



SOUTHERN AFRICA ROOT CROPS RESEARCH NETWORK (SARRNET)

A Vision based on Regional Integration through Partnership and participation for Demand-led Process of Root Crops Research and Development.

SUUMARY TERMINAL REPORT OF SARRNET PHASE II



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Acronyms

CBSD:	Cassava brown streak disease
CIAT:	Centro Internacional de Agricultura Tropical
CIP :	Centro Internacional de la Papa (International Potato Centre)
CLAYUCA:	Consortia Latinoamericano y del Caribe de Apoyo a la Investigacion y Desarrollo de la Yuca (Latin American Consortium for Cassava and development)
EARRNET:	East African Root Crops Research Network
ESARC:	East and Southern Africa Research Center, (IITA, Uganda)
ESARRN:	East and Southern Africa Root Crops Research Network
FANR:	Food, Agriculture and Natural Resources (SADC Directorate)
ha:	Hectare
IITA:	International Institute of Tropical Agriculture
mt:	Metric ton
NARS:	National Agricultural Resource systems
NGO:	Non-Governmental Organisation
NRI:	Natural Resources Institute, UK
RCSA:	Regional Center for Southern Africa (USAID)
SACCAR:	Southern Africa Centre for Cooperation in Agricultural Research and Training
SADC:	Southern Africa Development Community
SARRNET:	Southern Africa Root Crops Research Network
USAID:	United States Agency for International Development

EXECUTIVE SUMMARY

IITA/SARRNET Phase I was launched in 1994 and focussed on increasing income and improving household food security of resource in Southern Africa. The main objectives were to increase cassava and sweetpotato production and utilisation by smallholder households in the resource poor areas of Southern Africa through adoption of improved varieties and crop husbandry practices, and strengthening the capacity of national root crops research for development programs in the SADC region.

Phase II which started in 1999 shifted its focus to include the needs of the markets/consumers by promoting cassava and sweetpotato commercialisation. Thus, improved cassava and sweetpotato varieties and other technologies have been and are being developed for specific uses. The demand-driven approach being used helped the research agenda to focus on the needs of consumers/users of the commodity in the market chain with a strong bias on income generation, private sector participation and food security.

Sub-sector analysis

Sub-sector analysis studies were conducted in Malawi, Tanzania and Zambia to understand the structure and performance of cassava and sweetpotato markets in these countries. The studies showed that there has been significant increases in production and consumption of cassava and sweetpotato in the region in the recent years with production expanding even in non-traditional growing areas.

Pricing of cassava/sweetpotato is subjective with a certain level of bargaining for both quantities and price. No clear standards are set but tuberous root size, grade, farm gate price, and to a lesser extent, variety, freshness and colour play an important role in pricing. It was found out that the fresh market is more lucrative than the industry. In addition, the linkage between industrial processors and producers is very weak and non-existent in most areas.

Cassava commercialisation

There has been greater private/industrial sector participation in cassava production/utilisation and promotion. Significant increases in use and demand of cassava products by pre-selected industries in the region have been registered with usage increasing from 7000 MT in 1999 to 12000 MT in 2003. Similarly, industries utilising cassava products have increased in the three leading IITA/SARRNET countries: Malawi, Zambia and Tanzania. This has been a result of four functional models that IITA/SARRNET initiated to promote cassava commercialisation, which focussed on production, marketing and processing. There has also been greater participation of commercial cassava and sweetpotato plant material production in the region with commercial producers increasing from 2 firms/individuals in 2001 to more than 20 firms/individuals in 2003.

Demand-led Research for Development

IITA/SARRNET role in research for development was based on specific needs of the region. Several commissioned studies and small competitive grant projects were undertaken on participatory variety selection targeting specific uses and market. Through these and collaboration with NARS, 16 cassava varieties and 7 sweetpotato varieties have been released during SARRNET phase II. These were bred answering specific needs of both fresh and industrial markets; combating the emerging threat of Cassava Brown Streak Disease and those aimed at combating vitamin A deficiency. About 100,000 families in Mozambique, Tanzania and Malawi benefited from the distribution of orange-fleshed sweetpotato planting materials to combat vitamin A deficiency.

SARRNET also promoted the use of improved post harvest technologies on cassava and sweetpotato with a shift from the traditional rudimentary methods to modern labour saving, quality

improving and value adding technologies to improve on grades and standards of the end products. Graters, chippers, slicers were tested for acceptability in some SARRNET countries. Local artisans were trained for the fabrication and sale of these machines as business following the introductions of 17, 23 and 37 prototypes respectively in Tanzania, Malawi and Zambia.

Cassava in dairy cattle feed

IITA/SARRNET in partnership with CIAT/CLAYUCA and in collaboration with Land O'lakes in Malawi also conducted research on livestock feed in Tanzania and Malawi. Cassava silage which is made up of 80% leaves and 20% roots is a good feed for dairy animals and in Malawi resulted into increases in milk yield during the dry season from an average of 6 litres/animal/day to 13 with improvements in butterfat content from 3.2% to 3.6%. The health of the animals/body conditions was also improved. This implies that there is high potential for improving the dairy industry by using cassava silage in the SADC region. Dairy farmers have started growing cassava

Multiplication and distribution of improved/clean planting material

Cassava and sweetpotato multiplication programme was initiated in many SADC countries and this helped in the spreading of improved, introduced varieties and clean planting materials of recommended varieties. About 739 ha of cassava and 647 ha sweetpotato were planted as primary multiplication fields, which led to a multiplier effect of 7 per year for establishment of secondary and tertiary multiplication fields for distribution and/or sale to farmers/producers by NGOs and other private producers.

As a result of these multiplication and distribution activities, there has been steady but remarkable increases in area planted with improved/cleaned cassava and sweetpotato varieties. The percentage area put to improved sweetpotato varieties in the region grew from 12% to 29% while that of cassava grew from 7% to 13.5% during SARRNET Phase II.

Involvement of SARRNET in HIV/AIDS programme

IITA/SARRNET in partnership with Save the Children Federation (USA) carried out joint cassava and sweetpotato activities to assist people caring for the terminally ill patients and orphaned children in Malawi. A total of 21 community groups of HIV/AIDS were formed. Cassava and sweetpotato were found more appropriate to such communities dominated by reduced labour force as they demand fewer inputs. In addition, introduced processing machines reduced the high labour requirement and processing time. A total of 206 men and 98 women were trained as trainers in seed multiplication, agronomy, processing and utilisation, and HIV/AIDS prevention. About 18.8 hectares of cassava and 11 hectares of sweetpotato nurseries were established. An estimated number of 6000 vulnerable households benefited from the seed.

Information and technology transfer

SARRNET has been highly successful in developing effective means of sharing information and technology within the region. SARRNET released **ROOTS** newsletter bi-annually for information sharing within and outside SADC region. The posting of a web page www.sarnet.org on the Internet, which was updated regularly, also improved information sharing. SARRNET also conducted steering committee meetings where delegates shared information through presentations of technical papers and country reports; sponsored symposia and workshops and also produced technical reports, which were distributed to stakeholders. A scientific workshop was held in 2003 where commissioned and competitive grants studies were presented and are being peer-reviewed for publication in a special issue of *African Crop Science Journal*.

Training and capacity building

About 233 participants in the SADC countries have been trained in various themes.

Collaboration

To achieve the above outputs, SARRNET collaborated with the SADC/FANR, NARS and sister networks/institutions such as CIAT/CLAYUCA, EARRNET, FOODNET, NRI and NRI International and had efficient backstopping from IITA-Ibadan, IITA/ESARC and CIP-Nairobi.

1.0. Introduction

About SARRNET

The Southern Africa Root Crops Research Network (SARRNET) was inaugurated in 1994 as a follow-up of the East and Southern Africa Root Crops Research Network, which was split into SARRNET, and East Africa Root Crops Research Network (EARRNET). The International Institute of Tropical Agriculture (IITA) executes the project with the responsibility of coordinating the Network. The International Potato Center (CIP) through its regional headquarters in Nairobi, Kenya backstops activities on sweetpotato.

Twelve Southern Africa Development community (SADC) countries are members of the network including Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe and of late (2001) the Democratic Republic of Congo (DRC) who joined the network for its southern agro-ecological zones as DRC joined the SADC grouping. The network is working under the umbrella of SADC-FANR (Food, Agriculture and Natural Resource) directorate, which took over the Southern Africa Centre for Cooperation in Agricultural Research and Natural Resources (SACCAR) Board. The United States Agency for International Development (USAID) Mission in Malawi and later the Regional Center for Southern Africa (RCSA) has been the main financial support to SARRNET.

SARRNET Phase 1 had, as major goal to improve household food security of resource poor farmers in Southern Africa. The main objectives were to increase cassava and sweetpotato production and utilisation through adoption of improved varieties and practices and strengthening the capacity of national root crops research programs in the SADC region. The major thrusts of SARRNET I were research, training, information and technology exchange and institutional capacity building. Its main research objectives were in the fields of the development and/or introduction and evaluation of improved germplasm, managing pests and diseases through an ecologically sustainable plant protection (ESPP) approach, surveying production systems, development of post-harvest technologies and the establishment of rapid multiplication and distribution systems for improved planting material and technologies.

SARRNET phase II, jointly developed by representatives of the member countries, IITA and CIP, and USAID/RCSA at the Harare stakeholders meeting in 1999, shifted its focus to demand-led research and development in cassava and sweetpotato crops with strong bias on income generation, private sector participation, and food security. This objective was clearly based on tackling issues of poverty reduction through improving the opportunities for sustainable income generation. The network thus shifted its focus to include the needs of the markets/consumers by promoting cassava and sweetpotato not only as food crops but also as commercial commodities to create opportunities for off-farm employment. Thus, improved cassava and sweetpotato varieties and other technologies have been and are being developed for specific uses including industrial uses and animal feed. In addition, cassava and sweetpotato are low input requiring crops doing well in marginal production systems; hence, they have become important crops in HIV/AIDS afflicted communities facing shortage of labour force.

The recognition that these crops can also be transformed into broad-based commodities for sustained food security, better nutrition and income generation has helped accelerate its uptake. In view of this, SARRNET activities took pragmatic and holistic approach to broaden the mandate to accommodate cross cutting issues for the demand-led research and development. This was done in order to achieve high levels of commercialisation, a strong and vibrant private sector participation by linking farmers to the private/public sectors, increased environmental protection, expanded crop diversification and improved nutrition and health including involvement in HIV/AIDS programs and the promotion of orange flesh sweetpotato varieties rich in vitamin A.

2.0 Results Framework

SARRNET Phase II was designed on a Results Framework following the then USAID/RCSA strategic objective (SO3) “**Accelerated Regional Adoption of Sustainable Agricultural and Natural Resource Management Approaches**” through its IR1 and IR2.

SARRNET II project entitled “*A Vision based Regional Integration through Partnership and Participation for Demand-led Process of Root Crops Research and Development*” contributed to USAID/RCSA Intermediate Results 1 (IR1) “Functioning systems in place for transferring agricultural and natural resources management technologies and best practices across the region” with three expected results:

- SARRNET IR 1.1** **Farmers have access to a wider range of improved varieties resulting in higher rates of adoption**
- SARRNET IR 1.2** **Farmers in target areas using a wider range of crop management options leading to increased productivity**
- SARRNET IR 1.3** **Broader public and private partnerships promoting regional technology development, exchange and application leading to increased availability of improved technologies to end users.**

Phase II of SARRNET also contributed to USAID/RCSA IR2 “An enabling environment that provides increased incentives for smallholder and communities to adopt sustainable agricultural and natural resources management technologies and approaches” with one expected result.

- SARRNET IR 2.1** **Post-harvest systems linking root crops producers and industrial consumers to accelerate commercialisation of cassava and sweetpotato.**

To achieve the above IRs, activities were carried out through competitive grants and commissioned studies by IITA/SARRNET staff and/or in partnership with CIAT following a subcontract agreement between the IITA and CIAT on execution of SARRNET activities.

3.0 SARRNET vision, strategy and governance

SARRNET Phase II vision was to promote a dynamic economic growth in the agricultural sector in the region by linking farmers to private industries/markets so as to develop viable small, medium and large-scale enterprises both in the rural and urban areas that will look at root crops from a business point of view. It also believed that producers will only be motivated to adopt commercial production and increase their productivity if they can sell their produce to dependable and sustainable local industries and exporters based on a thorough understanding of domestic, regional and international markets.

SARRNET strategy was based on:

- 1. Food security** (ameliorating natural disasters and civil strife)
- 2. Income generation and equity** (high value markets linked to s/holder farmers)
- 3. Commercial crop and industrial uses** (import substitution/foreign exchange earnings & portion of the value added retained in the rural sector).

In pursuit of its goals and objectives, SARRNET conducted market-led research for development activities through small competitive grant projects, commissioned studies and through collaboration with the National Agricultural Resource Systems (NARS). In this endeavour SARRNET and its partners developed demand-driven technologies such as varieties targeting specific end-uses and

introduced processing technologies to the producers to improve on grades and standards of the end products following end-users requirements. As Such, SARRNET had to:

- Carry out an in-depth analysis of potential agricultural sub-sectors to determine appropriate commodities/products demanded from root crops and develop promotional interventions;
- Develop and introduce/promote market-led technologies such as germplasm adapted to specific uses and responding to commercial production
- Improve grades and standards, assure that food and products quality is maintained and that superior products attract premium from the market;
- Develop viable business models based on such analysis to link the producers, processors and users in the market chain (Consortium approach); and
- Provide practical advice to interested stakeholders in the production, processing and handling, utilisation of the products in order to improve the efficiency and quality products to meet the local and international high grades and standards.
- Conduct Integrated Production and Pest management (IPPM) including crop and soil management practices

In the **‘linking farmers/producers to markets’**, SARRNET used the following approach:

1. Market opportunities identification of root crops products (flour, feed and starch and other industrial applications);
2. Development of processed root crops products that fit the identified markets or industrial processors;
3. Industrial testing/applications of the root crops products with private sector partners;
4. Identification of suitable production areas and provide improved production and processing technologies to rural farmers to fulfil required market grades and standard and link them to identified markets;
5. Providing technical support/training to local partners (manufacturers development and extension partners, private sector);
6. Scaling up with assistance of support partners (NGOs, micro-credit facilitators, traders etc) and development of public-private sector partnerships;

SARRNET II as well as Phase I was managed by a Coordinator and governed by a Steering Committee (SC). The SC was a mix of private and public sectors comprising representatives from the private industries, National Agricultural Resources Systems (NARS: Farmers associations, research, extension, planning etc.), the universities, NGO’s, CG centers and donors. The SC was the policy making body of SARRNET and set the market-led research for development agenda, priorities. Other regional networks representatives and stakeholders participated in the SC annual meetings.

4.0 ACHIEVEMENTS

4.1. Sub-sector analysis of cassava and sweetpotato

Sub-sector analysis studies were conducted in Malawi, Tanzania and Zambia to understand the structure and performance of cassava and sweetpotato markets in these countries and draw inferences for Southern Africa. The surveys were carried out in major cassava and sweetpotato production, consumption and marketing areas between 2000 and 2002. Data was collected at farm, rural market, wholesaler, transporters, retailer and industrial processor level covering all marketing aspects including marketing opportunities for processed products. The surveys comprised of three phases: literature review, qualitative assessments and quantitative studies. A total number of 730 producers, 544 traders and 790 consumers were interviewed using structured questionnaires and participatory methodologies.

The studies showed that there has been significant increases in production and consumption of cassava and sweetpotato in the region in the recent years with production expanding even in non-traditional growing areas where 90% of the farmers sold their cassava, implying that cassava have become an important cash crop in the region. For more than 70% of the farmers, food and cash were the major reasons for growing cassava and sweet potato.

Consumers of cassava/sweetpotato are mainly low to middle income class people and these products are substitutes for products taken during breakfast. The major form of consumption reported was fresh boiled roots. Preferred varieties are those with good (sweet) root taste, fast cooking and high dry matter content, all related to fresh root consumption.

Players in the cassava/sweetpotato marketing chain: producers, traders (middlemen /wholesalers, retailers), transporters and consumers mainly rely on “social networks” and personal observations for marketing information. Pricing of cassava/sweetpotato is subjective with a certain level of bargaining for both quantities and price; however, traders especially middlemen have an upper hand in price determination. No clear standards are set but root size, grade, farm gate price, and to a lesser extent, variety, freshness and colour play an important role in pricing especially at retail markets. Transport costs constitute the major costs incurred by traders.

There are a number of industries using cassava products as raw materials; however, little cassava penetrates the industries at the time of the studies despite the fact that demand for industrial use has been increasing. Producers and traders mainly target the fresh cassava/sweetpotato market other than the processing industries. It was found out that the fresh market is more lucrative than the industry. In addition, the linkage between industrial processors and producers is very weak and in most areas, it is non-existent. Little processing of cassava was reported amongst players with most of it being done to change the form in which the product is consumed and to increase shelf life. Processing was mostly reported in areas where cassava is grown as a staple food. Processing methods reported were mainly rudimentary involving peeling, fermenting and pounding.

Fostering technological advances in domestic processing and strong linkages between producers and the industry would enhance consumption and utilisation of cassava /sweetpotato products. The supply of timely and reliable market information as well as establishing grades and standards would facilitate the marketing process. The country reports and a regional synthesis report have been published separately as monographs.

IR 1.1: Farmers have access to a wider range of improved varieties resulting in higher rates of adoption

1.1.1 Primary multiplication and distribution of improved/clean planting materials

Lack of adequate, high quality planting materials of improved varieties was identified as one of the bottlenecks to the expansion of cassava and sweetpotato in Southern Africa. This is compounded by the bulkiness and high distribution costs, low multiplication rates, and poor keeping quality of vegetative planting material. Multiplication and distribution of planting material is thus essential for successful adoption of improved cultivars at farm level. Thus, cassava and sweetpotato multiplication programme was initiated in many SARRNET country members. This has helped in the spreading of improved, introduced varieties and cleaned planting materials of locally recommended varieties.

Total area under cassava multiplication in the region in 2002/2003 was 739 ha, which produced a quantity of 33,923,300 m, which planted about 10,000 hectares of improved materials from nurseries alone. The hectarage for sweetpotato multiplication was 647 that produced about 38,820,000 m and this planted over 4,000 hectares (Table 1). The multiplied varieties are those that were released and recommended in the region.

Table 1. Area under primary multiplication (SARRNET, NGOs, GVT, FAO) with improved/clean planting materials in different SARRNET countries for 2002/2003.

Country	Area under cassava (ha)	Quantity of cuttings (m)	Area under sweetpotato (ha)	Quantity of vines (m)
Malawi	300	13,410,000	190	11,400,000
Mozambique	274	12,247,800	337	20,220,000
Zambia	35	2,458,500	60	3,600,000
Tanzania	85	3,795,500	40	2,400,000
Angola	45	2,011,500	20	1,200,000
Total	739	33,923,300	647	38,820,000

1.1.2 Adoption of improved varieties (Area planted with improved/clean varieties)

As a result of multiplication and distribution exercises carried out in the region, there has been a steady but remarkable increase in area planted with improved/cleaned cassava and sweet potato varieties (Table 2). During the period under review, the percentage area put to improved sweetpotato varieties in the region grew from 12% to 29% while that of cassava grew from 7% to 13.5%. The sweetpotato variety SPN/O called Kenya in Malawi and Chingova in Zambia, Zimbabwe, Mozambique and Democratic Republic of Congo, has extensively spread in Southern part of Africa with high rates of adoption (Fig 1). The slower growth rate for cassava adoption compared to sweetpotato has been due to shortage of planting material as a result of early harvests to circumvent the hunger crisis, pressure of diseases such as CBSD, drought and floods problem and the slow propagation rate. However, the participation of other stakeholders in the root crops plant material multiplication and distribution has been on the increase particularly for food security reasons. A total of 123 recorded stakeholders within the region have participated in plant material multiplication and distribution (Table 3).

Table 2. Percentage area planted with improved/cleaned cassava and sweet potato varieties in some SARRNET participating countries

Country	Crop	% Estimates of area put to improved varieties in target countries ¹				
		1998	1999	2000	2001	2002
Malawi	Cassava		21.81	20.89	22.87	24.0*
	Sweetpotato		5.22	5.84	6.70	30.0*
Mozambique	Cassava		0.04	0.044	0.063	6.10
	Cassava		0.66	0.69	0.858	5.0
Tanzania	Sweetpotato		7.2	7.5	8.208	8.3
	Cassava		7.0	13.5	15.31	19.0
Zambia	Sweetpotato		25.3	25.4	47.75	50.0
	Cassava		5.00	7.38	8.81	9.77525
% Regional average			6.00	12.57	12.77	15.6645
						29.4

Table 3: Number of Non governmental organisations (NGOs), community based organisations, private sector and public institutions involved in the multiplication and distribution systems in the region by country

Country	No. of NGOs	No. of CBOs	No of Private organisations	No. Public institutions
Malawi	24	2	14	9
Mozambique	7	27	-	5
Zimbabwe	2	1	2	8
Tanzania	5	1	-	2
Zambia	-	-	-	-
Angola	3	-	-	1
Lesotho	-	-	-	6
Swaziland	-	-	-	4
Total	41	31	16	35

Figure 1. SARRNET countries where SPN/O Sweetpotato variety has been adopted



1.1.3 Involvement of SARRNET in HIV/AIDS Programme

SARRNET in partnership with Save the Children Federation (USA) in Malawi decided to carry out joint cassava and sweetpotato activities to assist people caring for the terminally ill patients and orphaned children. Cassava and sweetpotato was chosen in the initiative because of their potential to make major contributions to socio-economic improvements. They demand less labour, requires less or no external inputs, are tolerant to drought and most crop diseases and pests and can provide cash when sold, vegetable relish and main dish when prepared at household level as cheap sources of Vitamin A, proteins, minerals and carbohydrates. The main activities were the establishment of nurseries in the target communities and training of the communities on root crops production and HIV/ AIDS prevention.

A total of 21 community groups of HIV/AIDS were formed in 3 districts of Malawi (Dedza, Mangochi and Nkhotakota) with 3 district AIDS Coordinating Committees (DACCs). A total of 206 men and 98 women were trained as trainers in seed multiplication, agronomy, processing and utilisation, and HIV/AIDS prevention. This activity resulted into increases in yields of sweetpotato and cassava in the target areas to an average of 12 and 15 tonnes per hectare respectively. About 18.8 hectares of cassava and 11 hectares of sweetpotato nurseries were established. An estimated number of 6000 vulnerable households benefited from the seed each planting 0.06 ha cassava and 0.04 ha sweetpotato. Harvested roots for both crops totalled 560 tonnes and benefited about 5000 vulnerable households each getting 112 kg. One community aids committee received a grater for cassava processing. The Processing period has been reduced from 7 days to 2 thereby enabling families to dedicate more time to care for the sick and orphaned children.

IR 1.2: Farmers in target areas using a wider range of crop management options leading to increased productivity

1.2.1 Demand-led Research for Development

SARRNET role in research for development was based on specific needs of the stakeholders. A number of researchable areas were undertaken to come up with improved agricultural technologies and practices in the region for adoption by farmers, public and private sectors. These included the following:

Germplasm development for targeted specific uses

SARRNET undertook several commissioned studies on participatory variety selection targeting specific uses and market. For fresh cassava market, SARRNET breeding and selection strategy was to develop sweet varieties with low cyanogens while bitter and high dry root yield varieties were being developed for industrial uses (starch, industrial flour etc.). Orange fleshed sweetpotato varieties; rich in Vitamin A were introduced for fresh market in rural and urban communities to combat vitamin A deficiency. For instance in Mozambique, distribution of improved orange-fleshed sweetpotato planting materials to combat vitamin A deficiency benefited 55,000 and 33,500 families respectively in Zambezia and Nampula provinces.

To increase the yields of cassava, SARRNET efforts were geared towards combating the emerging threat of Cassava Brown Streak Disease (CBSD). CBSD is a major biotic constraint to cassava production along the lakeshores of lake Malawi and in the coastal regions of Tanzania and Mozambique. The disease affects total root yield and root quality. Field trials conducted in Tanzania established that CBSD could decrease root yield up to 70 %. Collections and exchange of botanical seeds for different varieties and promising clones from Uganda, Tanzania and Malawi have been done for regional germplasm development work mainly for screening for CBSD

resistance (Table 4). More than 240,000 true seeds were exchanged between IITA Ibadan, IITA Uganda, Mozambique, Tanzania and Malawi.

Table 4: Seed collections and exchange for regional CBSD screening trials.

Country of origin	Number of seeds collected/introduced		
	To Malawi	To Tanzania	To Mozambique
Uganda	20,000	-	-
Tanzania	600	3000	-
Malawi	110,000	9000	30,000
Mozambique	-	-	-
IITA-Ibadan	20,000	30,000	18,000

Through commissioned studies, small competitive grant projects and through collaboration with the National Agricultural Resource Systems (NARS), a total of 32 cassava varieties were released during phase I and II of SARRNET (Table 5). Some of these varieties have high levels of tolerance to Cassava Brown Streak Disease (CBSD), which is becoming a threat in the region. In addition, 24 sweetpotato varieties were also released during the same period (Table 6).

SARRNET also conducted Leaf and Root Production trials for livestock feed industry. Results of these experiments are presented in Annex 7. Variety selection to produce low cost livestock feeds from root crops for increased milk, meat and egg production as demanded by the farmers was being done. Work was done with Land O Lakes and Central Region Milk Producers Association of Malawi, while in Tanzania work was done with egg and poultry producers.

Table 5. Cassava varieties released in the SADC region during SARRNET Phase I and II

Variety	Source or place of origin	Place of release, year and local name (<i>Italics</i>)	SADC population reached
Manyokola	Malawi	Malawi 1999 (<i>Manyokola</i>) Zambia (<i>Manyokola & Maniopola</i>) and Mozambique	20,000,000
TMS 91934	IITA (Nigeria)	Malawi 1999 (<i>Silira</i>)	1,000,000
TMS 60142	IITA (Nigeria)	Malawi 1999 (<i>Maunjili</i>), Angola	1,000,000
MK 95/478	Local selection from IITA OP	Malawi 1999 (<i>Mkondezi</i>)	1,000,000
CH92/112	Malawi (IITA OP)	Malawi 2002 (<i>Yizaso</i>)	1,000,000
CH92/077	As above	Malawi 2002 (<i>Sauti</i>)	2,000,000
Bangweulu	Zambia	Zambia 2001	2,000,000
Nalumino	Zambia	Zambia 2001	2,000,000
Kapumba	Zambia	Zambia 2001	2,000,000
Mbuyu/ Msufi/Mnazi	Tanzania	Tanzania	5,000,000
Kibangameno	Amani selecton	Tanzania, Kenya	3,000,000
Kigoma mweusi	Tanzania	Tanzania (<i>Kigoma Red</i>) <i>mweusi</i> , Mozambique (<i>Kigoma Red</i>)	30,000,000
Ngwananhanga	Tanzania	Tanzania	3,000,000
Mfaransa	Tanzania	Tanzania	3,000,000
Lumala mpunu	Tanzania	Tanzania	3,000,000
Kibaha	Amani selection	Tanzania	3,000,000
Hombolo 95/05	Selection from IITA OP	1998, Tanzania, drought resistant	200,000
Muzungu	Amani selection	Tanzania, Kenya	3,000,000
NDL 90/34	Tanzania	Tanzania	3,000,000
TMS42025	IITA	2002 Mozambique	2,000,000
TMS30001	IITA	2002 Mozambique and Tanzania	5,000,000
TMS30395	IITA	2002 Mozambique	2,000,000
MF 1	Australia	1994 Zimbabwe	3,000,000
MF 2	Australia	1994 Zimbabwe	3,000,000
MF 3	Australia	1994 Zimbabwe	3,000,000
MF 4	Australia	1994 Zimbabwe	3,000,000
Nachinyaya	Tanzania	Tanzania and Mozambique	15,000,000
TMS 60142	IITA (Nigeria)	1994 Angola	4,000,000
M 96000910	IITA parent I8200058HS (Nigeria)	1994 Angola	4,000,000
Precoce d'Angola	Local recommended variety	1994 Angola	4,000,000
TMS 40142	IITA Introduction	1994 Angola	4,000,000
Nganarico	Local variety	2000	4,000,000

Table 6. Sweetpotato varieties released in the SADC region during SARRNET Phase I and II

Variety	Source or Place of Origin	Place of release, Year and Local Name (<i>Italics</i>)	SADC population reached
Ribbok	South Africa	Botswana, Namibia and South Africa	10,000,000
Eland	South Africa	Botswana, South Africa	5,000,000
SPN/O	Tanzania selection	Malawi 1986 (<i>Kenya</i>), Mozambique (<i>Malawi</i>), Zambia and DRC (<i>Chingovwa</i>) and Zimbabwe (<i>Chingovya</i>), Botswana (<i>Kenya</i>), Swaziland <i>Kenya</i>)	80,000,000
Cemsa 74-228	(CIP)	Malawi 1999 (<i>Semusa</i>), Angola (<i>Cemsa</i>)	10,000,000
Mugamba	(CIP)	1999 Malawi	2,000,000
Tainoni	Asia (CIP)	1999 Malawi	2,000,000
Kakoma	Malawi	1999 Malawi	2,000,000
Salera (1941/121)		2002 Malawi (<i>Salera</i>)	2,000,000
Kapiri,	Zambia selection	Zambia (<i>Kapiri</i>)	3,000,000
Katondo	Zambia selection	Zambia (<i>Katondo</i>)	3,000,000
Mbete	Zambia selection	Zambia (<i>Mbete</i>)	3,000,000
TIS 25 32	IITA (Nigeria)	Mozambique 2002	1,000,000
TIS 2534	IITA (Nigeria)	Mozambique 2002	1,000,000
INIA 15	Mozambique	Mozambique 2002	1,000,000
INIA 9	Mozambique	Mozambique 2002	1,000,000
INIA 3	Mozambique	Mozambique 2002	1,000,000
NC1560,	Nigeria	Angola	3,000,000
Lanceolada,		Angola	3,000,000
Lo323,		Angola	3,000,000
W119,		Angola	3,000,000
Cubana	Angola selection	Angola	3,000,000
Bosbok	South Africa	Zimbabwe, South Africa, Botswana	15,000,000
Brondal	South Africa	Zimbabwe, South Africa, Botswana	15,000,000
Blesbok	South Africa	Botswana, Lesotho, South Africa, Namibia	15,000,000

IR 1.3: Broader public and private partnerships promoting regional technology development, exchange and application leading to increased availability of improved technologies to end-users

1.3.1 Networking

SARRNET has developed regional networks and strategic partnerships with government, non-governmental organisations and business sector organisations. Through these networks, SARRNET has been able to develop and introduce technologies and knowledge from one country/place to another.

1.3.2. Technology transfer

There have been several cases where technologies of cassava and sweetpotato developed in one country have proved to be well adapted and acceptable to farmers in several other countries. This is true for cassava and sweetpotato germplasm exchange and dissemination, processing machines dissemination, scientific and technical visits exchange among stakeholders. Seed multiplication and distribution systems developed in some countries were replicated in other countries to accelerate adoption of improved/cleaned varieties.

1.3.3. Information sharing

SARRNET II has published and distributed **ROOTS** newsletter bi-annually for information sharing within and outside the SADC region. Six regular issues and one special issue on CBSD totalling 15,000 copies were produced and distributed to various stakeholders and interested partners. SARRNET also posted a web page, www.sarnet.org on the Internet, which was updated regularly for efficient information dissemination. SARRNET conducted steering committee meetings where delegates shared information through presentation of technical papers, country reports and general

discussions (Annex 2, 3 and 4). SARRNET also sponsored symposia and workshops where stakeholders shared information (Table 7). In addition to these, 19 books titled “The CASSAVA Transformation” by Nweke, F.I. et al were distributed to some countries in the region. SARRNET also produced semi-annual and annual technical reports, which were distributed to all stakeholders and the donor.

Table 7: Workshops sponsored by SARRNET Phase II

Title	Year and place	No. of participants	Observation
Workshop/ Symposium			
Sweetpotato breeding study tour and training workshop.	14-22 May, 1999, Uganda and Tanzania	9	SARRNET sponsored SADC participants to the workshop
Production and Impact statistics for cassava and sweetpotato	13-16 Sept, 1999, Dar-es-Salaam, Tanzania	39	Jointly organized with other IITA networks
SARRNET stakeholders conference	18-20 Jan, 1999, Harare, Zimbabwe	74	Formulation of SARRNET II implementation strategy
2001 steering committee meeting	14-18 May, 2001, Dar-es-Salaam, Tanzania	33	Participants came from the private sector, NARS, NRI-UK, CIP and IITA. A total of 25 presentations were made including progress reports
Cassava commercialisation for economic development in Malawi	21 st –23 rd May 2001, Blantyre, Malawi	82	This was an in country symposium and the proceedings were distributed to all stakeholders
2002 SARRNET Steering Committee meeting,	29-30 April, 2002, Pretoria, South Africa	37	Participants came from the private sector, NARS, sister networks, CIP, IITA and USAID. 10 country reports, 12 papers on commissioned studies and 4 progress reports for small grants were presented
2003 SARRNET Steering Committee and 2 nd SARRNET scientific workshop	19- 24 May 2003, Lusaka, Zambia	24 and 64	Proceedings of the workshop published in a special crop science journal.

1.3.4. Training and capacity building

One of the goals of SARRNET was to develop manpower through higher degree/non-degree training, and in service training to develop their capacity for research on root crop research for development. About 233 participants from the SADC countries were trained in various themes as presented in Table 8. The direct impact of these training programmes has therefore been attainment of skills to better execute research activities, which ultimately leads to increase in the production and productivity of the agricultural and natural resource sector.

Table 8. Short-term courses sponsored by SARNET Phase II

Title of course	Country/Locati on	No. of participants	Gender		Period
			Male	Female	
Mozambique					
Multiplication of cassava and sweetpotato	Nampula	30	23	7	2-13 July 2001
Nutrition and Agro-processing of cassava and sweetpotato	Maputo	26	10	16	29Oct-9Nov, 2001
Rapid multiplication of cassava and sweetpotato	Gaza	4	4	0	11-14 Nov, 2001
Rapid multiplication of cassava and sweetpotato	Gaza	8	7	1	25-29 Marco 2002
Nutrition and Agro-processing of cassava and sweetpotato	Maputo	9	6	3	25-29 Marco 2002
Nutrition and Agro-processing of cassava and sweetpotato	Maputo	4	2	2	17-22 April 2002
Tanzania					
Training of local manufacturers in the construction of cassava processing	Mwanza	2 Workshops	5		May-Aug 2001(each workshop 3-5 working days)
On-farm cassava and sweetpotato rural processing and product development	Dar es Salaam	29	15	14	9-19 Oct, 2000.
Training of local processors in cassava processing	Kibaha	10	-	10	March 2001 (2 days)
Malawi					
Root crops production processing and utilization	Blantyre, Thuchila	34	24	10	1 st week August 2000
Root crops production processing and utilization	Ntcheu, Nkhanda	52	39	13	1 st week July 2000
Commercialization and enterprise development of cassava and sweetpotato planting material	Lilongwe	27	16	11	24July-4 August 2000
Training of local manufacturers in the construction of cassava processing equipment	Lilongwe/Blantyre	2 workshops	8		May-Aug 2001(each workshop 3-5 working days)
Zambia					
Training of local manufactures in the construction of cassava processing equipment	Lusaka	1 Workshop	4		Aug 2001

Workshops and training outside SADC region

Table 9 gives a summary of workshops and training courses attended by SARRNET staff/collaborators.

Table 9. Workshops attended by SARRNET Staff or Collaborators

Course/ Workshop	Period	No. of SARRNET sponsored participants	Location/organizer
Agro-enterprise course,	May 2001	5	Entebbe, Uganda/ FOODNET
GIS- course,	June 2001	3	Kampala, Uganda/ IITA
Post-harvest and Marketing course,	9 – 19 October 2000	29	SARRNET/ Tanzania
ISTRC-AB,	12 – 16 November 2000	12	ISTRC-AB/IITA/ Nigeria;
Quantitative Analysis of Data from Participatory Plant Breeding workshop	23 – 25 August, 2001	1	Giessen, Germany
Sweet potato symposium	November 2001	2	Lima, Peru
Sub-Sahara African Network of the International Biometrics Society	3 – 8 December 2001	1	IITA, Uganda

IR 2.1: Post harvest systems linking root crops producers and industrial consumers to accelerate commercialisation of cassava and sweetpotato

2.1.1 Promotion of cassava commercialisation

SARRNET in collaboration with CIAT /CLAYUCA promoted a dynamic economic growth in the agricultural sector in the region by linking root crops farmers to private industries so as to develop viable small, medium and large-scale enterprises both in rural and urban areas. Strong private sector participation has been developed in the region following four functional models that SARRNET initiated which focussed on production, processing and marketing. As a result, the region registered increasing demand and use of cassava as a raw industrial material. Cassava has application in food, confectionery, timber, paper, packaging, pharmaceutical and textile industries. Ethanol and gel fuel manufacturing and animal feeds are emerging uses of cassava. Industrial demand and use of cassava products by pre-selected industries in the region rose from 7000 mt in 1999 to 12000 mt in 2003 (Figs. 2 and 3; Table 10). Within the same period, there was also an increase in the number of industries utilising cassava products in the three leading countries: Zambia, Tanzania and Malawi. With the projects efforts, other companies such as METL (Mohammed Enterprises Tanzania Limited) in Tanzania are planning to develop a commercial cassava starch factory targeting at 15000-18000 mt of native starch per year (around 80,000 mt of fresh cassava roots). The company supported SARRNET and the national program on cassava research activities with land, labour and logistics and SARRNET and NARS Tanzania provided technical backstopping (germplasm, agronomy trials, contacts and technical information). In Malawi, an Ethanol extraction company and a gel fuel company are also planning to start utilizing cassava products of up to 36,000 mt per year.

The region has also seen the growth of fresh cassava and sweetpotato markets in urban and peri-urban centers where these crops have acted as substitutes for bread. The four functional models that SARRNET initiated include:

2.1.1a Promotion of cassava production and marketing using farmers' associations

Two farmers' associations as 'pilots', one in each, Malawi and Tanzania were formed under SARRNET guidance and technical support from CIAT/CLAYUCA following the sub-contract signed in 2000 between IITA/SARRNET and CIAT.

In Malawi, SARRNET worked with Phalombe farmers association, which is under Christian Service Committee (CSC). Phalombe is located 137 km east of Blantyre and is accessed by traders including intermediate buyers. Industries establish satellite depots from where they purchase agricultural produce. SARRNET took advantage of this situation to rejuvenate production, processing and marketing of cassava, a crop that was previously grown in the area but abandoned due to lack of market incentives and declining yields due to pests and diseases. SARRNET worked with 100 farm families from eight villages. Clean cassava seeds of improved varieties were distributed to 100 farmers for 25 ha since the major constraint in the area was lack of planting material. A demonstration on improved processing methods involving use of motorised cassava chipper was done. SARRNET contacted Rab processors and Universal industries on behalf of the farmers to get their industrial demand for cassava chips. These companies accepted to purchase cassava chips from farmers as long as quality was assured. So far these companies require over 12,000 metric tonnes of cassava chips for their domestic industrial production and export. SARRNET installed a motorised cassava chipping machine, a drying floor to improve grades and standards for products to be processed at the site. Although farmers accepted the technology and produced good quality chips, distance between the pilot site and the main road to the urban market was the major limiting factor hindering the success of this project as the industries contacted wanted farmers to deliver the products at their factory.

In Tanzania, SARRNET worked with Bungu community in Rufiji district, eastern Tanzania, where four farmers associations have been formed for cassava processing and marketing. Bungu community was identified as a potential area for cassava processing, as farmers are not able to sell fresh cassava into Dar es Salaam market due to poor road linkages despite high cassava production in the area. Traders from the city prefer buying cassava from areas closer to Dar es Salaam where farmers get as high as 30 US \$/mt while farmers at Bungu are offered as low as 10 US \$/mt due to extra transport costs (distance and poor roads). Cassava yields are good in Bungu and there is low disease pressure. Traditionally farmers eat cassava in fresh form or processed (makopa). However, the processing of makopa takes long and is very basic. The entire drying process takes over 10 days, while the roots are getting fermented subsequently discoloured. Most often drying is done on the ground hence the final product contains a lot of sand and dust or soil particles. SARRNET introduced motorised cassava chippers and drying racks in the area so that farmers can produce dried, clean white chips- producing higher quality products in a shorter time. The group was invited to Dar-es -Salaam to visit major markets and potential buyers. The group is now able to sell processed cassava chips/flour at 150 US\$/mt, is less dependent on few traders of fresh cassava, and there are new employment opportunities for women including the elderly (peeling, processing and harvesting). (See details in Annex 6 of the full report)

In addition to these, other cassava production associations were organised in collaboration with NGOs such as World Vision in Malawi and Food net in Tanzania.

2.1.1 b Promotion of cassava production through out-growers schemes.

Most private industries using cassava do not produce enough cassava for their requirements. For example, a Cassava Starch Manufacturing Company in Pietersburg in South Africa produces cassava for its factory on more than 2000 ha. To catch up with its daily requirements of 250 tons per day of fresh cassava roots, CSM contracts farmers in Mpumalanga region to produce cassava for the factory.

In Malawi, Njuli farm of Universal Industries distributed cassava seed to farmers for 260 hectares. It buys the roots from farmers. The farm has a power chipper for making chips introduced by SARRNET and hammer mill for flour making. The farm also participated in evaluating 5 new cassava clones.

2.1.1c Promotion of cassava production and marketing through commercial producers and processors

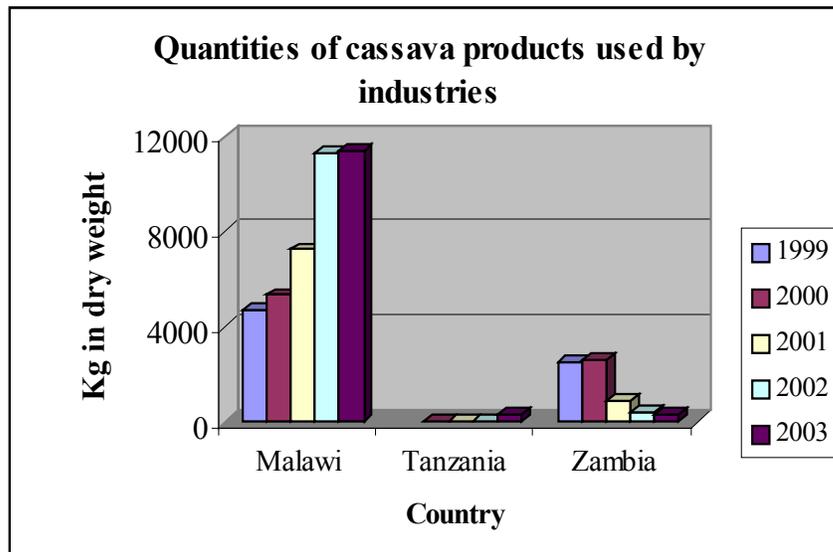
SARRNET efforts also resulted in some estates diversifying their production to cassava with the intention of processing cassava into various products such as flour and starch. Chitipi farm is one such a case in Malawi where over 120 ha of cassava has been planted on the farm with technical backstopping from SARRNET. The farm has already profited from the sale of planting material to NGOs and other farmers and has plans of processing the roots into starch, flour or pellets (see success story, Annex 9 in the full report)

In Tanzania, METL, Tanzania's largest Agro-enterprise company has decided to invest in large scale starch processing.

2.1.1d Promotion of cassava marketing through intermediate traders: “The middlemen”

The strategy was used to promote marketing of cassava products through intermediate buyers (IBs) in the region. IBs play an important role in the fresh cassava and sweetpotato markets by sourcing the products from the rural areas into urban markets. The role that SARRNET played was to link the IBs to the industry. These reach remote areas to source cassava chips/roots for sell to consumers and industries. Some industries have benefited from the use of intermediate buyers in Zambia, Tanzania and Malawi. Examples of such industries are one timber industry in Malawi (ITL, a plywood manufacturing company) and Rab processors (produces cassava/maize blended flour).

Fig 2. Quantities of cassava products used by industries in the three leading countries for 1999-2003.



Note: The market of cassava is just coming up in Tanzania as a result of SARRNET and NARS activities. The crop suffered the image problem and was confined to the rural areas. The decline in cassava use by industries in Zambia for 2001 and 2002 is attributed to hunger such that most of the cassava was consumed than sold to industries and for 2003, data from other companies could not be collected.

Fig 3. Number of Industries utilising cassava products in the three leading countries since 1999

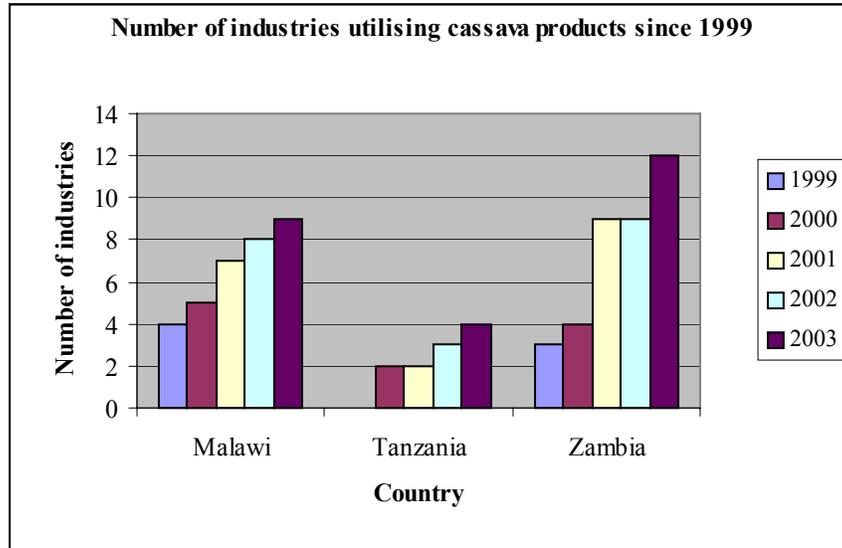


Table 10. PRE-SELECTED PANEL OF COMPANIES USING CASSAVA IN SARRNET TARGET COUNTRIES

Country	Industry	Estimated utilization of cassava per year in metric tons of fresh cassava				
		1999 (baseline values)	2000	2001	2002	2003
Malawi	David Whitehead	520	1,200	344	0	0 ¹
	Universal Industries	227	333	700	1000	1000 ²
	Rab Processors	3,000	1,800	6,000	10000	10,000 ³
	Hussen Mahommed	1,000	2,000	0	60	- ⁴
	ITL	0	0	192	220	300 ⁵
	Katete farm	-	-	-	-	100
Mozambique	Casa do Gaiato	0	-	12	-	- ⁶
Tanzania	Ramesh Patel Mlandizi	0	0	0	-	- ⁷
	Power Foods Limited, Igesa and Kitco Ltd		12	12	20	180 ⁸
	Mtwara Farmers	0	0	0	-	- ⁹
	Jayaba Mills			0	10	- ¹⁰
	Vita Feeds	-	-	-	-	120
Zambia	Chundleigh Bakery (Pro-Processing Enterprises)	2,400	2,400	100	150	- ¹¹
	Namando Investments	50	50	500	10	- ¹²
	Wood Processing Industry – Ndola	50	50	167	121	- ¹³
	Unity Paper Packaging Company Ltd		153	157	130	140 ¹⁴
	Trishul	-	-	-	-	50
	Zambezi paper mills Ltd	-	-	-	-	100
	Monterey printing & packaging	-	-	-	-	36
	19 industries	7,247	7,997	8,166	11,721	12,026¹⁵

¹ The company is on the verge of collapsing and is working on skeleton staff through government intervention

² There is steady increase in utilisation of cassava flour for biscuits making, also flour was being sold to consumers.

³ Rab launched cassava maize flour blend, which is selling very well. The management provides figures which cannot be verified but which seem underestimated.

⁴ Though not open with figure, but bought about 28MT of chips

⁵ Have started using in plywood manufacture

⁶ A catholic processing unit producing cassava gari (Farinha)

⁷ Is failing to install an already bought cassava starch plant

⁸ Producing flour 1kg packs. Volumes to supermarkets are on the increase

⁹ Used to export cassava chips but stopped due to low world prices

¹⁰ Mills flour and sell to supermarkets

¹¹ Company changed name to Pro-Processing Enterprises. Sell pure cassava flour or cassava blended with wheat flour. May have used more but is withholding information

¹² Activities of the company were scaled down to closing levels due to scarcity of cassava as a result of food crisis and due to managerial problems

¹³ Uses cassava flour in timber, but has problems with suppliers who provide poor quality flour (impregnated with foreign particles) and the quantities are reduced to famine.

¹⁴ Uses cassava for making glue for laminating carton boxes. Manufacturer of packaging material.

¹⁵ This data is on the 3 lead countries

2.1.2 Quantity of improved clean planting material sold by private sector

SARRNET promoted production of clean planting materials of improved varieties for multiplication and dissemination. Commercialisation of planting material has now taken a definite shape. At first (in the year 2000), only few farmers were reporting that they sold or bought some cassava or sweetpotato planting material. Commercial seed production was observed only with Mtendere Campus in Malawi who produced 3 ha of land for cassava and ZIMCAP Company in Zimbabwe who produced sweetpotato seed. However, SARRNET and NARS have witnessed 4 more established multipliers of cassava and sweetpotato-planting material while in Zimbabwe ZIMCAP was joined by Dr Robertson to multiply sweetpotato. The commercial market has rapidly developed in Malawi, Zimbabwe and Zambia. For instance, 15 firms/stakeholders were involved in the production and selling of cassava and sweetpotato seed over the last two years (Table 11). In addition to these, there are a number of public and private multiplication sites some of which were established by SARRNET/NARS but supervised by extension staff. NGOs, CBOs, CSOs, and individuals buy planting materials from the multiplication sites.

Table 11 Companies/individuals multiplying cassava and sweetpotato planting material, 1999-2002)

No	Name of Farmer	Planting Material	Land (ha) in 2002	
1	Mtendere Campus	Cassava	20	
		Sweet potato	2	
2	Malindi Farm	Cassava	15	
3	Mr Mafuta	Cassava	3	
4	Nathenje Farmers Group	Cassava	10	
5	Mtukuso Chitedze Farm	Cassava	1	
6	Mr Tembo Chiwamba	Cassava	0.4	
7	Mr Steven Banda	Sweetpotato	0.3	
8	Nathenje EPA	Cassava	2	
		Sweetpotato	0.4	
9	Mr Chinzimu	Cassava	2.0	
10	Mr Munthali	Cassava	3	
11	Chitipi farm	Cassava	120	
12	Research Institutions	Cassava	5	
		1. Chitedze		
		Sweetpotato	0.5	
		2. Bvumbwe	Sweetpotato	1
		3. Zombwe	Cassava	1
4. Kasinthula	Cassava	3.5		
13	ADDs	Cassava	20	
14	Mr Mwananema Zimbabwe	Cassava	5	
15	Macheke	Sweetpotato	10	
16	ZIMCAP Company	sweetpotato	3	
	Total for cassava		210.9	
	Total for sweetpotato		17.2	

2.1.3 Post harvest technologies and research on product development

SARRNET and NARS promoted the use of improved post harvest technologies on cassava and sweetpotato with a shift from the traditional rudimentary methods to modern labour saving quality improving and value adding technologies to improve on grades and standards of the end products. To this effect, SARRNET promoted the use of modern chipping, slicing, and grating technologies, which were introduced in Zambia, Tanzania and Malawi from IITA/ESARC Uganda. In line with this, 10 local commercial fabricators in Zambia (1), Tanzania (7), and Malawi (2) were trained to fabricate technologies imported from other countries and produce them locally (Table 3). The adoption of these processing equipments is quite good with increasing level of commercialisation of cassava.

In Zambia, the processing technologies were introduced through a competitive grant project: “Promotion of Cassava Processing Equipment and Product Development”. The project introduced the technologies to over 2000 farm families in five provinces Northern, Western, Central, Lusaka, Eastern and Southern province. The main districts where the technologies were introduced include Lusaka, Kaoma, Kasama, Samfya, Solwezi, Choma and Chipata. About 37 units of machines were distributed in these areas to groups of farmers and a few entrepreneurs through project activities and those of collaborators (Table 12). In Malawi, the technologies were introduced in selected districts in the three regions of the country namely: Mzimba, Lilongwe, Nkhhotakota, Phalombe, Blantyre and Mulanje (Table 13). About 1600 farmers were reached.

In Tanzania, Powerfoods Limited was the first private company taking up processing technology and started selling high quality cassava flour after introducing equipment at the factory in Dar es Salaam. Later, more urban groups started using cassava processing (like women groups in Tanga town and in Kibaha). In addition to these, SARRNET introduced processing efforts further out of town in areas of high cassava production but poor market linkages due to distance to town and poor roads. One of such areas is Bungu in Rufiji district where farmers are now able to sell processed cassava products and are benefiting significantly from the intervention. Tables 14 and 15 present the distribution of processing machines in Tanzania and Zambia.

Table 12. Local artisans trained to modify and/or fabricate the imported processing machines

Tanzania	Malawi	Zambia
Nyumbu Automotive Technical Centre	Luso Workshop in Lunzu in Blantyre	Sams
Relaible Motor Works	Petroleum Services in Lilongwe	
Workshop Mtana		
Mushi Engineering		
Intermech Engineering		
Vitanda Engineering		
Pemba Engineering		

Table 13. Distribution of processing machines in Malawi

Type of machine	Distributed to/location	Collaborating Institution	Remarks
1Engine driven grater 1Manual chipper 1Pressing machine	Chintheche EPA	Mzuzu ADD	Demonstrations on Processing for home consumption
Manual chipper	Mulanje	GTZ	Demonstrations on Processing for home consumption
1Engine driven grater 1Manual chipper	Nkhotakota	Save the Children Federation (US)	Mitigation of HIV/AIDS impact on affected communities for processing cassava for home consumption
6 Engine driven Chipping machines	Chata ADP (Chiwamba)	World Vision International	Processing for home consumption and sale to industrial markets
1Motorized Chipper	Njuli Farm	Universal Industries	Processing cassava chips for biscuit and other confectionery manufacturing
1Engine driven grater	Nali factory	Kay Marketing	Starch extraction
1Engine driven slicer	Bunda College	Private processor	Processing cassava flour for making baby foods
1Manual chipper	Area 25	Farmer (Mr Phiri)	Processing cassava for home consumption
1Engine driven slicer	Bvumbwe Research Station	DARTS	Demonstrations on Processing for home Consumption
1Engine driven Chipper	Embangweni	Christian Service Committee	Processing cassava chips for sale to timber industry
1Engine driven slicer 1Engine driven chipper 1Engine driven grater 1Manual chipper 1Manual slicer	Chitedze Research Station	DARTS	For research purposes and Demonstrations on Processing for home Consumption

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Table 14. Distribution of processing machines (Chippers) in Tanzania

Institution	Purpose/location	Type of equipment
Women group	Kibaha	Chipper
Women group	Tanga town	Chipper
Farmer groups	Zanzibar isles	2 manual; 2 petrol driven units 1 electric chipper
NRI/IITA project on CMVD	Lake Zone	Various units
Farmers group	Mvuti (Pugu)	1 motorised unit
Farmer group	Mkuranga	1 motorised unit
Power foods	Dar es Salaam	1 motorised unit
TFNC		1 Motorised chipper
Kibaha Team	Research, Kibaha	1 Motorised chipper; 1 grater
SUA departments	Demonstration, Kibaha	4 Chippers; 1 motorised unit

Table 15: Distribution of processing machines to collaborators/stakeholders in Zambia.

Institution	Purpose/location	Type of equipment	Remarks
Mt. Makulu Research Station	Demonstration & Promotion	1 Manual chipper; 1 Grater 1 Electric chipper; 1 Screw press	Delivered
Dept of Field Services Western Province	Demonstration & Promotion in Kaoma District	5 Manual chippers; 1 Petrol chipper	Delivered
PAM	Demonstration & Promotion in Eastern Central & Western provinces	1 Petrol chipper; 5 Manual chippers; 1 Grater +1 press	Delivered
AFRICARE	Setting up a livestock feed mill at Refugee camp in Kasama	1 Petrol chipper; 3 Manual chippers 1 Electric chipper	Delivered
Mansa TAS	Demonstration & Promotion in Samfya	1 petrol grater; 1 Petrol chipper 5 Manual chippers	Delivered
SAMs	Demonstration & Promotion	1 Electrical chipper; 1 Manual Chipper	Delivered
Mutanda Research Station	Demonstration & Promotion in Solwezi	5 Manual chippers; 1 Petrol chipper	Delivered

2.1.4 Research on product development

SARRNET Phase II also promoted research on product development. Products developed from cassava and sweetpotato have been accepted while some products need further research. The most successful product from improved technologies is non-fermented cassava flour. Unlike traditionally made flours fermented and unfermented, flours made from slicing, chipping or grating technologies is superior in quality and also the advantage of bulk processing during short period of time makes it get premium price from industries. Cassava flour has multiple uses; it substitutes maize flour, wheat flour and sometimes starch in various industrial and food applications.

So far it is used in:

Meal flour, pure or blended with maize (Malawi, Zambia and Tanzania)

Paper mill industry (carton and tissues) substituting starch (Zambia)

Plywood Industry. Glue (Malawi and Zambia)

Packaging industry glue for cartons (Zambia)

Confectionery Biscuits and crisps (Malawi)

Bakery (Malawi, Zambia and Tanzania (*secretive industry*))

Other products Gari (Zambia), scones, cakes and doughnuts (Malawi and Zambia)

For sweetpotato, the most successful sweetpotato post harvest product is Sweetpotato juice. The product is produced by women groups and sold in Mozambique. Other products which have been selected for further trial in Zimbabwe (Rukuni, 2001) after successful preliminary sensory testing include jam, crisps and bakery or confectionery products.

The silage and compound feeds from sweetpotato and cassava roots and leaves also showed strong signals for growth of the livestock feed industry in the region. In Malawi research work on silage was done with Land O Lakes and Katete livestock farm. In Tanzania, joint field trials were conducted with feed millers and livestock farmers on silage and compound feeds from sweetpotato and cassava roots. These include Farmers' Centre (Nguva farm, Kigamboni); Interfarm feeds (Kiwalani area); Odata farms- Dairy farm with various crops, Mpigi/Magore; Tan Daries, Kimara (dairy cattle keeper) and others.

2.1.5 Cassava in livestock feed

SARRNET in collaboration with CIAT/CLAYUCA conducted research on livestock feed in Tanzania and Malawi. In Malawi cassava feed production trials were conducted with Land O lakes and Katete farm while in Tanzania, research was conducted with some egg and poultry farmers (Annex 6). In Malawi, the research was aimed at determining the acceptability of cassava silage by dairy animals, the effect of feeding cassava root and leaf silage on the health of the animals and milk yield. Six animals were used of which 3 were fed from cassava silage (80% leaves and 20% roots) and the other 3 were controls fed on grass and maize silage. A mixture of four varieties of cassava namely Silira, Mbundumali, Maunjiri and Mkondezi were used for making the silage. Fresh leaves and roots were chopped using pangas (machetes) and tractor-operated chopper to make the silage. Results indicated that the animals accepted the cassava silage and that their body conditions/health were improved. The cassava silage increased milk yield from an

average of 6 litres/animal/day to 13 litres during the dry season. Results also indicated that butterfat content of the milk was improved by the cassava silage from 3.2% to 3.6%. Economic analyses of feeding cassava on dairy animals indicated that every money invested in cassava silage brought a return of 49.20 more folds in milk as opposed to investment in maize/grass silage which brought a return of 14.00 more folds only. There seems high potential for improving the dairy industry by using cassava silage in Malawi.

5.0 Competitive Grants to SADC stakeholders

Various competitive small grant studies were awarded to SADC NARS (Scientists, NGO's/extension officers, universities etc). The project steering committee took the responsibility of collaborative work plan proposals and grant allocations. A total of 27 small grants projects were funded and conducted demand –led research and development in germplasm, post harvest and market studies. Details of the small grants studies are presented in Annex 1 and are reported per country. There were 10 approved sweetpotato, 12 cassava and 5 for both cassava and sweetpotato funded projects (Table 16).

Table 16. Number of funded projects for each intermediate result (IR)

I.R.	Activity	Cassava	Sweetpotato	Both crops	Total
1.1	Improved varieties/multiplication and distribution	5	8	1	14
1.2	Agronomic improvement/plant protection	0	1	0	1
1.3	Regional exchange	0	2	1	3
2.1	Post harvest	5	1	2	8
	Total	10	12	5	27

Following the IRs, the small grants could be grouped as follows:

IR1: Farmers have access to a wider range of improved varieties resulting in higher rates of adoption

Project Leader	Budget (US\$)	Project title and objectives
Mr. Haij Hamid Saleh	6,000	Title: On-farm evaluation of improved cassava clones to facilitate farmers' choice in Zanzibar Objective: To evaluate and screen improved and local clones of cassava under farmer's conditions that will resist diseases, pests and give good yield and are acceptable to farmers adaptable to different agro ecological zones.
S.M. Shaali	6,000	Title: On-farm evaluation of improved sweetpotato varieties in Zanzibar Objective: To test on-farm selected sweetpotato varieties for weevil resistance
Mr. Haij Hamid Saleh	6,000	Title: Expanded multiplication and delivery of cassava and sweetpotato planting materials through wider partnerships in Zanzibar Objective: To increase the distribution of improved sweetpotato planting materials to smallholder farmers
Ms. Esther Masumba	9,772	Title: On-farm evaluation of improved sweetpotato varieties in the eastern zone of Tanzania Objective: Generation of promising genotypes which are potential in yield and other attributes such as pest and disease resistance and drought tolerance.
Mrs. Kiddo Mtunda	14,570	Title: Enhanced multiplication and distribution of cassava planting materials through expanded partnerships in Tanzania Objective: To multiply improved varieties of cassava resistant to cassava mosaic virus disease and cassava brown steak virus disease
Mrs. Kiddo Mtunda	12,000	Title: Increasing sweetpotato production in Tanzania through the distribution and multiplication of improved farmers selected varieties Objective: Expand area under improved varieties establishing effective system of planting materials to farmers.
Mr. Gabriel Ndunguru	13,500	Title: On-farm testing and utilisation of orange-fleshed sweet potato varieties in the lake Zone, Tanzania Objective: Promote the best available orange-fleshed sweet potato
Mr. Davies Chitundu	8,000	Title: On-farm testing of introduced and locally bred cassava genotypes in Zambia Objective: To increase the number of adapted cassava varieties from which farmers can make choices
Davies Chitundu	7,500	Title: Evaluation of improved sweetpotato varieties under on-farm conditions in different agro-ecological zones in Zambia Objective: Evaluate agronomic Performance of new sweetpotato Genotypes in varying environments
J. Allemann	9,000 \$	Title: On-farm validation of superior cassava clones for different agro-ecologies of South Africa Objective: To evaluate improved cassava genotypes developed by the cassava breeding programs in Tanzania and Malawi, as well as at IITA, in four provinces in South Africa under local conditions.
S. Laurie	5,000	Title: Accelerated multiplication and distribution of selected improved sweetpotato genotypes in South Africa Objective: To train trainers and leading farmers on the principles of rapid

		multiplication and distribution of improved sweetpotato genotypes. To assist in the establishment of secondary multiplication and distribution systems in target areas in six provinces in South Africa.
D. Kanyerere WorldVision	10,000	Title: Expanding production and utilisation of cassava through farmer training, seed multiplication and distribution of improved varieties in Chata, Malawi Objectives: To make improved cassava varieties available to 240 farmers in 8 commitment areas in Chata ADP by September 2002. To institute sustainable seed supply system for cassava in Chata community by 2002. To improve the processing and utilization methods of cassava and add value to the crop by September 2002.
F. Chipungu	US\$11,658	Title: Scientist-Farmer participatory sweetpotato selection for the different production seasons and for year round supply - by Mrs. F. Chipungu - Bvumbwe Research Station Objectives: To characterise sets of newly released and promising sweetpotato cultivars and breeding lines for yield potential and stability, pests and diseases, consumer acceptability and storability under local conditions. To identify key environmental factors that limit sweetpotato production and make recommendations of varieties. To link the formal sector breeding with farmers breeding, selection and evaluation of the released and promising varieties. To attempt to combine the best scientists and farmers knowledge in research and development in an innovative way.
S. Laurie	14,981	Title: Evaluation of improved and imported sweetpotato genotypes in sub-humid and dryer agro-ecologies in South Africa Objective: To multiply improved sweetpotato genotypes developed by the regional breeding program in South Africa and imported lines and disseminate mother plants to target areas in six provinces in South Africa for evaluation, as well as to the sweetpotato evaluation programs of Namibia, Botswana, Swaziland, Lesotho and Zimbabwe

IR1.2: Farmers in target areas using a wider range of crop management options leading to increased productivity

Project Leader	BUDGET ET US\$	Project Title and objectives
M. Simwambana	6,000	Title: On-farm demonstration of staggered planting dates in Zambia to optimise the marketing of sweetpotato Objective: To generate technologies that widen period for supply of sweetpotato tubers to the fresh market

IR1.3 Broader public and private partnerships promoting regional technology development, exchange and application leading to increased availability of improved technologies to end users

Project Leader	BUDGET US\$	Project Title and objectives
D. C. Chitundu	15,000	Title: Regional breeding programme for sweetpotato based on the needs of farmers in the northern region of SADC Objective: Hybridisation as a means of developing new sweetpotato genotypes.

G.C. Bothma	15,000	Title: Facilitating the regional exchange of the best improved varieties and land races of cassava and sweetpotato among SADC countries Objective: To produce pathogen-free material of local cultivars and land races of cassava and sweet potatoes from SADC countries.
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IR2.1: Post-harvest systems linking root crops producers and industrial consumers to accelerate commercialisation of cassava and sweetpotato

Project Leader	BUDGET (US\$)	Project Title and objectives
Ms. M.S. Zulu Mr. Ivor Mukuka	24,000	Title: Introduction and demonstration of processing equipment and product development of cassava through promotion of recipes Objectives: To improve the processing of cassava through introduction and demonstration of processing machines. To develop products from cassava so as to widen the use of cassava at household and industrial level
Dr.A. Temu, Dr. D. Nyange, Mr. F. Mashamba	17,450	Title: Cassava and sweetpotato marketing study in Malawi, Zambia, and Tanzania. Objective: Determine household and commercial demand for raw and processed cassava and sweetpotato and supply
Montford Mwiko	10,000	Title: Utilization of sweetpotato in livestock feed production in Zambia Objective: To Enhance Income Generation and Food Security
D. Kanyerere WorldVision	10,000	Title: Expanding production and utilisation of cassava through farmer training, seed multiplication and distribution of improved varieties in Chata, Malawi Objectives: To make improved cassava varieties available to 240 farmers in 8 commitment areas in Chata ADP by September 2002. To institute sustainable seed supply system for cassava in Chata community by 2002. To improve the processing and utilization methods of cassava and add value to the crop by September 2002.
J.D. Kalenga Saka	7,000	Title: Processing and marketing of high quality cassava products Objective: To promote cassava processing and marketing by women and their households in the rural and peri-urban areas of Malawi.
Mrs A. Mwangwera	15,000	Title: Commercial Processing of Cassava and Cassava-Maize Blended Flour. Objectives To develop a consumer acceptable cassava - maize blended flour To commercialise cassava flour
C.C. Moyo	7,000	Title: SARRNET II Baseline Studies in Malawi
Rukuni/A. Mutungamiri	15,000	Title: Cassava product development & marketing studies in Zimbabwe Objective: Improve the profitability of cassava production through exploitation of post harvest technologies

6.0 Subcontract Agreement between the International Institute for Tropical Agriculture (IITA) and the International Center for Tropical Agriculture (CIAT) on SARRNET

The subcontract agreement between the International Institute of Tropical Agriculture (IITA) and the International Center for Tropical Agriculture (CIAT) was to provide professional and other related services to meet the overall objective of SARRNET. CIAT provided these services through its membership of the Latin American Consortium for Cassava Research and Development (CLAYUCA) and its own Rural Agro enterprise Development Project. These services contributed to the achievement of the specific objectives as detailed in annex 5.

7.0 SARRNET Staffing

SARRNET has at present local and International staff located in Malawi, Mozambique and Tanzania. Mozambique is now under IITA bilateral project directly funded by USAID mission in Mozambique. SARRNET works in collaboration with National Agricultural Research and Extension Systems in these countries. Tables 17 and 18 present the list of international and local staff in these countries.

Table 17: Internationally recruited staff

Name of staff	Activity/Specialisation	Country
Dr. Nzola Meso Mahungu (PhD)	Coordinator (Breeder)	Malawi
Dr. James Teri	Coordinator (Pathologist, left Sep. 2000)	Malawi
Dr. Maria Isabel Andrade (PhD)	Agronomist (affected to bilateral in 2001)	Mozambique
Mr. Sicco Koliijn (MSc)	Post harvest/Agric. Engineering	Tanzania
Dr. I Kasele (PhD)	Agronomist (left 2001)	Zimbabwe

Table 18: Nationally recruited staff

Name of staff	Activity/Specialisation	Country
Mr. Vito Sandifolo (BSc)	Integrated Projects Research Associate	Malawi
Mr. Albert Mhone (MSc)	Post harvest/ Administrative Officer	Malawi
Mr. C.C. Moyo (MSc)	Documentation Officer	Malawi
Mrs Sella Jumbo (MSc)	Agric. Economist (Monitoring & evaluation)	Malawi
Mr Vianey Rweyendela	Agro-processing	Tanzania
Mr. Josie Edwardo (3 others on bilateral project)	Agronomists	Mozambique

8.0 NARS CONTRIBUTION TO ROOT CROPS ACTIVITIES

SARRNET as a research for development network organisation is working hand in hand with the NARS especially on cassava and sweet potato market-led activities. As a result the NARS benefit from SARRNET through technical, financial and material support. They also benefit from training opportunities and capacity building. On the other hand SARRNET benefit from the expertise and manpower and also from numerous other resources such as land, offices and laboratory, equipment and many operational costs. Below is a table of NARS contributions to SARRNET activities.

Table 19: NARS contribution to SARRNET

Country	Item	No/Quantity	US\$ Annual
Tanzania	Number of staff	25	199,200.00
	Number of office and laboratory equipment	15	4,235.00
	Annual Value of land used for field trials and multiplication		8,235.00
	Annual operational costs incurred		16,605.00
	Total		228,275.00
Malawi	Salaries	46 people	178200.00
	Office hiring	17 offices	4,080.00
	Lab hiring	6 laboratories	14,400.00
	Processing shade hiring	2 processing shades	3,200.00
	Service bills	180000	3,000.00
	Vehicle cost	1200km monthly hiring cost	4,800.00
	Fuel cost		2,000.00
	Land hiring	15 hectares	52,000.00
	Totals		303,680.00
Zambia	Salaries	24 people	240,000.00
	Office hiring and Lab hiring	12 offices and 7 laboratories	20,000.00
	Operational cost		50,000.00
	Land for trials	17 hectares	4,590.00
	Land for multiplication	50 hectares	13,500.00
	Totals		328,090
Zimbabwe	Number of staff:	15	54,720.00
	Offices: 9 and 4 Laboratories:	13	800 000.00
	Value of land:		1,000,000.00
	Operational costs:		6,000,000.00
	Total		7,000,800.00
DRC	Number of staff	17	72,000.00
	Offices		1,800.00
	Laboratory and equipment		2,000.00
	Annual Value of land used for field trials and multiplication	25ha	2,700.00
	Vehicles		11,000.00
	Others services		8,100.00
	Total		97,600.00

9.0 Conclusion

SARRNET has made great progress in achieving its objectives in the area of germplasm development, multiplication and distribution, creation of awareness among policy makers, farmers and the private sector, promotion, and setting ground for cassava and sweetpotato commercialisation. The project has made great impact in changing the image of cassava and sweetpotato in the SADC region such that there has been an overall increase of recognition of the importance of cassava. Cassava has gained recognition by various stakeholders in the SADC region including the private sector. Due to the joint efforts of SARRNET, NARS and key stakeholders, cassava has seen its way into various industries, which were utilising wheat products as raw materials such as timber and confectionery as well as the livestock industry. However there are great challenges for cassava commercialisation, which will require more attention. The challenges here include development of technologies in addition to those already existing, that will lead to increased level of productivity (both crop production and processing) and suit industrial uses as they emerge. Some of such technologies include fertiliser recommendations, irrigation requirements, storage of harvested fresh roots before processing and various other industrial requirements.

The project also allowed participating collaborators to gain some skills and experience to direct their own projects and ensure sustainability. At the same time an effective collaborative regional research system is now established. The provision of a reasonable amount of training to many collaborators in the region will continue to play a role in institutionalisation of skills for root crops research and technology transfer and help in improving the productivity of the farmers.

The partnership established in the network has enabled the collaborators to harness the comparative advantages of each program for the mutual benefit of the region. The network has assisted NARS in keeping active programs with well-focussed research for development enabling them to select new varieties. However, the impact of such new technology can only effectively reach the majority of farmers if government agencies and NGOs are involved particularly in extending proven results of research to end users (farmers).