen other districts of Uganda 1991/1992 to 1995/1996

District	Variety	1991/92	1992/93	1993/94	1994/95	1995/96
Gatsby (6)	Nase 1	<1	3	64	362	2,037
	Nase 2	-	10	72	432	2,539
	Migyera	3	18	110	690	4,137
	SS4	-	-	3	-	25
	Sub-total	*3*	*31*	*249*	*1,484*	*8,738*
	Others	18	132	943	5,644	32,372
	All vars	*21*	*163*	*1,192*	*7,128*	*41,110*
	% Others	**86**	**81**	**79**	**79**	**79**
Elsewhere (17)	Nase 1	<1	15	88	539	3,208
	Nase 2	2	80	489	990	4,540
	Migyera	21	160	968	3,677	13,365
	SS4	-	-	-	<1	5
	Sub-total	*23*	*255*	*1,545*	*5,206*	*21,118*
	Others	7	56	334	1,661	8,293
	All vars	*30*	*311*	*1,879*	*6,867*	*29,411*
	% Others	**23**	**18**	**18**	**24**	**28**
All (23)	**Nase 1**	**1**	**18**	**152**	**901**	**5,245**
	Nase 2	**2**	**90**	**561**	**1,422**	**7,079**
	Migyera	**24**	**178**	**1,078**	**4,367**	**17,502**
	SS4	**-**	**-**	**3**	**<1**	**30**
	Sub-total	***26***	***286***	***1,794***	***6,690***	***29,856***
	Others	**26**	**188**	**1,277**	**7,305**	**40,665**
	All vars	***52***	***474***	***3,071***	***13,995***	***70,521***
	% Others	**50**	**40**	**42**	**52**	**58**

Notes:

1. All figures rounded off to nearest whole number.
2. See Tables 6 and 7 for detailed breakdown for each district.
3. 'Others' includes TMS 4(2)1425, TMS 30786, TMS 30001 and the Ugandan varieties Bao, Ebwanateraka and Aladu.

Table 9: Multiplication plots in hectares of virus-resistant and other improved varieties being grown at Namulonge Agricultural and Animal Production Research Institute (NAARI) to provide cuttings for distribution to rehabilitation projects and farmers

Variety	Year					
	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97
Nase 1	0.50	5.32	26.42	28.66	14.56	8.77
Nase 2	2.32	4.32	9.06	9.06	-	-
Migyera	5.41	5.41	7.03	7.03	3.00	3.00
Bao	1.61	1.61	-	-	-	-
B11	3.70	3.70	-	-		-
TMS 4(2)1425	0.20	0.74	5.74	5.74		2.35
TMS 30786	3.00	3.00	-	-		-
Ebwanateraka	24.91	11.61	-	-		-
SS4	-	-	0.30	3.58		47.45
Total	**41.65**	**35.71**	**48.55**	**54.07**	**61.57**	**61.57**

Table 10a: Number of stems of five improved virus-resistant varieties distributed from the Namulonge AARI 1991/1992 TO 1996/1997

Year	1991/92				1992/93					1993/94				
District	**Nase 1**	**Nase 2**	**Migyera**	**Total**	**Nase 1**	**Nase 2**	**Migyera**	**4(2)1425**	**Total**	**Nase 1**	**Nase 2**	**Migyera**	**4(2)1425**	**Total**
Gatsby (6)														
Apac	100	-	-	100	1,100	2,088	-	-	3,188	2,500	27,560	-	1,000	31,060
Kibaale	-	-	-	-	1,000	-	-	-	1,000	70	1,200	-	-	1,270
Lira	200	-	-	200	2,000	3,400	-	-	5,400	2,390	32,440	-	-	34,830
Luwero	-	-	-	-	280	80	-	-	360	2,200	20	-	-	2,220
Masindi	-	-	500	500	580	100	27,000	-	27,680	750	1,100	18,600	-	20,450
Mpigi	-	-	-	-	80	80	-	-	160	970	120	-	-	1,090
Sub-total	**300**	**-**	**500**	**800**	**5,040**	**5,748**	**27,000**	**-**	**37,788**	**8,880**	**62,440**	**18,600**	**1,000**	**90,920**
Other (23)														
Arua	-	-	22,250	22,250	-	-	-	-	-	-	-	31,300	-	31,300
Bundibugyo	-	-	-	-	-	-	-	-	-	500	-	-	-	500
Gulu	-	980	-	980	4,000	-	-	-	4,000	-	-	-	-	-
Iganga	-	-	-	-	-	-	-	-	-	1,850	1,456	-	-	3,306
Jinja	-	-	-	-	-	-	-	-	-	50	25	-	-	75
Kamuli	-	-	-	-	-	-	-	-	-	-	-	-	770	770
Kampala	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kasese	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kiboga	-	20	-	20	-	-	-	-	-	7,200	-	-	-	7,200
Kitgum	70	50	-	120	-	-	-	-	-	-	-	-	-	-
Kumi	-	18,500	-	18,500	-	2,650	-	-	2,650	5,080	-	-	-	5,080
Masaka	-	-	-	-	-	-	-	-	-	2,220	-	-	-	2,220
Mbale	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mityana	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moyo	-	-	8,000	8,000	1,950	250	250	-	2,450	-	-	20,700	-	20,700
Mubende	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mukono	100	400	-	500	-	-	-	-	-	1,020	-	-	-	1,020
Nebbi	-	-	-	-	-	-	280	-	280	-	-	6,700	-	6,700
Pallisa	-	-	-	-	4,000	-	-	1,250	5,250	1,440	9,000	-	140	10,580
Rakai	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rukungiri	-	-	-	-	-	-	-	-	-	7,000	-	-	-	7,000
Soroti	-	560	-	560	10,850	7,460	-	-	18,310	3,400	4,300	-	-	7,700
Tororo	-	-	-	-	-	-	-	-	-	600	1,300	-	-	1,900
Sub-total	**170**	**20,510**	**30,250**	**50,930**	**20,800**	**10,360**	**530**	**1,250**	**32,940**	**30,360**	**16,081**	**58,700**	**910**	**106,051**
Total	**470**	**20,510**	**30,750**	**51,730**	**25,840**	**16,108**	**27,530**	**1,250**	**70,728**	**39,240**	**78,521**	**77,300**	**1,910**	**196,971**

Table 10a: Stem distribution (Cont'd)

Year	1994/95					1995/96					1996/97			
District	**Nase 1**	**Nase 2**	**Migyera**	**SS4**	**Total**	**Nase 1**	**Nase 2**	**Migyera**	**SS4**	**Total**	**Nase 1**	**Migyera**	**SS4**	**Total**
Gatsby (6)														
Apac	3,000	1,000	-	-	4,000	-	-	-	-	-	-	-	-	-
Kibaale	4,200	-	-	-	4,200	-	-	-	-	-	-	-	-	-
Lira	-	-	-	-	-	-	-	-	3,500	3,500	-	-	-	-
Luwero	-	-	-	-	-	2,200	-	-	2,150	4,350	-	-	-	-
Masindi	-	-	-	-	-	-	-	-	2,800	2,800	-	-	3,200	3,200
Mpigi	-	-	3,300	-	3,300	14,300	2,500	-	16,820	33,620	22,320	12,120	1,100	35,540
Sub-total	**7,200**	**1,000**	**3,300**	**-**	**11,500**	**16,500**	**2,500**	**-**	**25,270**	**44,270**	**22,320**	**12,120**	**4,300**	**38,740**
Other (23)														
Arua	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bundibugyo	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gulu	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iganga	3,730	1,025	-	-	4,755	13,200	2,000	-	560	15,760	-	-	700	700
Jinja	2,200	-	-	-	2,200	-	-	-	-	-	-	-	-	-
Kamuli	1,000	800	-	-	1,800	3,000	-	-	-	3,000	-	-	-	-
Kampala	-	-	-	-	-	4,200	-	-	-	4,200	-	-	-	-
Kasese	-	-	-	-	-	3,800	4,500	-	-	8,300	-	-	-	-
Kiboga	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kitgum	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kumi	-	-	-	-	-	-	-	-	150	150	-	-	-	-
Masaka	-	-	-	-	-	16,100	-	-	1,000	17,100	-	-	-	-
Mbale	-	-	-	-	-	300	-	-	800	1,100	-	-	3,000	3,000
Mityana	-	-	-	-	-	3,500	-	-	4,200	7,700	-	3,200	700	3,900
Moyo	-	-	8,000	-	8,000	3,700	-	4,200	-	7,900	-	-	-	-
Mubende	-	-	-	-	-	6,500	-	-	2,000	8,500	-	-	700	700
Mukono	-	-	-	-	-	4,200	-	-	5,200	9,400	-	-	-	-
Nebbi	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pallisa	3,800	7,000	-	800	11,600	-	-	-	400	400	-	-	-	-
Rakai	-	-	-	-	-	-	-	-	700	700	-	-	-	-
Rukungiri	-	-	-	1,340	1,340	-	-	-	-	-	-	-	-	-
Soroti	-	-	-	-	-	-	-	-	1,650	1,650	-	-	-	-
Tororo	-	-	-	-	-	-	4,000	-	9,300	13,300	-	-	-	-
Sub-total	**10,730**	**8,825**	**8,000**	**2,140**	**29,695**	**58,500**	**10,500**	**4,200**	**25,960**	**99,160**	**-**	**3,200**	**5,100**	**8,300**
Total	**17,930**	**9,825**	**11,300**	**2,140**	**41,195**	**75,000**	**13,000**	**4,200**	**51,230**	**143,430**	**22,320**	**15,320**	**9,400**	**47,040**

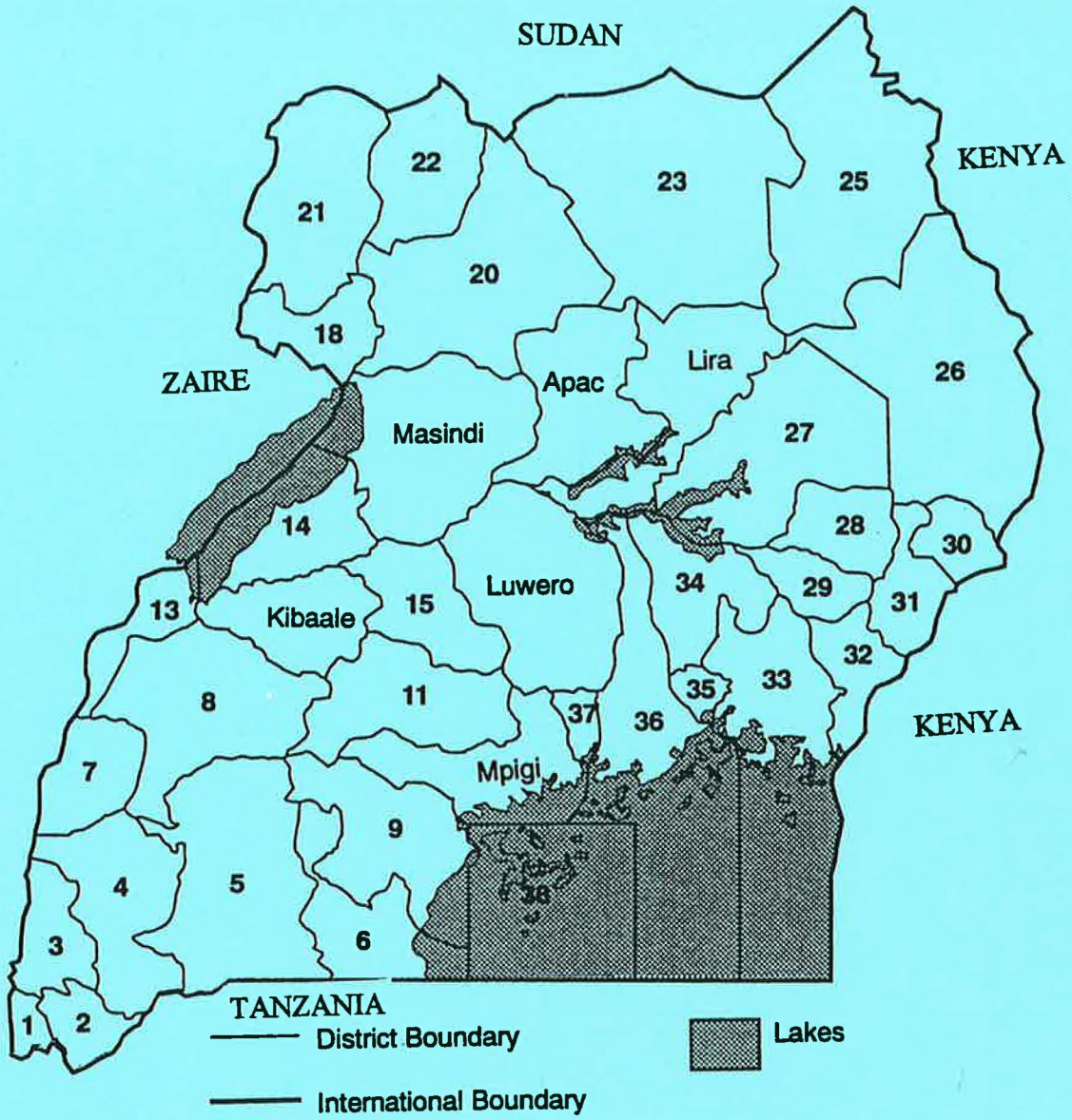
Table 10b: Summary of stem distribution of five improved virus-resistant varieties from the Namulonge AARI to the six Gatsby and twenty-three other districts each year from 1991/92 to 1996/97

Variety	Year						
	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	Total
Gatsby (6):							
Nase 1	300	5,040	8,880	7,200	16,500	22,320	60,240
Nase 2	-	5,748	62,440	1,000	2,500	-	71,688
Migyera	500	27,000	18,600	3,300	-	12,120	61,520
SS4	-	-	-	-	25,270	4,300	29,570
TMS4(2)1425	-	-	1,000	-	-	-	1,000
Sub-total	**800**	**37,788**	**90,920**	**11,500**	**44,270**	**38,740**	**224,018**
Other (23):							
Nase 1	170	20,800	30,360	10,730	58,500	-	120,560
Nase 2	20,510	10,360	16,081	8,825	10,500	-	66,276
Migyera	30,250	530	58,700	8,000	4,200	3,200	104,880
SS4	-	-	-	2,140	25,960	-	28,100
TMS4(2)1425	-	1,250	910	-	-	5,100	7,260
Sub-total	**50,930**	**32,940**	**106,051**	**29,695**	**99,160**	**8,300**	**327,076**
All districts (29):							
Nase 1	470	25,840	39,240	17,930	75,000	22,320	180,800
Nase 2	20,510	16,108	78,521	9,825	13,000	-	137,964
Migyera	30,750	27,530	77,300	11,300	4,200	15,320	166,400
SS4	-	-	-	2,140	51,230	9,400	62,770
TMS4(2)1425	-	1,250	1,910	-	-	-	3,160
Total (29)	**51,730**	**70,728**	**196,971**	**41,195**	**143,430**	**47,040**	**551,094**

Table 10c: Summary of stem distribution of five improved virus-resistant varieties from Namulonge AARI to each of six Gatsby and twenty-three other districts between 1991/92 and 1996/96

District	Variety					Total
	Nase 1	Nase 2	Migyera	SS4	TMS4(2)1425	
Gatsby (6):						
Apac	6,700	30,648	-	-	1,000	38,348
Kibaale	5,270	1,200	-	-	-	6,470
Lira	4,590	35,840	-	3,500	-	43,930
Luwero	4,680	100	-	2,150	-	6,930
Masindi	1,330	1,200	46,100	6,000	-	54,630
Mpigi	37,670	2,700	15,420	17,920	-	73,710
Sub-total	**60,240**	**71,688**	**61,520**	**29,570**	**1,000**	**224,018**
Other (23):						
Arua	-	-	53,550	-	-	53,550
Bundibugyo	500	-	-	-	-	500
Gulu	4,000	980	-	-	-	4,980
Iganga	18,780	4,481	-	1,260	-	24,521
Jinja	2,250	25	-	-	-	2,275
Kamuli	4,000	800	-	-	770	5,570
Kampala	4,200	-	-	-	-	4,200
Kasese	3,800	4,500	-	-	-	8,300
Kiboga	7,200	20	-	-	-	7,220
Kitgum	70	50	-	-	-	120
Kumi	5,080	21,150	-	150	-	26,380
Masaka	18,320	-	-	1,000	-	19,320
Mbale	300	-	-	3,800	-	4,100
Mityana	3,500	-	3,200	4,900	-	11,600
Moyo	5,650	250	41,150	-	-	47,050
Mubende	6,500	-	-	2,700	-	9,200
Mukono	5,320	400	-	5,200	-	10,920
Nebbi	-	-	6,980	-	-	6,980
Pallisa	9,240	16,000	-	1,200	1,390	27,830
Rakai	-	-	-	700	-	700
Rukungiri	7,000	-	-	1,340	-	8,340
Soroti	14,250	12,320	-	1,650	-	28,220
Tororo	600	5,300	-	9,300	-	15,200
Sub-total	**120,560**	**66,276**	**104,880**	**33,200**	**2,160**	**327,076**
Total (29)	**180,800**	**137,964**	**166,400**	**62,770**	**3,160**	**551,094**

Sketch map of Uganda showing the six Gatsby and 32 other districts.



1	Kisoro	11	Mubende	21	Arua	31	Mbale
2	Kabale		Kibaale	22	Moyo	32	Tororo
3	Rukungiri	13	Bundibugyo	23	Kitgum	33	Iganga
4	Bushenyi	14	Hoima		Lira	34	Kamuli
5	Mbarara	15	Kiboga	25	Kotido	35	Jinja
6	Rakai		Luwero	26	Moroto	36	Mukono
7	Kasese		Masindi	27	Soroti	37	Kampala
8	Kabarole	18	Nebbi	28	Kumi	38	Kalangala
9	Masaka		Apac	29	Pallisa		
	Mpigi	20	Gulu	30	Kapchorwa		