PROCEEDINGS
ORANGE-FLESHED SWEETPOTATO SYMPOSIUM

PRETORIA

3 October 2007

Compiled by **Mieke Faber, Sunette Laurie and Paul van Jaarsveld**

MRC SOUTH AFRICA

ARC • LNR

THE VITAA PARTNERSHIP
VITAMIN A FOR AFRICA

This report gives a summary of the presentations presented at the following symposium:

Orange-fleshed Sweetpotato Symposium

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PROGRAMME

ABBREVIATIONS

ANOVA	Analysis of variance
ARC	Agricultural Research Council
ARC-ISCW	ARC Institute for Soil Climate and Water
ARC-PPRI	ARC Plant Protection Research Institute
ARC-VOPI	ARC - Vegetable and Ornamental Plant Institute
ARDI	Agricultural Research and Development Institution
BUCADEF	Buganda Cultural and Agricultural Development Foundation
CCT	Christian Church of Tanzania
CDCynergy	Centre for Disease Control computer based micronutrient program
CIP	International Potato Center
CRP	C-reactive protein
CRS	Catholic Relief Services
DFID-NRI	Department of International Development - Natural Resources Institute
DHS	Demographic and Health Survey
EARO	Ethiopian Agricultural Research Organization
EC	Eastern Cape Province
FADEP	Farming for Food and Development Program
FAO	Food and Agricultural Organization
FFS	Farmer Field School
IFPRI	International Food Policy Research Institute
KARI	Kenya Agricultural Research Institute
MDG	Millennium Development Goal
MI	Micronutrient Initiative
MP	Mpumalanga Province
MRC	Medical Research Council
MRDR	Modified-relative-dose-response
MUK	Makerere University of Kampala
NAADS	National Agricultural Advisory Services
NARIS	National Agricultural Research Institutes
NARO	National Agricultural Research Organization (Uganda)
NGO	Non-governmental Organization
NRI	Natural Resources Institute
OFSP	Orange-fleshed sweetpotato
PCA	Principal component analysis
PEM	Protein energy malnutrition
PRAPACE	French acronomy for the Regional Program for the Improvement of Potato and Sweetpotato in East and Central Africa
RAE	Retinol activity equivalents
REU	Reaching end user
SARRNET	Southern Africa Root Crops Research Network
SAVACG	South African Vitamin A Consultative Group
SSA	Sub-Saharan Africa
TSNI	Towards Sustainable Nutrition Improvement
VEDCO	Volunteer Efforts for Development Concerns
VITAA	Vitamin A for Africa
WFSP	White-fleshed sweetpotato

FOREWORD

Hunger and malnutrition is still a major problem throughout the world today. High rates of micronutrient malnutrition persist despite commitments made globally to reduce the malnutrition status of the world's population. Vitamin A deficiency is of public health significance in South Africa and affects large numbers of people, especially women and children in rural areas. Hunger and malnutrition and their devastating consequences can be dramatically reduced through well conceived and carefully developed and implemented food-based programmes.

In an attempt to address vitamin A deficiency in South Africa, the Medical Research Council (MRC), with the Agricultural Research Council (ARC) as agricultural partner, developed and implemented integrated household food production and growth monitoring projects in a number of rural areas in KwaZulu-Natal, the Eastern Cape and The North West provinces of South Africa since the 1990's. The aim was to improve the vitamin A status of children through the production and consumption of provitamin A-rich vegetables and fruit together with nutrition education. One of the main crops used in the programme is orange-fleshed sweetpotato since it is a hardy, widely adapted, multi-purpose crop requiring low input and is rich in energy as well nutritional value (especially provitamin A but also vitamin C and some iron, riboflavin, thiamine and niacin). Orange-fleshed sweetpotato was used together with other provitamin A-rich vegetables and fruit crops to provide variety in the diet and extend the period of availability.

These interventions resulted in significant increases in vitamin A intake and serum retinol concentrations of 2-5 year old children and therefore proofed that this type of intervention is successful. The home-garden approach can complement both fortification and supplementation programs and provides a sustainable means to food and nutrition security. Rural areas will benefit most from the inclusion of vitamin A-rich vegetables into gardening projects, since people in rural areas often do not benefit from clinic-based nutrition programs because of a lack of health facilities within these areas, and because they have limited access to commercially available fortified foods.

The purpose of the orange-fleshed sweetpotato symposium was to provide information on the status of the food-based programmes and implementation in South Africa and other African countries, provide specific information regarding the status of research and production of orange-fleshed sweetpotato in South Africa and other African countries as well as lessons learned from all these programmes. The VITAA partnership provided the opportunity to combine the orange-fleshed sweetpotato symposium with the VITAA steering committee meeting held from 1-3 October 2007 in South Africa.

The MRC and the ARC wish to thank the participants, presenters and chairpersons for their contribution to the success of the symposium. The authors wish to thank the MRC and ARC for their support for the continued development and research on food-based models and the role-out of the programmes.

FOREWORD

I am sure that this proceedings will prove extremely useful not only to those interested in food-based programmes and production of orange-fleshed sweetpotato, but also those concerned with the training of health, nutrition and extension workers in general. We will continuously strive to find ways to distribute the latest research results to ensure we enrich the current and future implementation of food-based programmes.

Dr SL Venter
Research and Technology manager: ARC - Vegetable and Ornamental Plant Institute

SCHOOL GARDENS WITHIN THE NATIONAL SCHOOL NUTRITION PROGRAMME

Presented by: Mamokhele Maduna
National School Nutrition Programme: Department of Education, Pretoria, South Africa

The National School Nutrition Programme has three sub-programmes whose main focus areas are:

- Feeding Programme: contributes to active learning capacity by reducing short term hunger.
- Sustainable Food Production in Schools: promotes and supports the implementation of food production initiatives in schools in order to improve household food security. The main objective is to impart knowledge and practical skills on food production and sustainable use of natural resources.
- Nutrition Education: strengthens nutrition education for school-communities in order to promote healthy lifestyles and empower the citizens to make informed choices with regard to nutritious and safe food.

The number of (i) schools with a feeding programme, (ii) learners being fed, and (iii) schools with food gardens are given in table 1 below.

TABLE 1: The statistics as at 1 April 2007.

Province	Feeding schools	Learners	Schools which have food gardens
Eastern Cape	4 978	1 265 295	1800
Free State	1 472	413 546	617
Gauteng	1 143	400 096	845
KwaZulu-Natal	3 619	1 418 180	1 202
Limpopo	2 622	1 177 770	711
Mpumalanga	1 478	572 876	433
Northern Cape	440	169 772	188
North West	1 154	420 820	375
Western Cape	993	203 026	219
Totals	**17 899**	**6 041 381**	**6 390**

SUSTAINABLE FOOD PRODUCTION IN SCHOOLS

INSTITUTIONAL CAPACITY

The Department of Education has appointed full time staff, including qualified agriculturalists in each province, to implement and manage the programme.

ACTIVITIES

- Develop guidelines on promotion of school gardens and other food production initiatives.
- Train the school-communities on setting-up and management of food

gardens. The workshops are held at the schools to create an opportunity for theory and practical work in the school garden.
- Assist the schools to set up food gardens.
- Monitor progress in schools and provide technical assistance where it is needed.
- Facilitate partnerships between the Departments of Education and other strategic partners such as other government departments, United Nations Agencies (Food and Agriculture Organisation), Business Sector, Non-Governmental Organisations and school-communities.
- Provide schools with agricultural inputs including irrigation systems and borehole in some districts through collaboration with other government departments, business sector and individual community members.

ACHIEVEMENT

- Most schools are gradually recognising their role to contribute towards promoting learning about food production, especially vegetable gardens and nutrition. They are aware that they can serve as a channel for community participation. The children's and parent's participation is therefore improving.
- Strong partnerships with departments and non-governmental stakeholders. Collaboration with the Agricultural Research Council is significant in the North West province. By October 2006, 320 teachers from 54 schools had received training on the planting of orange-fleshed sweetpotato and each school was provided with orange-fleshed sweetpotato cuttings. In February 2007, 12 different cultivars of orange-fleshed sweetpotato were planted on a 20m x 20m garden at Mokasa Primary School in Taung (North West) – see figure 1. The future plan is to convert this into a community-based orange-fleshed sweetpotato nursery.
- The Department of Education is collaborating with the Food and Agriculture Organization to develop guidelines and classroom resources for school gardens and nutrition education.

FIGURE 1: Garden with orange-fleshed sweetpotato at Mokasa Primary School

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GARDEN PROJECTS WITHIN THE INTEGRATED NUTRITION PROGRAMME

Presented by: B P Sikhakhane
Deputy Director: Community-based Nutrition Programme, National Department of Health, Pretoria, South Africa

NUTRITION SITUATION IN SOUTH AFRICA

Micronutrient deficiencies	
Vitamin A	33.3%
Iron	21.4%
Iodine	10.6%
Stunting	24%
Underweight	10.3%
Household food insecurity	75%

IMPLICATIONS

- Inadequate consumption leads to insufficient intake of essential micronutrients
  - Susceptible to malnutrition
  - Malnutrition increases vulnerability to infections which can result in death
- Malnutrition has social and economic impacts
  - Affects cognitive development
  - Reduces resources and earning capacity of households

FOOD SUPPLY

- A sustainable supply of food can be achieved through:
  - Own production
  - Purchasing from suppliers/retailers
- Access to food impacts supply. The food might be available but if it cannot be accessed then supply is negatively affected.
- Supply has to be in sufficient quantity to meet the nutrient requirements as per recommended daily allowances.
- No single food contains all essential nutrients. Therefore, a variety of foods has to be consumed to ensure that all the essential nutrients are provided.
- Utilization of food both physiological (ability to digest the food and absorb the nutrients by the body) and physically (the manner in which food is handled, stored and prepared); both these factors can affect supply if not taken into consideration.

GARDENS AND THE INTEGRATED NUTRITION PROGRAMME (INP)

- Gardens can be an immediate accessible source of micronutrients.
- Can be cultivated throughout the year thus ensuring a constant supply of food and essential micronutrients. This can be achieved by staggering the planting - mixture of early, average and late-maturing varieties.
- Gardens can help to overcome seasonality of available nutrients
  - seasonal malnutrition accentuate already existing malnutrition
- Gardens should be cultivated in relation to other interventions such as nutrition education and promotion, other development initiatives and basic hygiene.
- The Department of Health is involved in the following initiatives:
  - Home gardens with intentions of nutritional benefits and some income-generation for the intended
  - beneficiaries.
  - Communal or clinic gardens which include the following:
    - On site-feeding
    - Integral aspect of rehabilitation/nutrition support (PEM Scheme)
    - Nutrition education
    - Take-home rations (supplement home meals)
    - Form of supplementary income
  - School gardens, driven mainly through Health Promotion to encourage consumption of vegetables and linked to the school feeding programme (see pages 1 to 3).

CHALLENGES

- Paucity of data on outputs and outcomes:
  - Nutritional
  - Economical
  - Developmental
  - Improve nutritional knowledge and practices
  - Social
- “Low esteem” and stigma associated with food gardens (anecdotal evidence), implying that gardens are only for the poor or those infected with TB, HIV and AIDS.
- Limited crop diversity. Only the ‘common’ crops spinach, cabbage, carrots and beetroot are cultivated in most of these gardens.
- Identifying or developing a market for extra produce is underdeveloped within this intervention.
- Community mobilization for gardening. Getting the community to participate and sustain their participation in gardens has proved to be one of the biggest challenges.

CONCLUSION

- Elements for consideration:
  - Gardens form part of a wider household livelihood system and therefore a good understanding of local conditions is needed
  - To translate gardens into nutritional benefits it is important to link the gardens to nutrition education and provide information about nutritional value of the crops produced and utilization thereof in the diets
  - Diversity and cultivation of local varieties to enhance nutritional value
  - Technical know-how is fundamental
  - Regular monitoring and evaluation are needed to provide information on the gardening activities and to quantify gardening outputs and outcomes (powerful advocacy tool)
  - Community involvement and participation are essential

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CURRENT NUTRITIONAL STATUS IN SOUTH AFRICA: SCOPE FOR FOOD-BASED INTERVENTIONS

Presented by: Mieke Faber
Nutritional Intervention Research Unit, Medical Research Council, Cape Town, South Africa

South Africa experiences a quadruple burden of disease, namely:

i. Chronic diseases linked to over-nutrition and a western type of diet and lifestyle
ii. Infectious diseases associated with under-development, poverty and under-nutrition
iii. The HIV/AIDS epidemic
iv. Burden of injury related deaths

Over-nutrition and under-nutrition therefore co-exist.

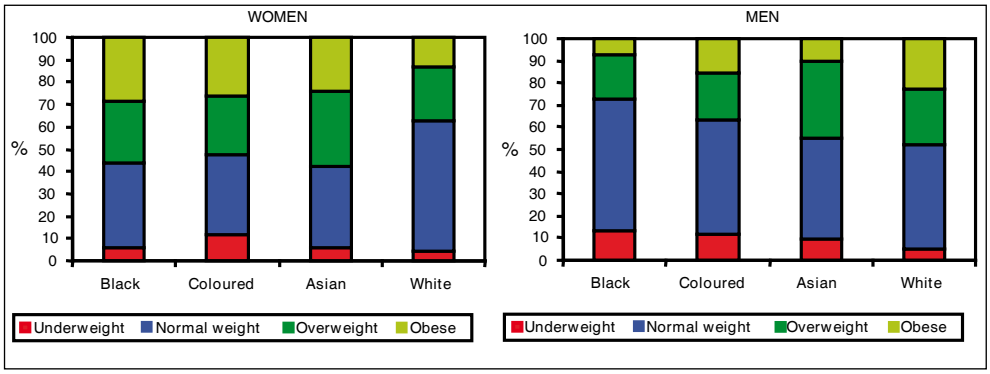


FIGURE 1: Nutritional status of adults aged 15 years and above (Source: DHS, 2003).

The high prevalence of overweight and obesity should be taken into consideration when developing (i) strategies to address childhood malnutrition and (ii) post harvest products, as not to exacerbate the prevalence of overweight and the consequences thereof. High-fat, high-sugar and high-salt post-harvest products should therefore be avoided.

Growth faltering in 6-71-month-old children

- 23% stunted
- 9% underweight
- 3% wasted

It is chronic malnutrition, rather than acute malnutrition (Labadarios et al., 1995)

Stunting was shown to be associated with an increased risk of overweight in 1-9-year-old children (Steyn et al., 2005)
Micro-nutrient deficiencies in 6-71-month-old children

- 33% vitamin A deficient
- 21% anaemic

(Labadarios et al., 1995)

In 2000:

- 3 000 deaths in 0-4-y-old children were attributed to vitamin A deficiency
- more than 2 000 deaths were attributed to iron deficiency anaemia

(Nojilana et al., 2007a, 2007b)

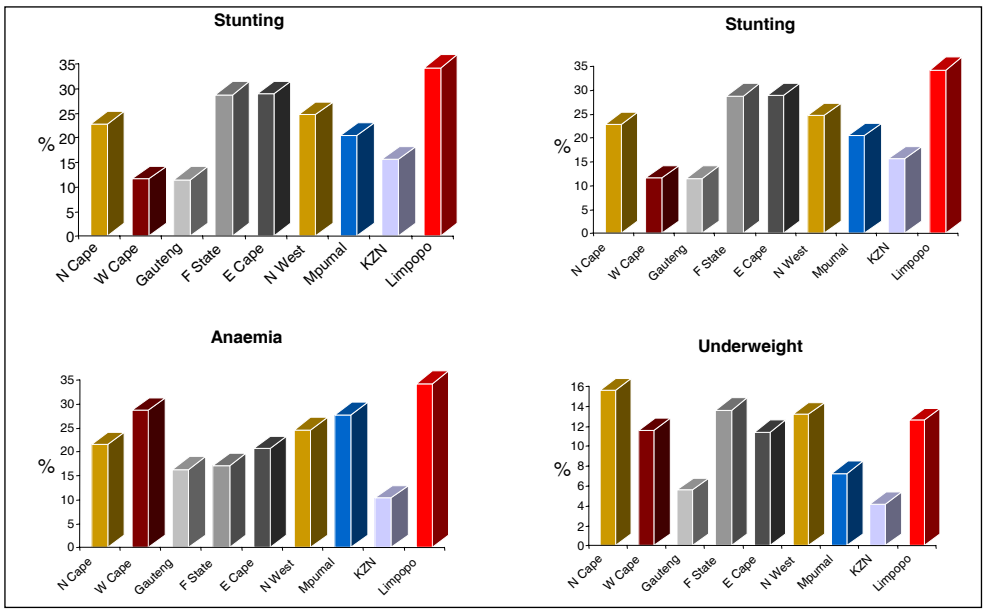


FIGURE 2: Differences in the prevalence of childhood malnutrition among provinces (Source: Labadarios et al., 1995)

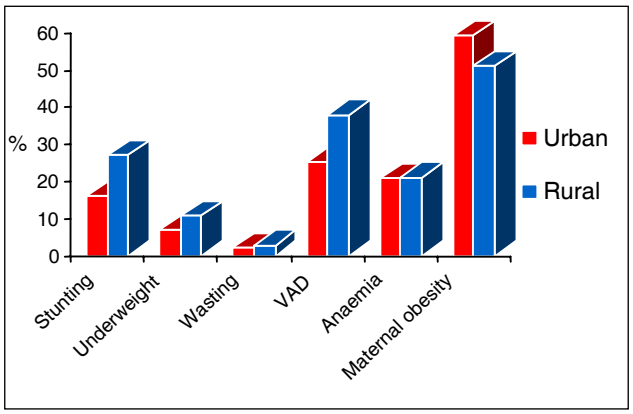


FIGURE 3: Prevalence in childhood malnutrition and maternal overweight in rural and urban areas (Sources: Labadarios et al., 1995; DHS, 2003).

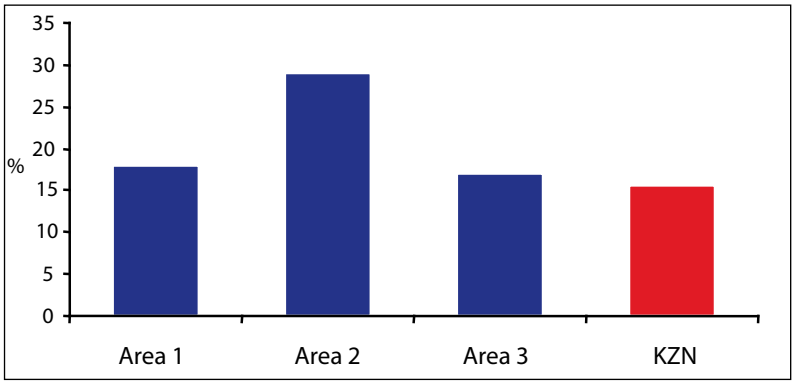


FIGURE 4: Pockets of more severe malnutrition exist within provinces, e.g. stunting in three areas in KwaZulu-Natal and the prevalence of stunting for KwaZulu-Natal as determined in the SAVACG study (Sources: Smuts et al., 2004; Labadarios et al., 1995).

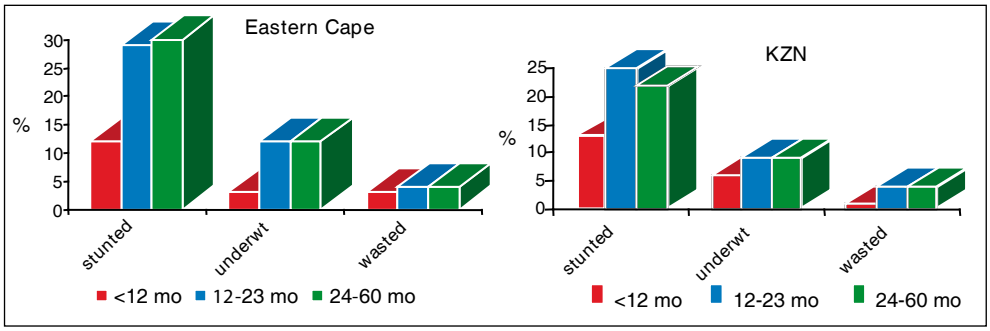


FIGURE 5: Critical period for developing childhood malnutrition: doubles from first to second year of life (Source: Smuts et al., 2004)

The first two years of life are the critical period for developing childhood malnutrition and this coincides with the introduction of complementary foods, which are often of poor nutritional quality. The nutrient composition of complementary foods among rural South African infants was shown to be inadequate, especially for iron, zinc and calcium (figure 6).

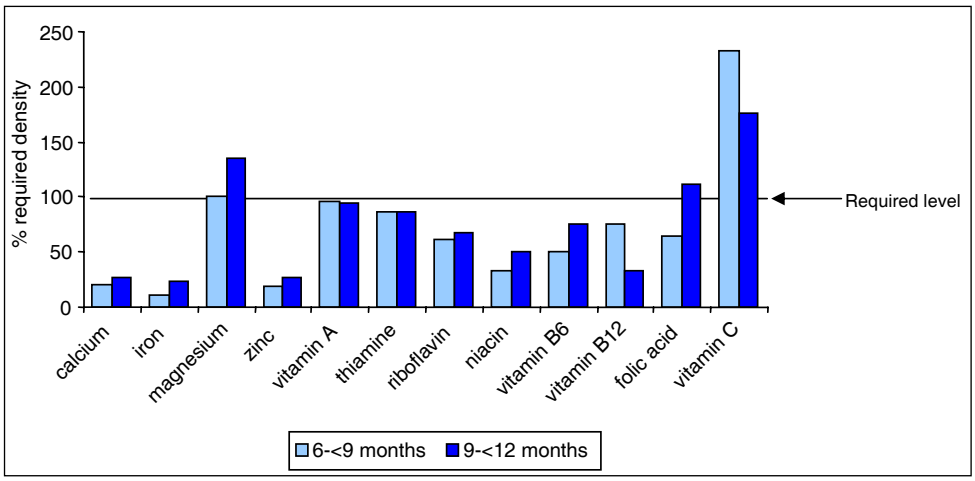


FIGURE 6: Nutrient density of the complementary diet of 6-12-month-old breastfed South African infants (Source: Faber, 2005).

Dietary intake

The National Food Consumption Survey of 1999 showed that for 1-9-year-old children:

- the great majority of children consumed a diet deficient in energy and of poor nutrient density
- more than 50% had an intake that was half the recommended level for e.g. calcium, vitamin A, iron, zinc
- foods most frequently consumed were maize, white sugar, tea, whole milk and bread

(Labadarios et al., 2000)

Dietary diversity

Analysis of the National Food Consumption Survey showed the following (Steyn et al., 2006):

- Food variety score (number of different foods per day): 5.5 ± 2.5
- Dietary diversity score (number of different food groups per day): 3.6 ± 1.4
- Food variety score and dietary diversity score can be used as indicators of the micronutrient adequacy of the diet
- Dietary diversity was associated with child growth

Increase dietary variety by

- Introducing new crops e.g. orange-fleshed sweetpotato
- [The orange-fleshed sweetpotato breeding program of the Agricultural Research Council - Vegetable and Ornamental Plant Institute is described on pages 19-24; and the efficacy of orange-fleshed sweetpotato to improve vitamin A status is described on pages 29-32]
- Promoting indigenous foods
- Promoting home-gardens – i.e. local production of vegetables and fruit to supplement the cereal based diet

Examples of programs promoting yellow fruit and vegetables

Dietary modification programs: Yellow/orange-fleshed vegetables and fruit are promoted because of their potential favourable effect on vitamin A status.

Food-based dietary guidelines: A set of food-based dietary guidelines forms the core of the Government's nutrition education messages to promote healthy eating habits among South Africans. Within the guideline 'Eat plenty of fruit and vegetables' it is suggested that, for example, a yellow and a green vegetable are eaten with the main meal of the day.

5-a-day for better health: The mission of the "5-a-Day for Better Health Trust" is to, through promotion and education, increase the consumption of fresh fruit and vegetables by South Africans (2 of the recommended 5 fruit and vegetables consumed per day should be yellow).

Vegetables available in 5 local shops from Jan – Dec 2004

Vegetables available in five local shops in a rural village in KwaZulu-Natal were observed and recorded daily from January to December in 2004. Cabbage, onions, potatoes and tomatoes were almost always available, while carrots, butternut and pumpkin were never available (Faber & Laubscher, 2008). It is therefore important to ensure availability of yellow / orange and dark-green leafy vegetables before promoting the consumption thereof. Availability of these vegetables can be increased through local production, e.g. home-gardens.

Selection of crops to be promoted for home-gardens

Mono-crop production of low nutrient content crops does not translate into adequate nutrition. It is therefore important to diversify crops.
Grow crops to meet the nutritional needs of vulnerable populations – the following needs to be considered:

- Nutrients that are limited in the diet
- Nutrient content of the crop
- Potential contribution towards nutrient requirement of target population

Benefits of vegetable gardens

- Long-term strategy to complement supplementation and food fortification programmes
- Includes nutrition education: mothers can take informed decisions regarding food choices
- Vegetable garden projects usually focus on producing crops for household consumption, but the surplus harvest can be sold - potential for income generation
- Multiple nutrients are supplied
- Nutrients are within physiological levels, risk of toxicity is minimised
- Natural balance of nutrients (interactions are minimised)

Vegetable gardens can be sustainable and affordable, and provide a continuous supply of vegetables. Vegetable garden projects empower households to take ultimate responsibility for the nutritional quality of their diets by growing their own nutrient-rich food and making informed consumption choices.

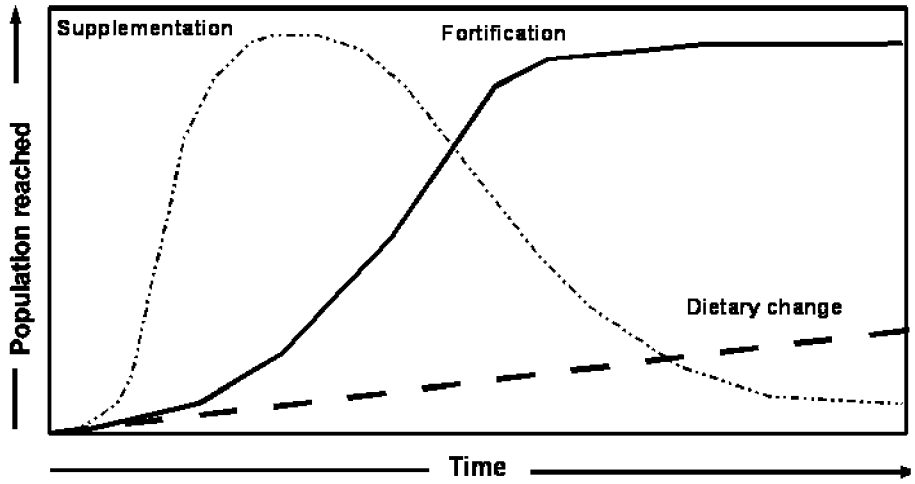
In South Africa, vegetable gardens have a role to play in:

- Integrated Nutrition Programme (see pages 4-6)
- Integrated Food Security Strategy
- National School Feeding Programme (see pages 1-3)

National food fortification program

Maize meal and bread are fortified with thiamine, niacin, pyridoxine, riboflavin, iron, zinc, folate and vitamin A (legislated in October 2003).
Fortification of staple foods will probably have a limited impact on the

nutritional status of small children because of the small portion size they consume.



Adapted from "Forum on Food Fortification, Ottawa", Canada, 1995

FIGURE 7: Strategies for the eradication of micronutrient deficiencies

Supplementation, food fortification and dietary diversification all have a role to play in the eradication of micronutrient deficiencies. Dietary diversification (modification / change) is the more long-term and sustainable strategy.

Community nutrition projects should have a holistic approach, as malnutrition is caused by both an inadequate dietary intake and diseases, and these are affected by three underlying causes namely (i) household food insecurity, (ii) inadequate maternal and child care, and (iii) insufficient health services and an unhealthy environment (as illustrated in the UNICEF conceptual framework for childhood malnutrition in figure 8.

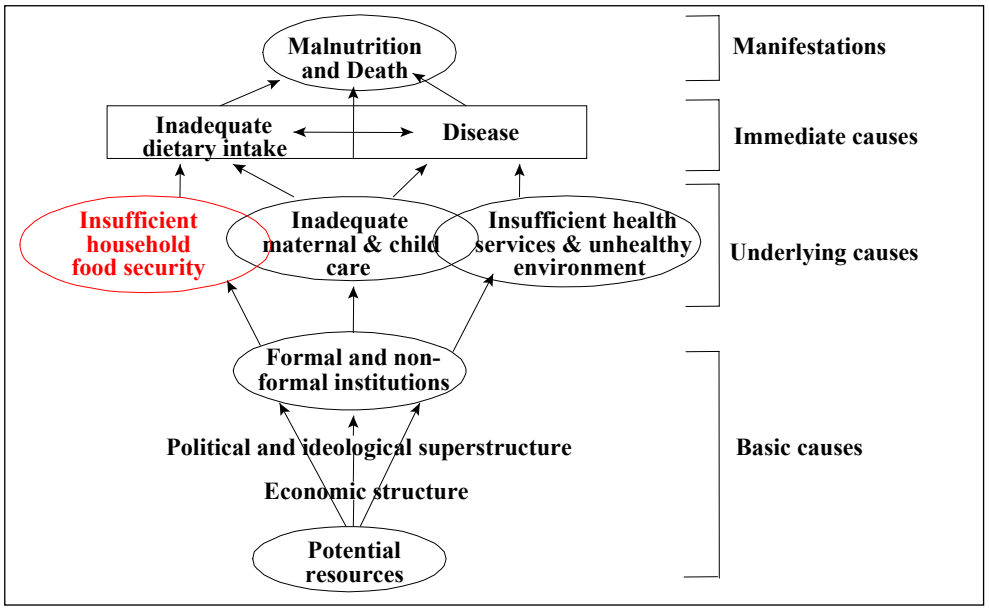


FIGURE 8: Conceptual framework for childhood malnutrition (Source: UNICEF, 1990)

When vegetable garden projects focus on children under five years of age, it is therefore important to also pay attention to the following issues:

- Promote breastfeeding
- Ensure that the children's immunization status is up to date
- Teach the mothers on the role of vitamin A supplementation
- Teach the mothers on the role of deworming
- Encourage the mothers to take their children to the clinic for regular growth monitoring
- Address aspects of hygiene and sanitation
  - Food quality and safety
  - Disposal of household refuse
  - Sanitation
  - Clean and safe water

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PROMOTION OF ORANGE-FLESHED SWEETPOTATO TO COMBAT VITAMIN A DEFICIENCY IN SUB-SAHARAN AFRICA REGION: VITAA EXPERIENCES

Presented by: Regina Kapinga
International Potato Center, Uganda

Vitamin A for Africa (VITAA) is a partnership program promoting the consumption of orange-fleshed sweetpotato as an approach to combat vitamin A deficiency in Sub-Saharan Africa.

Major purpose of VITAA

Children and adults (women) consume orange-fleshed sweetpotato in quantities that lead to reduced vitamin A deficiency.

Millennium Development Goals (MDGs)

"We will spare no effort to free our fellow men, women, and children from the abject and dehumanizing conditions of extreme poverty, to which more than a billion of them are currently subjected."

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria, and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

United Nations Millennium Declaration – September 2000

VITAA addresses MDG Target 4 (Reduce child mortality) and MDG Target 5 (Improve maternal health).

Potential of orange-fleshed sweetpotato in combating vitamin A deficiency in Sub-Saharan Africa

Orange-fleshed sweetpotato can significantly contribute towards reducing Vitamin A deficiency among 50 million children under 5 years of age in Sub-Saharan Africa (Low et al., 2001).

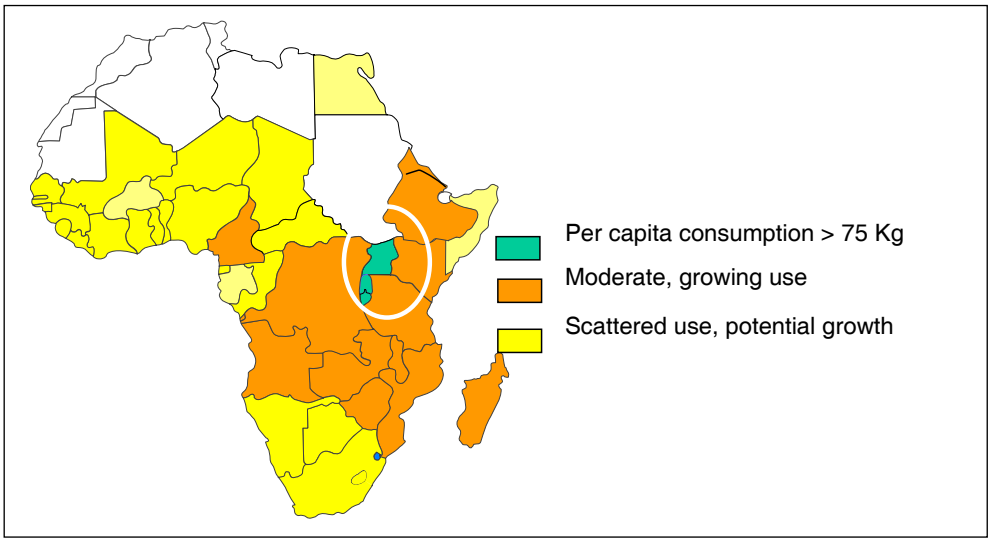

FIGURE 1: Areas in Africa where sweetpotato is produced and consumed

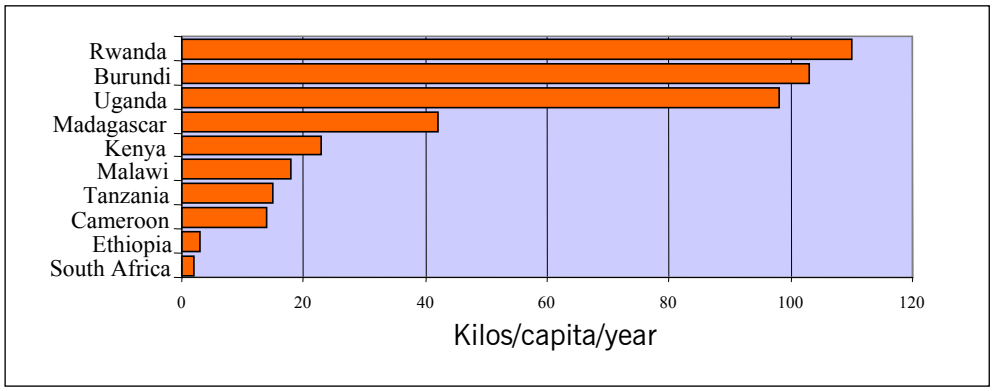

FIGURE 2: Sweetpotato production per capita in ten selected countries

An efficacy trial that was conducted in South Africa in 2002 showed that feeding 125 g orange-fleshed sweetpotato to school children for 5 days a week for 3 months significantly improved amounts of vitamin A stored in the liver (Van Jaarsveld et al., 2005) (see pages 29-32).

VITAA History

- VITAA was launched by the International Potato Center (CIP) in May 2001 by a group of 70 agriculturists, health experts, nutritionists, media, NGO's, etc.
- Partner agencies: about 44 in 2001 -> 70 to-date (2007).
- Current partner countries: Kenya, Uganda, Tanzania, South Africa, Ethiopia, Ghana, Mozambique, Zambia, Nigeria, Rwanda, Malawi.

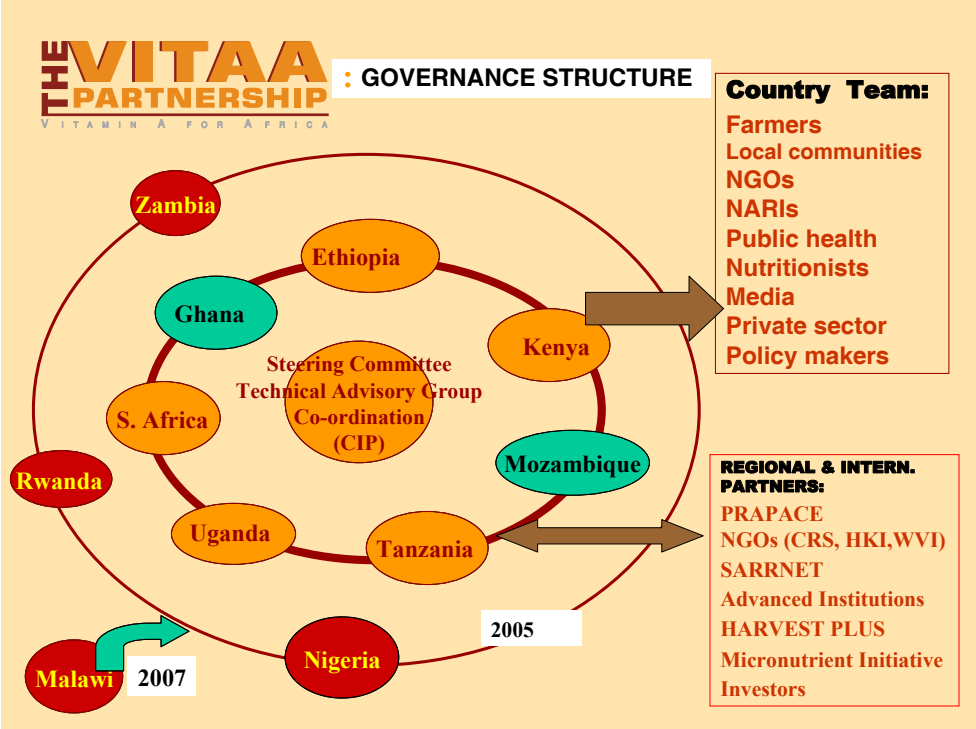

FIGURE 3: Schematic overview of VITAA governance structure

TABLE 1: VITAA components and responsibilities by partners

Theme	Related Activities	Implementing partners
Germplasm breeding and dissemination	Field assessments Acceptability studies Seed systems	NARI's, CIP Farmers NGO's
Post-harvest and commercialization	Products, processing and handling Nutrient composition Market opportunities Micro-enterprise development	NARI's, NGO's Universities & Advanced institutions Private sector National Bureau of Standards
Health and nutrition	Community and household based action plans Growth monitoring β-carotene retention, nutritional intervention and efficacy studies	Nutrition and health institutes Advanced institutions Local governments Caregivers & mothers National ethics committees
Awareness and communication strategy	Information systems & databases Community mobilisation Public education (agriculture, health & nutrition) Website Nutritional forums Social marketing	Nutrition and health centres Local communities NGO's NARI's Local media VITAA coordination unit
Monitoring, impact, and policy	Impact and household surveys Ex ante case studies Effectiveness studies Policies	Universities Nutrition centres NARI's; CIP Farmers
Linkages and partnerships	Broaden membership Scaling-up Steering committee (SC) Inter-sectoral & country working groups Other initiatives	CIP VITAA-SC National teams Regional networks

TABLE 2: Popular sweetpotato varieties currently promoted in selected VITAA countries

Country	Promoted varieties	
	Non-orange-fleshed sweetpotato	Orange-fleshed sweetpotato
Uganda	NewKawogo, Naspot 1, TZ, Kyabandula, Magabale	SPK 004, Ejumula, SPK004/6, SPK004/6/6
Kenya	Marooko, Kalumb, Nyerere, Jayalo, Nyathiodiewo, Ex-Diani, Muibai	SPK004, 566682/03, 566632
Mozambique	Chingowva, Nemanete,	Japon Tres., Zapallo, Mafutha, Resisto, Codinor, CN-1448-49, Persistente, Gabagaba
Tanzania	Simama, Juhudi, Sinia, Mavuno, Vumilia	Zapallo, Japon Tres., Resisto, Karoti, SPK 004
South Africa	Mafutha, Bosbok, Ndou, Monate, Mokone, Letlhabula, Amasi, Phala, Mamphenyane	Resisto, Excel, W-119, Serolane, A15, Khano
Ghana	Sauti, Okumkom, Santum Pona, Faara	Jukwa, CRI-Apomuden

TABLE 3: VITAA / PRAPACE / CIP / SARRNET: Coordinated vine distribution (2003-June, 2006)

Country	No. of cuttings distributed	Estimated coverage (ha)	Collaborating partners
Tanzania	9,259,950	309	TAHEA, CARE, World Vision, CCT, Prisons, ARDI – Maruku, Kibaha, Ukiruguru, and Plan International.
Uganda	18,896,374	630	BUCADEF, Africare, SOCADIDO, JAF, World Vision, VEDCO, NARO, MPs, NAADS, FFS, MUK.
Kenya	12,093,920	403	KARI, REFSO, Africa Now, CRS, UCRC, Agric. Environmental Prog. Homabay, Akukuranut Development Trust (ADT).
Ethiopia	1,691,920	56	CARE, EARO, Alemaya University of Agriculture
Mozambique	20,621,185	>750	CARE, Action Aid, SARRNET, World Vision, INIA, World Relief, Save Children

Issue: Underestimation due to lack of records from recipients and vine multipliers

Product development for utilization and rural income generation

Lessons learned:

- Some products are highly profitable and acceptable, especially those using boiled and mashed sweetpotato.
- Less sugar and eggs are required.
- Recipes are easily adaptable at farm level.
- Children like the products.
- Women able to raise income for household chores.

Challenges:

Quality, poor packaging, short shelf-life, retention of β-carotene contents.

Sweetpotato in disaster mitigation - A case of Northern and Eastern Uganda:

Orange-fleshed sweetpotato has been playing a big role in feeding the internally displaced communities in Northern Uganda where people have

left their homes due to internal civil wars. CIP-VITAA, PRAPACE and the disaster mitigation programs such as Red Cross and World Food Program have distributed dried chips for food and sweetpotato vines for the production of food.

Community awareness, communication campaigns and nutrition education through different set ups:
Different approaches have been used for creating awareness and sensitization on the benefits of orange-fleshed sweetpotato to combat vitamin A deficiency. These were through media, popularization campaigns, agricultural shows, and launching events by involving the most influential individuals at policy and community levels. These have helped to spread the word of orange-fleshed sweetpotato and attracted more partners on board. It has been noted, however, that through different approaches the demand for orange-fleshed sweetpotato had been increased tremendously. Below are the lessons learned:

1. Increased awareness.
2. Public interest builds demand.
3. More partners on-board.
4. Large coverage at relatively low cost.
5. Be prepared with vine supply!

Major issues for follow-up

- Orange-fleshed sweetpotato is acceptable to African consumers, especially children.
- Breeding is a continual process - currently working on improved drought and virus resistant lines.
- Research is underway on most cost-effective way to deliver orange-fleshed sweetpotato with adequate nutritional information.
- Further research is needed on retention of beta-carotene in processed products.
- Adequate amounts of planting material at the beginning of the rainy season are a major constraint. Improvements in water control and vine management are needed.

ACKNOWLEDGEMENTS

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BREEDING CROPS FOR MICRONUTRIENT DENSITY: A CASE FOR, AND CURRENT STATUS, OF ORANGE-FLESHED SWEETPOTATO

Presented by: Sunette Laurie
Agricultural Research Council - Vegetable and Ornamental Plant Institute, Pretoria, South Africa

INTRODUCTION

- Plant biofortification is the breeding of food crops with enhanced micronutrient contents
- The strategy holds great promise because of it's enormous potential to improve dietary quality (Bouis, 2006; Ruel & Levin, 2002)
- Sweetpotato breeding has been conducted at ARC-VOPI for past 50+ years; breeding for orange-fleshed types since 1996.
- The aim of the breeding programme is to breed for good yield, good storability, sweet taste, and dry texture. Additional traits are drought and disease tolerance.
- Conventional breeding practices are used.
- Linked with HarvestPlus and VITAA

Advantages of orange-fleshed sweetpotato for South African conditions

- High productivity per area per time
- High level of adaptability
- Hardy crop compared to, for example, spinach and carrot
- Less labour and input required
- Good storability
- A multi-purpose crop, e.g., fresh and post-harvest products

(Laurie, 2004)

TABLE 1: Comparative nutrient content of orange-fleshed sweetpotato and some other beta-carotene-rich vegetables (per 100 g cooked portion)

Vegetable	Energy	Protein	Fibre	Iron	Zinc	K	Vit A	Thiamine	Riboflavin	Niacin	Vit B6	Folic Acid	Vit C
	kJ	g	g	mg	mg	mg	µg RE[1]	mg	mg	mg	mg	µg	mg
Butternut	235	1.5	1.9	0.3	0.29	274	332	0.05	0.02	1.4	0.09	8	4
Carrot	162	0.9	3.1	0.6	0.39	156	2880	0.03	0.02	0.4	0.05	6	4
Orange-fleshed sweetpotato	446	1.7	3.0	0.5	0.29	348	1663[2]	0.07	0.13	0.6	0.24	23	25
Pumpkin	135	0.7	1.4	0.3	0.21	157	401	0.04	0.02	1.1	0.06	2	9
Spinach	134	2.7	2.5	2.3	0.52	177	342	0.02	0.07	0.4	0.04	22	6

METHODS

Sources: Kruger et al., 1998; Van Jaarsveld et al., 2005

[1]RE: 1 µg retinol equivalents = 1 µg vitA = 6 µg beta-carotene

[2]RAE: 1 µg retinol equivalents = 1 µg vitA = 12 µg beta-carotene

ARC-VOPI imported orange-fleshed sweetpotato cultivars from the USA as they lacked these cultivars. These cultivars were used in polycrossing and evaluation programmes.

Germplasm of sweetpotato lines and cultivars are maintained in glass houses; a collection of about 444 accessions.

The polycross method is used to combine required traits. Between 15 and 25 parents are selected for specific traits. Cross pollination is achieved through natural occurring insects. About 10 000 - 15 000 seeds are produced annually at two localities. Additionally, directed crosses are performed in a glass house. High yielding, good tasting cream varieties are combined with dark orange-fleshed varieties.

The seeds are treated with sulphuric acid (promotes germination) and sown in seedling trays inside a glass house. Seedlings are transplanted into 12 cm diameter pots and after 2½ months the small storage roots are cut transversely enabling the identification of orange lines. Cream lines are discarded.

Cuttings of the orange lines are then planted in the field in a seedling nursery (1500 - 2000 lines). Harvesting is done after five months and 2-3% of lines are selected for further evaluation based on yield, flesh colour, raw taste, dry matter content and storage root appearance.

The next phase is a preliminary yield trial where 100 - 150 lines are evaluated in single plots. The most promising 20 - 30 lines are retained for further evaluation through intermediate yield trials, which are at ARC-VOPI and another site with a warmer climate. These are replicate trials from which the best lines are selected. Selection criteria are:

- Yield and appearance
- Orange colour and total carotenoid content (spectrophotometer measurements)
- Dry matter content and taste of boiled roots
- Storability and disease tolerance
- Oxidation (grey colouring)

Screening of 40 lines per time for drought tolerance is conducted in plastic boxes with drought sensitive Resisto and Letlhabula as tolerant control. This is a quick preliminary screening based on vegetative performance only (2-3 months).

Screening for disease tolerance include: viruses and *Alternaria* leaf - and stem blight; both conducted in glass houses and field trials at ARC-VOPI.

After 5-6 years the ±20 most promising advanced lines are selected to be tested for adaptability and acceptability in the main production areas (multi-location trials) and at farmer's conditions. These trials are conducted in collaboration with extension officers from the Department of Agriculture. Farmers evaluate the taste of the cooked storage roots as well as the appearance of the raw roots. After two seasons at each locality, varieties are recommended to be produced in the area based on yield potential and taste

acceptability.

Agronomy trials are performed at ARC-VOPI to test the new varieties using:

- different plant spacing and planting dates
- different water regimes in rain-out shelters to determine water requirements
- different fertilizer levels

These results are included in varietal recommendations.

The sweetpotato virus-tested scheme provides healthy, true-to-type planting material of popular varieties in nursery bags for sale. Sweetpotato nursery projects provide farmers with cuttings for production and training in sweetpotato cultivation practices.

PERFORMANCE OF ORANGE-FLESHED SWEETPOTATO VARIETIES

- Multi-location trials were done from 2004 to 2006 in four provinces, namely Limpopo (Polokwane), Eastern Cape (Lusikisiki), Gauteng (Roodeplaat) and Northern KwaZulu-Natal.
- Mean yield estimates of the orange-fleshed sweetpotato varieties are given in figure1.

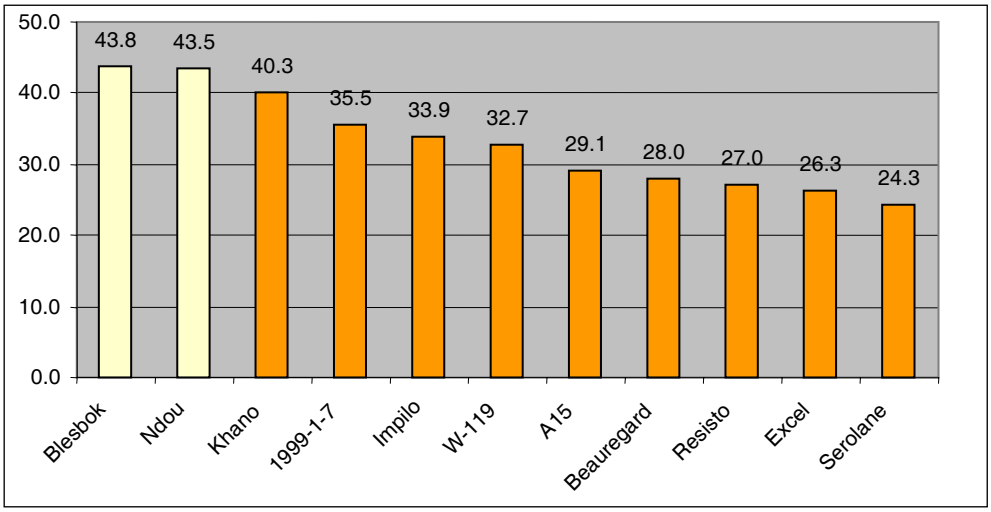

FIGURE 1: Mean marketable yield (t/ha) of orange-fleshed sweetpotato varieties over 4 environments (Blesbok and Ndou, cream-fleshed cultivars, are given as reference)

TABLE 2: Quality of sweetpotato varieties

Variety	Oxidation	Dry matter content %	Cooked taste	TSS (°Brix)	Keeping ability
Blesbok	4.1	17.2	Poor-to-average	5.4	41.9
Ndou	2.7	25.0	Good-to-average	6.2	13.1
Khano	2.7	18.5	Average-to-poor	7.3	18.6
1999-1-7	3.0	21.3	Average-to-good	7.1	10.9
Impilo	3.1	20.8	Average-to-good	8.5	4.4
W-119	2.7	25.7	Good	7.6	1.8
A15	3.8	20.7	Average	8.5	5.0
Beauregard	3.6	17.6	Average-to-poor	6.5	10.5
Resisto	3.6	24.0	Excellent	7.8	19.5
Excel	3.8	21.9	Very good-to-good	8.3	2.7
Serolane	4.0	26.0	Very good-to-average	7.6	0.8
Mean	3.4	21.7		7.3	11.7
P-value	**	**		**	
S.E.D	0.098	0.359		0.245	
CV%	7.1	4.1		8.2	
LSD (P=0.05)	0.19	0.72		0.49	

** Significant at P = 0.05

TABLE 3: Description of orange-fleshed sweetpotato varieties

Name	Flesh colour	Advantages	Disadvantages	Picture
A15 (Univ. Natal)	Darker orange	Medium-to-high total carotenoid content (9180 µg/100g)	Average taste Medium-to-low yield Some long irregular Some cracks Sensitive to Alternaria	
Excel (USA)	Orange, yellow cortex	Very good taste	Low yield Some long irregular Lower total carotenoid content (5330 µg/100g) Sensitive to Alternaria	
Impilo (ARC)	Light orange to orange-yellow	Medium-to-high yield Good taste	Medium-to-low total carotenoid content (6280 µg/100g) Some cracks	
Khano (ARC)	Dark orange	High yield High total carotenoid content (13710 µg/100g)	Lower dry matter content Average-to-poor taste Some cracks Some long tails	
Resisto (USA)	Very dark orange	Excellent taste Very high total carotenoid content (15840 µg/100g)	Medium-to-low yield Sensitive to weevil Sensitive to drought Veins	
Serolane (ARC)	Orange with yellow ring	Very good taste	Some constrictions Medium-to-low total carotenoid content (6181 µg/100g) Poor storability Low yield	
Beauregard (USA)	Orange to dark orange	Medium-to-high total carotenoid content (8365 µg/100g) Commercial cultivar	Watery texture, poor taste Medium-to-low yield.	
W-119 (USA)	Orange	Medium-to-high yield Good taste Tolerates low input conditions	Some long irregular Poor storability Medium total carotenoid content (7574 µg/100g)	
1999-1-7 (ARC)	Orange	Medium-to-high yield Average-good taste Medium carotene content (7918 µg/100g)	Some long irregular	

CONCLUSIONS

- Achieved success with breeding
  Seven orange-fleshed sweetpotato varieties are currently used in food-based projects (Faber et al., 2006): A15, Excel, Resisto, W-119, 1999-1-7, Impilo, Khano
  Resisto: excellent taste, high total carotenoid content
  W-119: widely adapted, tolerates low input conditions
  Khano: high yield but average to poor taste
  Impilo, 1999-1-7: medium to good yield, acceptable taste.
- These varieties are to be replaced over time as better varieties are released
- Breeding of orange-fleshed sweetpotato continues at ARC focusing on varieties that are:
  - tasty
  - high yielding
  - high in beta-carotene content
  - drought tolerant
  - resistant to important pests & diseases.

ACKNOWLEDGEMENTS

Co-authors: Andrè van den Berg, Sidwell Tjale, Musa Mtileni, Patrick Adebola, Jan Viljoen, Sharon Mulandana

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PRODUCTION SYSTEMS FOR ORANGE-FLESHED SWEETPOTATO

Presented by: Ian du Plooy
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INTRODUCTION

- Although the sweetpotato (*Ipomoea batatas* L.) is widely grown in South Africa it can be considered as a minor vegetable crop being less than 2% of the total vegetable production in the country.
- Sweetpotato is an important food security crop in small holder farming systems.
- The storability of sweetpotato limits availability (in season), especially in the rural areas of South Africa.
- Successful storage of sweet potatoes depends on proper curing practices.
- Because of a lack in infrastructure and financial resources small scale farmers in the rural production areas cannot utilize this technology to expand the availability of the crop.
- ARC-VOPI recently released several new sweetpotato cultivars, bred specifically for the small scale rural farmers including orange-fleshed sweetpotato.
- Objective of this research - to determine the effect of successive plantings, combined with different in-row spacings and growth periods on yield and quality of new sweetpotato cultivars.

MATERIALS AND METHODS

Field trials were established at ARC-VOPI (Roodeplaat). Top vines used as planting material, were planted at three different in-row spacings with three nodes underground and 1m between rows. Three different in-row plant spacing was tested: 15 cm, 30 cm, 50 cm.

Treatments

The following cultivars were planted at Roodeplaat (experiment 1):

- Ribbok, Ndou, Mokone (local cream-fleshed varieties)
- Resisto, Excel, W-119 (imported orange-fleshed varieties)

Planting dates	Harvesting dates
21/11/2004	08/03/05; 20/04/05
23/12/2004	07/04/05; 24/05/05
01/02/2005	Aug 2005 & Nov 2005
24/03/2005	Sep 2005 & Dec 2005
30/11/2005	23/03/06; 18/05/06
02/03/2006	30/10/06; 15/01/06

In the follow up trials the following cultivars were planted at Roodeplaat (experiment 2):

- Amasi, Letlhabula, Mamphenyane, Monate, Ndou, Phala (cream-fleshed)
- Serolane, A15, Resisto, Impilo, 1999-1-7, Khano (orange-fleshed)

Planting dates	**Harvesting dates**
30 November 2005	23/03/06 & 08/05/06
03 March 2006	15-20/01/07

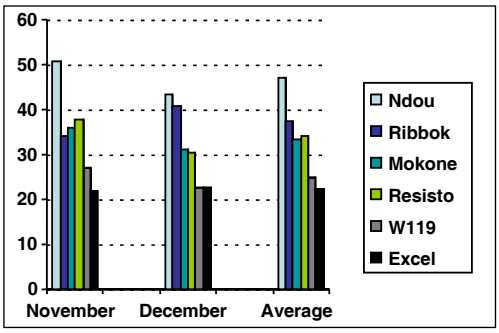
In-row spacing was 15 cm, 30 cm, 50 cm

Data collection:
The effect of growth period, planting date, spacing and cultivar differences were determined on the total and marketable yield (t/ha), number and size of storage roots, as well as disease susceptibility.

RESULTS AND DISCUSSION

1. **Marketable Yield** (Experiment 1)

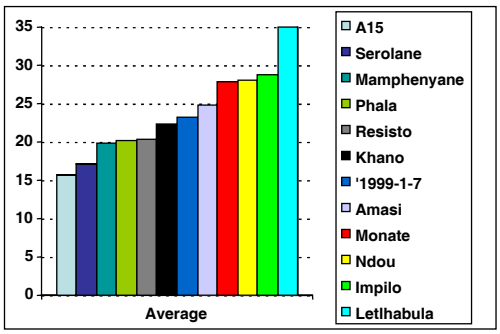
- Yield of November and December plantings were similar with an increase from the first to second harvest date.
- Yield increased with increasing plant population
- Storage root size and number decreased with increase plant population



- Locally released cream-fleshed cultivars out yielded imported orange-fleshed cultivars.
- High yielding cultivars: Ndou, Ribbok
- Medium yielding cultivars: Mokone, Resisto
- Low yielding cultivars: W119, Excel
  LSD (P=0.05)
  November – 4.37 t/ha
  December – 3.19 t/ha

2. Marketable Yield (Experiment 2)
Plant 30 November
Mean yield for harvesting March and May

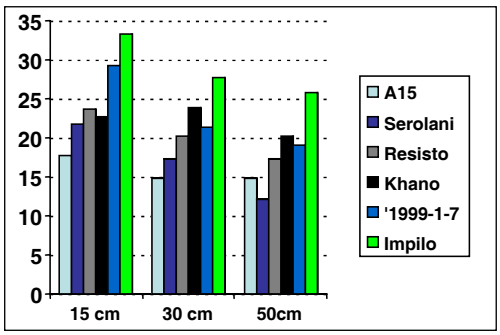
- High yielding cultivars: Letlhabula, Ndou, Monate, Amasi, Impilo
- Medium yielding cultivars: 1999-1-7, Khano, Resisto, Phala, Mamphenyane
- Low yielding cultivars: Serolane, A15
  LSD (P=0.05) = 2.4 t/ha



Cream-fleshed cultivars out-yielded orange-fleshed cultivars

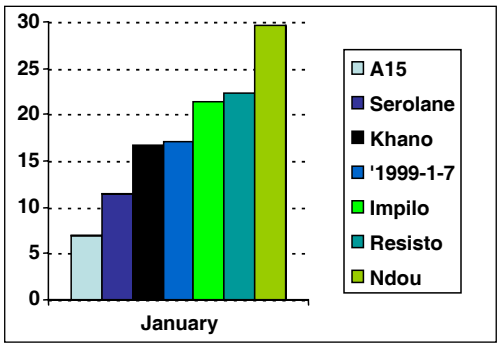
3. Effect of spacing on marketable yield of orange-fleshed sweetpotato
Plant 30 November
Mean yield for harvesting March and May

- Yield decrease with increase in spacing
- Highest yield at 15 and 30 cm (except for 1999-1-7 and Impilo)
- For 1999-1-7 and Impilo the highest yield was with in-row spacing of 30 cm
  LSD (P=0.05)
  Cultivar x spacing = 4.1 t/ha



4. Effect of in soil storage on yield of orange-fleshed sweetpotato
Plant February/March
Harvest following January

- High yielding cultivars: Ndou, (cream cultivar), Resisto, Impilo
- Medium yielding cultivars: 1999-1-7, Khano
- Low yielding cultivars: Serolane, A15
  LSD (P=0.05)
  Cultivars = 4.6 t/ha



GENERAL CONCLUSIONS

- Optimum planting date for orange-fleshed sweetpotato is November to December
- Growth season is 4 to 5 months
- Optimum in-row spacing is 15-30 cm
- Increased plant population resulted in fewer and smaller sweet potatoes per plant
- Most orange-fleshed cultivars are susceptible to Alternaria with a lower yield as compared to local cream-fleshed cultivars
- Orange-fleshed cultivars with tolerance to Alternaria are Khano and Impilo
- Orange-fleshed cultivars with good in soil storage ability are Resisto and Impilo
- Availability of orange-fleshed sweetpotato can be extended to at least 9 months with planting/harvest dates and in soil storage (summer rainfall areas)

ACKNOWLEDGEMENTS

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EFFICACY OF PROVITAMIN A-RICH SWEETPOTATO TO IMPROVE VITAMIN A STATUS

Presented by: Paul van Jaarsveld
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OBJECTIVE OF THE STUDY

To determine the efficacy of daily consumption of boiled and mashed β-carotene-rich orange-fleshed sweetpotato in improving the vitamin A status, measured by the modified-relative-dose-response (MRDR) test, of primary school children participating in a school-feeding programme.

STUDY POPULATION

- The study population resided in a rural area of KwaZulu-Natal Province, South Africa.
- The primary school was identified with help of The Valley Trust (an NGO).
- Informed consent was obtained from parents and children.
- Children aged 5–10 years in Grades 1–3 took part in the study.
- Children participated in a school-feeding programme.
- The community was unfamiliar with orange-fleshed sweetpotato varieties, and white-fleshed sweetpotato was not regularly consumed.

STUDY DESIGN

- A randomized, controlled, unmasked feeding trial.
- All children were dewormed.
- Children were stratified by classroom and gender; randomly assigned to two groups:
  - Treatment group received orange-fleshed sweetpotato (n=90)
  - Control group received white-fleshed sweetpotato (n=90)

SWEETPOTATO CULTIVATION AND SUPPLY

- Continuous supply of high quality fresh mature roots of Bosbok (white-fleshed sweetpotato) and Resisto (orange-fleshed sweetpotato) was produced in one geographical area by ARC-VOPI.
- Planting was staggered. Ten-day supplies were harvested bi-weekly, packed in colour-coded meshed bags and transported by road overnight to the school and kept in a lockable room.

MEASUREMENTS

- Baseline survey: No significant differences between the two groups for anthropometric measurements, serum retinol, MRDR value, anaemia, serum ferritin and serum zinc.
- Follow-up survey:
  10 day washout period during which sweetpotato was not consumed
  – MRDR test repeated

STUDY MONITORS AND COOKS

Five classroom monitors and two sweetpotato cooks were recruited from the local community and trained to follow standard procedures.

INTERVENTION

- Children were fed sweetpotato five days per week (Monday–Friday).
- The school meal was served after the sweetpotato serving was consumed.
- Compliance and reasons for absence from school were recorded daily by the classroom monitors.
- No sweetpotato feeding during 8-day April school holiday, weekends, and public holidays.
- Sweetpotato was provided on 53 school days over 10.6 weeks (March to June 2002).

The cooking procedure was standardised. Sweetpotatoes were washed and cooked in large pots until just done. Cooked sweetpotatoes were peeled, mashed and transferred to colour coded containers.




Ice cream scoops were used to serve 125 g sweetpotato portions in colour-coded dessert bowls.


Children ate sweetpotato under close observation and compliance was monitored.

Mean compliance:

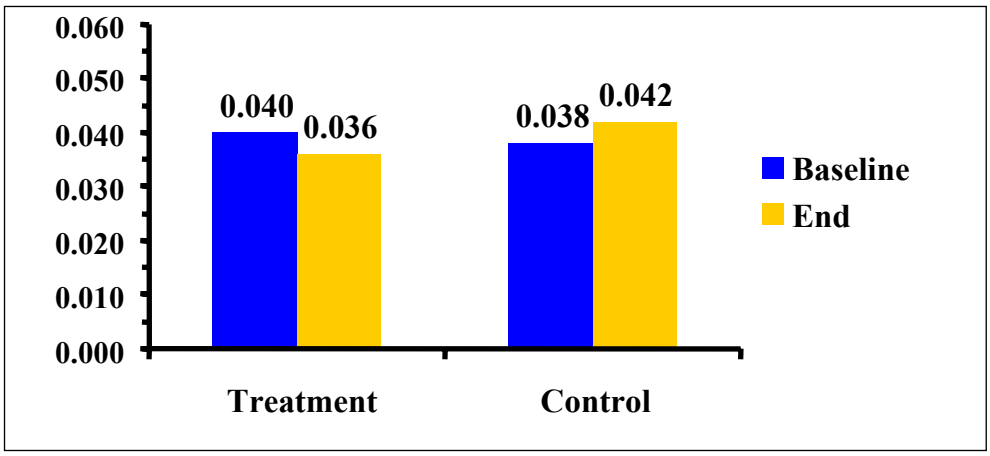
- Treatment group (orange-fleshed sweetpotato) - 90%
- Control group (white-fleshed sweetpotato) - 89%

RESULTS

TABLE 1: Serving size and amount of nutrient provided during the intervention

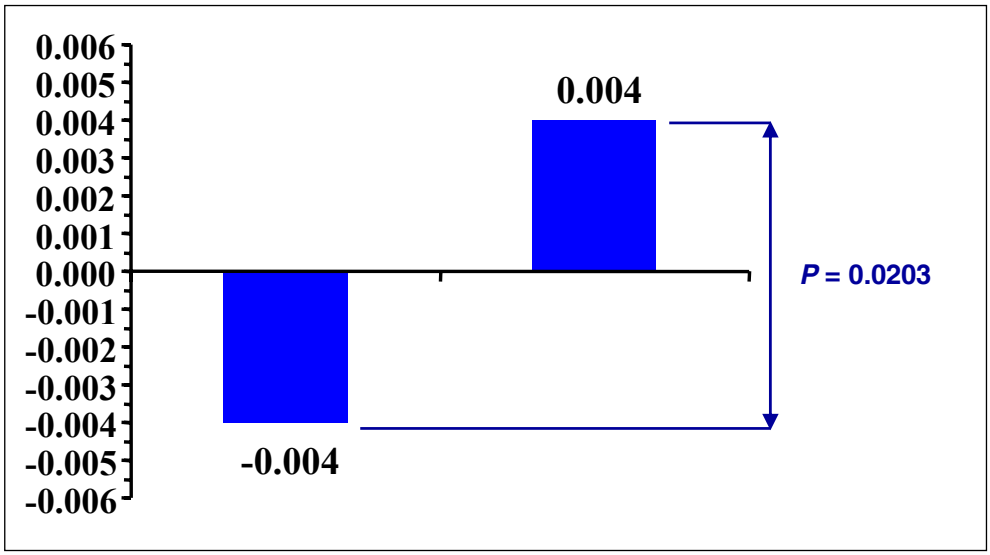
	Treatment Group	Control Group
Sweetpotato serving (g)[1]	123.5 ± 14.0	128.7 ± 16.4
μg β-carotene per serving[2]	12 375	-
μg RAE per serving[3]	1 031	-

[1] Average weight; mean ± SD was determined from 360 servings
[2] μg β-carotene per serving: 124 g / 100 g X 9 980 μg β-carotene
[3] μg RAE per serving: 12 375 μg β-carotene / 12



Change from baseline within-group - Not significant

FIGURE 1: Vitamin A Status as measured by MRDR test: Serum DR:R (mol/ mol)



Significant intervention effect (P = 0.0203): difference in mean change with 95% CI in brackets -0.008 (-0.015, -0.001)

FIGURE 2: Change in serum DR:R (mol/mol): MRDR value

CONCLUSIONS

- Vitamin A status improved significantly as assessed by the MRDR test.
- Orange-fleshed sweetpotato, naturally rich in β-carotene, is an excellent food source of provitamin A.
- Boiled and mashed orange-fleshed sweetpotato provided 12.4 mg β-carotene per 125 g serving. This translates to 250% of the Recommended Dietary Allowance for 4-8-year-old children (400 μg RAE per day).
- High β-carotene orange-fleshed sweetpotato varieties have the potential to control vitamin A deficiency in developing countries.
- Food diversification through production of yellow-orange β-carotene-rich vegetables (e.g. orange-fleshed sweetpotato varieties) is seen as a viable long-term strategy to complement supplementation and fortification programs.

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Results published in: Van Jaarsveld PJ, Faber M, Tanumihardjo SA, Nestel P, Lombard CJ and Benadé AJS. β-carotene-rich orange-fleshed sweet potato improves the vitamin A status of primary school children assessed with the modified-relative-dose-response test. *American Journal of Clinical Nutrition* 2005; 81:1080-1087.

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LESSONS LEARNED FROM THE INTRODUCTION AND PROMOTION OF ORANGE-FLESHED SWEETPOTATO IN MOZAMBIQUE

Presented by: Jan Low
International Potato Center, Nairobi, Kenya

OBJECTIVE

To assess the effectiveness of introducing orange-fleshed sweetpotato (OFSP) into an integrated agriculture and nutrition intervention aimed at increasing vitamin A intake and serum retinol concentrations in young children.
Orange-fleshed sweetpotato is:

- a low cost source of pro-vitamin A
- an excellent source of B vitamins, except for vitamin B12
- easy to produce as it is propagated with vines, can produce in marginal soils, and is flexible in terms of planting and harvesting
- liked by young children
- controlled by women

The project aimed to simultaneously (i) increase farmers' access to orange-fleshed sweetpotato vines, (ii) increase nutrition knowledge and create demand for orange-fleshed sweetpotato, and (iii) ensure sustainability through market development (see figure 1).

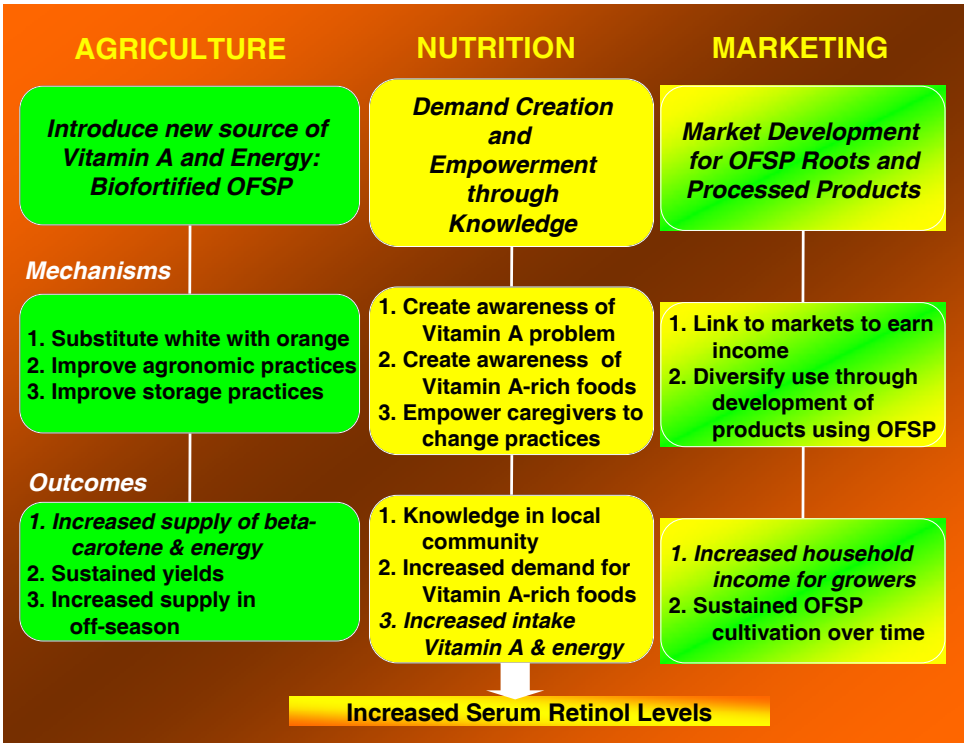

FIGURE 1: Schematic overview of project outline

The project was implemented by 5 partners, namely World Vision (Mozambique), Southern Africa Root Crops Research Network, Michigan State University, Nutrition Division: Ministry of Health, and Helen Keller International.

STUDY AREA AND DESIGN

Design:

2 year quasi-experimental design

The study was done in two intervention districts and one control district. Within these three districts, villages were stratified by distance to basic services (same language, agro-ecologies). Villages were randomly selected proportional to population. In the intervention districts, villages were randomly assigned to either high or low intensity of the nutrition intervention

90% of the original households completed the study (2 intervention groups: 498 households; control group: 243 households)

BASELINE STATUS OF THE TARGET COMMUNITIES

Extremely resource poor:

- Low productivity, drought-prone
- The principle staple was cassava
- 68% households were growing white-fleshed sweetpotato, which was a secondary staple that was consumed 2-3 times per week
- Animal ownership low
- 61% mothers never went to school
- Poor quality health services and limited access

High Levels of malnutrition among reference children (mean age 13 months):

- 71% low serum retinol concentration (<0.70 μmol/L)
- 25% severely anaemic (haemoglobin<7 g/dL)
- 62% stunted (<-2 Z-scores for height-for-age-age)
- 12% wasted (<-2 Z-scores for weight-for-height)
- C-reactive protein, an indicator of inflammation / infection, was higher in the control group

RESULTS

Five of the nine orange-fleshed sweetpotato varieties were accepted by farmers both in terms of taste and agronomic performance. Resisto was the most popular variety. 86% intervention households reported higher yields from orange-fleshed varieties than local varieties.

	2003	2004
No. of households receiving or retaining vines	548	993
Total Area under production (ha)	1.4	30.1
Average plot size (square meters)	33	369
% growing 500 m^2 or greater	0	35

Did the marketing pilot succeed in increasing awareness and commercialization?

Year 1: Market channel research and price monitoring

Year 2: Innovative grading for quality pilot

- 1st grade: ≥ 200 gram, no pest damage, whole
- 2nd grade: ≥ 100 gram, some pest damage, cut roots
- 3rd grade: not purchased

Intervention Households: 13% sold sweetpotato at baseline, versus 30% at year 2

Effect on nutritional knowledge

At baseline, nutritional knowledge scores were very similar across the groups. At the end of the study, intervention women scored higher than at baseline and higher than the control women, Intervention men also improved their scores and scored higher than the control men. Control women and men also improved their scores over baseline scores, but the increases were much smaller than those in the intervention areas (see figure 2).

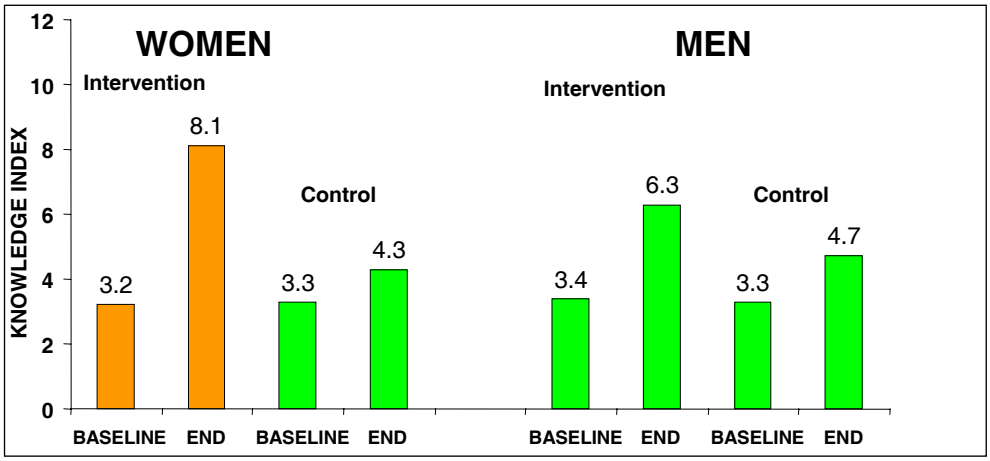

FIGURE 2: Nutritional knowledge (based on 12 point score) at baseline and end.

Impact on the young child's diet

- The median intake of vitamin A was almost 8 times higher in the intervention children (426 μg RAE) compared with control children (56 μg RAE), using a 24-hr recall (see figure 3)
- Orange-fleshed sweetpotato contributed 35% to the vitamin A intake of all children in the intervention group; and 90% in those when consumed orange-fleshed sweetpotato during the recall period
- Children > 1 year old eat sweetpotato when caregivers eat it

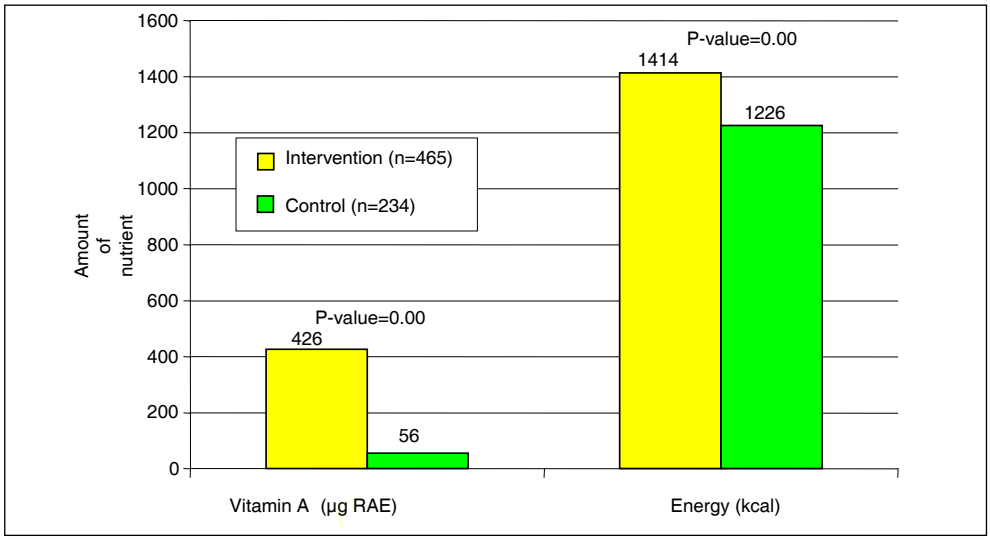

FIGURE 3: Median nutrient intakes yesterday, for non-breastfed children (mean 32 months old) during main sweetpotato harvest season, year 2

Impact on serum retinol concentration

At baseline, the adjusted mean serum retinol concentration between intervention and control children did not differ. The within-group difference between baseline and end-line was significant for intervention children but not for control children. The difference in the change in serum retinol concentration is obtained by subtracting the baseline difference between intervention and control groups from the final difference between the groups. The magnitude of this between-group "double difference" was 0.076 µmol/L (P<0.001) (see table 1).

The prevalence of low serum retinol concentration was significantly less in intervention than control children at the end of the study. Between group difference was 15%.

TABLE 1: Effect of the intervention on serum retinol concentrations (in µmol/L), controlling for age, infection, and estimated income by source: between group differences, with group changes, and double difference.

		P-value
Adjusted mean difference between intervention and control groups - within round		
Baseline (n=733)	-0.002	0.91
End of Study (n=733)	0.074	<0.001
Adjusted mean within-group difference between rounds		
Intervention (n=490)	0.100	<0.001
Control (n=243)	0.019	0.54
Adjusted mean difference between groups in change ("double difference")		
All children (n=733)	0.076	<0.01

CONCLUSIONS

Food-based approaches using orange-fleshed sweetpotato clearly have potential to increase young child intakes and serum retinol concentrations.

Further research is called for:

- Cost-effectiveness of scaling-out an integrated approach
- Improving seed systems in drought-prone areas
- Developing more drought-resistant orange-fleshed sweetpotato
- Market linkages and processed product development

ACKNOWLEDGMENTS

Micronutrient Initiative; Rockefeller Foundation; USAID; Harvestplus

Results published in: Low JW, Arimond M, Osman N, Cunguara B, Zano F, Tschirley D. A food-based approach introducing orange-fleshed sweet potatoes increased vitamin A intake and serum retinol concentrations in young children in rural Mozambique. *Journal of Nutrition* 2007; 137: 1320-1327.

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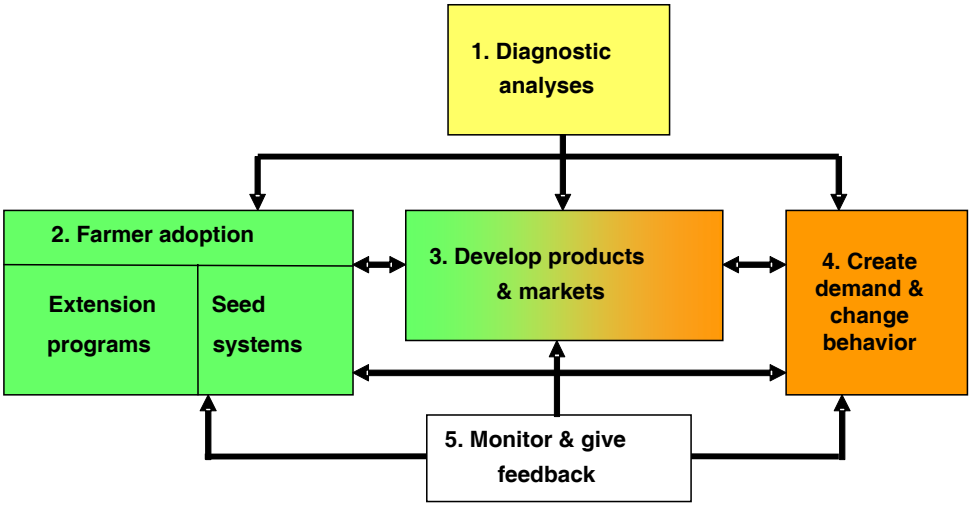
REACHING END-USERS WITH BIOFORTIFIED CROPS: THE CASE OF ORANGE-FLESHED SWEETPOTATO

Presented by: Anna-Marie Ball
Team leader: Reaching end-users orange-fleshed sweetpotato project, Harvest Plus

Reaching End-Users with Orange Fleshed Sweetpotato:

- Identify most cost effective strategies for farmer adoption and consumer acceptance of orange-fleshed sweetpotato, including:
  - Identify bottlenecks in the production-marketing-consumption continuum and strategies to relieve them
- Translate successes and "lessons learned" into "best practices" for application by HarvestPlus and other programs to make impact on human nutrition and health

The Reaching End-User Program Activities



Implementation sites

Uganda

- Sweetpotato is a primary staple crop
- Two growing seasons

Mozambique

- Sweetpotato is a seasonal secondary crop
- One growing season

Mozambique: an overview

Project is being implemented in Zambezia Province by World Vision Mozambique & Helen Keller International

Extension system

- 9 agricultural extensionists and 9 nutrition extensionists in 9 distinct areas in 4 districts
- Each pair of extensionists works with 12 organisations
- Each organisation has about 100 member families
- Each organisation selects one orange-fleshed sweetpotato agriculture promoter and 8 nutrition promoters

Organisations identified

- 108 organisations
- 108 orange-fleshed sweetpotato agriculture promoters selected
- Target of 10,800 members of organisations in year 1

Vine distribution and sale

Each family can receive 2 kg vines free; additional vines must be bought

- >49,000 kg vines distributed and sold to primary beneficiaries
- >7,050 beneficiaries received vines this year (2007)
- Other beneficiaries retained vines from previous year

Training given to orange-fleshed sweetpotato promoters

All orange-fleshed sweetpotato promoters receive training in:

- Planting of orange-fleshed sweetpotato
- Production of quality roots
- Vine conservation
- Storage of fresh roots
- Drying of orange-fleshed sweetpotato

Medium scale producers

- >80 medium scale producers of orange-fleshed sweetpotato roots; some also produce vines for sale
- 0.25 – 2.5 hectares size fields
- total 44 hectares planted

Nutrition and demand creation

- 971 nutrition promoters have been selected
- Promoter training program includes six

topics, namely:
i. balanced diet
ii. exclusive breast-feeding
iii. complementary feeding
iv. vitamin A-rich foods
v. recipe demonstrations
vi. hygiene

- Promoters train mothers on same topics

Use of mass media

Community drama

Use to introduce the project

Radio programs

Vitamin A program (five episodes) adjusted, translated and broadcasted into three local languages

Song

Developed, recorded and distributed to radio stations and used in other events

Market and product development

Promotional designs have been developed to raise awareness of orange-fleshed sweetpotato in the province

- Promotional murals painted
- Promotional orange-fleshed sweetpotato covered sales table in Milange market
- Promotional sign boards for traders
- Orange-fleshed sweetpotato Promotional Event Days are arranged to coincide with Market Days.

Training of sweetpotato traders

- Traders trained in improved trading practices
- Traders linked to medium-scale orange-fleshed sweetpotato producers and promoters
- Orange-fleshed sweetpotato medium-scale producers and promoters are taken to markets and linked to traders
- Links made to institutional buyers (hospitals, schools, etc.)

Market stalls

Promotion of golden bread and juice

Awareness raising designs

Year 2

Second vine distribution with continued agriculture training
Nutrition training continued
Radio programs, theatre & awareness raising
Market promotions, training and linkages
Expansion into new villages

The Future …

Successes …
Lessons Learned …
Best Practices ….
Shared with YOU!

Collaborators

CIP; NRI, University of Greenwich; HarvestPlus; IFPRI; World Vision Mozambique; Helen Keller International; PRAPACE; VEDCO; FADEP

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MDANTSANE FOR VITAMIN A ORANGE-FLESHED SWEETPOTATO INTEGRATED WITH HEALTH PROGRAMS

Presented by: Linda Mdingi
Nutrition Manager, Buffalo City Sub district, Department of Health, Eastern Cape, South Africa

BACKGROUND

Mdantsane (in the Eastern Cape) is the second biggest township in South Africa. Vegetable gardens are a common sight in the area and introducing the orange-flesh sweetpotato was done realizing the community could identify with the message.

The Eastern Cape Department of Health introduced a vitamin A supplementation program in 2001 to address the vitamin A deficiency that affected 1 in 3 children (Labadarios et al., 1995).

A community-based vitamin A communication strategy was developed, implemented and evaluated by the Academy for Educational Development and University of Western Cape from October 2002 to September 2004.

OBJECTIVES OF THE PROJECT

- To increase the number of children 6-24 months of age in the target community who receive vitamin A supplementation at clinics.
- To increase the awareness and consumption of vitamin A-rich foods including orange-fleshed sweetpotato.

METHODOLOGY

A team of representatives of organizations active in Mdantsane combined skills with the locally employed project manager to implement the program. Stakeholders became partners in the program and met regularly.

The project team used the "Plan" function of the CDCynergy Program and communication strategy skills of consultants to formulate a communication strategy.

Partner's meetings: the number of members grew from 25 to 60, and the agenda changed from English to Xhosa. These meetings therefore became community owned.

A program name and identity was developed through partner's meetings. A logo was developed by students from a local graphic design school and tested in the community. This process built trust among the partners and a connection with the community.

Formative research was used to collect baseline data on the intervention and control sites.

A structured questionnaire was administered to health professionals to test their knowledge and practices of

vitamin A supplementation.

Focus-group discussions were held with caregivers of children 6 to 24 months of age to gain insight into their knowledge of vitamin A supplementation and vitamin A-rich food sources.

Main messages were developed and tested with the target group. The messages were translated into Xhosa, as this was the language of communication. The following two core messages repeated on all communications together with the logo:

- Take your child to the clinic to get vitamin A at 6, 12, 18 and 24 months.
- Give your family vitamin A-rich foods every day.

IMPLEMENTATION OF THE PROGRAM

The program was launched by partners to the community. The partners incorporated vitamin A into their core business. Four training packages/kits with information and activities were developed (see below).

Health facility based interventions:

- Training of health care workers (including community health care workers) on vitamin A supplementation and diet diversification.
- Planting of orange-fleshed sweetpotato at clinic gardens.
- Cooking demonstrations of orange-fleshed sweetpotato and development of a vitamin A-rich soup recipe.
- Educational talks on vitamin A.

Community based interventions:

- Garden projects focusing on introducing orange-fleshed sweetpotato and other vitamin A-rich vegetables.
- Cooking demonstrations.
- Promotion of vitamin A supplementation.

Health promoting schools including pre-schools:

- Curriculum activities on vitamin A.
- School gardens with vitamin A-rich foods including orange-fleshed sweetpotato.

RESULTS

- Period of the project was 2002-2004.
- "Word of mouth" was shown to be the best method of communication.
- Messages were tested with community activities they could identify with, e.g. gardens as entry point.
- 32 schools participated in the program.

- 3 community gardens produced orange-fleshed sweetpotato for income generation.
- 15% of gardens in Mdantsane planted orange-fleshed sweetpotato compared to 4% in the control group.
- 21% more people served orange-fleshed sweetpotato to their families and 32% more served it to children
- From baseline to end:
  - Increase in the number of children who received required dose of vitamin A supplementation.
  - Increase in knowledge of vitamin A needs and benefits by caregivers, mothers and clinic staff.
  - Increase in cultivation and consumption of orange-fleshed sweetpotato.

A significant improvement in vitamin A coverage was observed from the baseline in 2002 (25% coverage) to 2004 (98%). Thereafter, there was a slight decline in coverage suggesting that more efforts to sustain the program are needed (see figure 1 below).

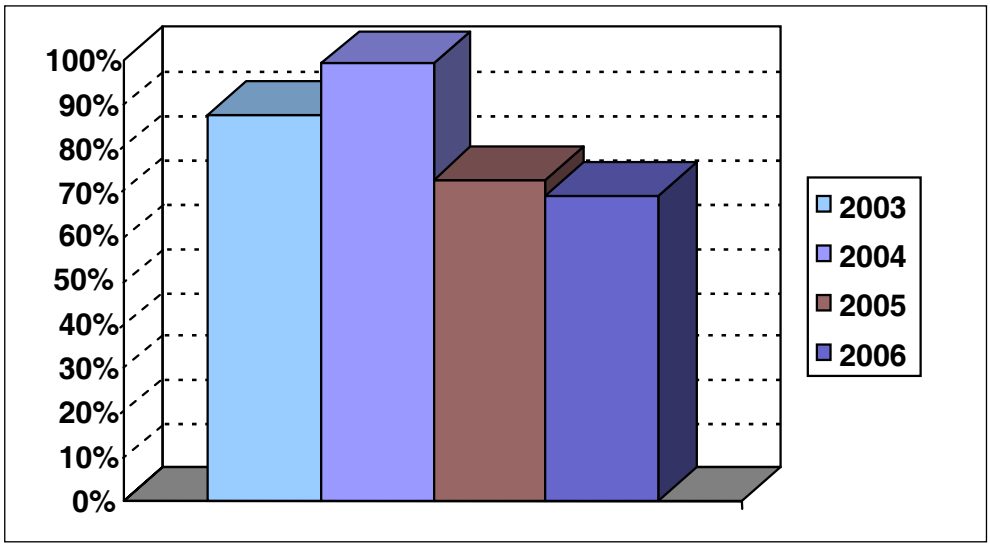

FIGURE 1: Vitamin A supplementation coverage (age 6-11 months).

SUSTAINABILITY

Program funding and University of Western Cape support ceased in August 2004. Program is sustained up to now (2007) but with different opportunities and challenges.

Opportunities

- Mdantsane urban renewal program promoting the urban agriculture supports the gardens.
- Cotlands (an NGO) extended the program to East London areas.

Challenges

- Funding ceased, hence the project manager dedicated to the Mdantsane for Vitamin A project is no longer available. Human resources in the nutrition program are a challenge.
- Staff turnover in health facilitates is high and continuous training is needed.

ACKNOWLEDGEMENTS

The following stakeholders were involved: Departments of Health and Agriculture; Local Government; Zakhe Peace and Development Trust; South African Council for Early Childhood Development; University of Western Cape; Academy for Educational Development

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ACHIEVING NUTRITIONAL IMPACT WITH VITAMIN A-RICH VEGETABLE GARDENS

Presented by: Mieke Faber
Nutritional Intervention Research Unit, Medical Research Council, Cape Town, South Africa

AIM OF THE VEGETABLE GARDENS

To increase household production and daily consumption of β-carotene rich fruit and vegetables as a way of supplementing the cereal-based diet. Encourage communities to produce β-carotene rich fruit and vegetables, in addition to any existing crops.

HOME-GARDEN PROJECT IN NDUNAKAZI

The combination of agricultural activities plus community-based growth monitoring plus nutrition education resulted in improved maternal nutritional knowledge, dietary vitamin A intake and serum retinol concentrations (Faber et al., 2002a, 2002b)

SEASONALITY

Dietary intake over seasons for 2-5-year-old children was measured using a 5-day repeated 24-hr dietary recall during February, May, August and November 2005. An adequate dietary vitamin A intake was observed for all four study periods. A large proportion of total dietary vitamin A intake was derived from vegetables and/or fruit. An adequate dietary vitamin A intake over seasons was maintained through (i) planting a variety of vitamin A-rich crops and (ii) staggered planting (Faber & Laubscher, 2008).

STEPS OF THE FOOD-BASED APPROACH

Step 1. Community entry

Step 2. Situation assessment

Determine

- infrastructure
- current dietary and gardening practices
- constraints and resources, especially the availability of land, water and fencing

Methods

- review existing data
- observation
- speaking to key informants
- semi-structured interviews
- group discussions
- questionnaire

The magnitude of the situation assessment depends on the aims of the project and the availability of resources

Step 3. Project planning meeting(s)
Continuous activity
- Involve the community in the decision making process
- Invite stakeholders
- Discuss results from situation assessment
- Take community's opinions into account
- The community should take ownership of the project
- Establish a garden committee

Step 4. Recruit and train fieldworkers
They should be recruited by the community, but guidelines must be provided.

Step 5. Establish demonstration gardens
Demonstration gardens serve as training centres to teach mothers how to plant β-carotene-rich vegetables, e.g. butternut, carrot, orange-fleshed sweetpotato and spinach. The demonstration garden can be at e.g. schools, crèche, clinic, health centre, communal garden, etc., but it must be easily accessible to both the fieldworkers and the community members.

Step 6. Establish community-based nursery
Regular supply of quality seed and sweetpotato cuttings (replace material every 2-3 years) at an affordable price

Step 7. Promotion
i) Introduce β-carotene-rich vegetables to small children
ii) Teach mothers to how prepare β-carotene-rich vegetables
iii) Educate mothers on the importance of β-carotene-rich vegetables
iv) Provide training in planting of β-carotene-rich vegetables
v) Promote home-gardens
vi) Create awareness

Step 8. Monitor and evaluate project activities
Monitoring provides information on
- where problems are occurring
- why certain activities are succeeding or faltering
- which aspects of the project need to be adjusted

Therefore: areas of concern are addressed as they arise and corrective measures can be instituted, thus improving the changes for project success. Evaluation measures whether project activities made a difference to the peoples lives.

For sustainability of donor-driven projects it is important to:

- withdraw gradually
- develop an exit strategy at the start of the project
- invest in human resources
- identify an organization that can provide technical assistance to the community

Various projects that were implemented using this approach are described on pages 49-56.

Reference: Faber M, Laurie S, Venter S. Home-gardens to address vitamin A deficiency in South Africa: a food-based approach. Agricultural Research Council, Pretoria, 2006.

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EXPERIENCES WITH ORANGE-FLESHED SWEETPOTATO IN VEGETABLE GARDEN PROJECTS

Presented by: Sunette Laurie
Agricultural Research Council - Vegetable and Ornamental Plant Institute, Pretoria, South Africa

BACKGROUND

- Based on the approach that was used in the Ndunakazi project (see pages 46-48), the ARC-VOPI implemented several vegetable garden projects, but with less input from the research team, focusing on technology transfer and mobilization of local organizations.
- Essential components of the approach are (i) nutrition education and (ii) training in production of crops rich in β-carotene such as orange-fleshed sweetpotato, carrot, butternut, and Swiss chard.
- The long term goal is to facilitate the role out of the crop-based approach and promotion of orange-fleshed sweetpotato on national level by other role players e.g. government departments, NGO's, municipalities.
- Requests for general training in vegetable production are used as an opportunity to implement the crop-based approach.
- In the next section of this presentation various projects that were implemented using the approach described in the previous presentation are described, highlighting different entry points, using existing infrastructure, and the flexibility in implementation.

ARC LONG TERM PROJECTS

1. Individual vegetable growers / garden groups / crèche gardens

Lusikisiki, Eastern Cape

- In 2002 ARC-VOPI joined a Landcare project of the ARC - Institute of Soil Climate & Water
- Role players:
  - 4 extension officers from the local Department of Agriculture
  - Staff from the Integrated Nutrition Program of the local Department of Health, and nurses from Gateway Hospital
  - 14 project health volunteers (2 per village)
- The project health volunteers were trained in:
  - growth monitoring and nutrition education by the local Department of Health
  - cultivation of vegetables by ARC-VOPI
- The responsibilities of the project health volunteers were to:
  - conduct monthly sessions for growth monitoring of preschool children & nutrition education

  - refer children with growth faltering to clinic
  - cultivate and promote β-carotene-rich vegetables
- Sites for growth monitoring were at crèches, chief's residence, church hall, health volunteer's house
- 120-150 children attended these growth monitoring sessions per month
- Agricultural extension officers were trained in cultivation of orange-fleshed sweetpotato and other β-carotene-rich vegetables – they served as agricultural advisors for the project
- Agricultural training in the production of orange-fleshed sweetpotato and other β-carotene-rich vegetables was done at the demonstration gardens. Production in home gardens was promoted.
- Field nurseries of orange-fleshed sweetpotato were established.
- Support in growth of orange-fleshed sweetpotato and other β-carotene-rich vegetables.
- Creation of public awareness.

Health, nutrition and agricultural activities were therefore integrated.

A similar approach was employed in Ndonga near Queenstown.
In 2003 community garden activities were extended to Qunu (3 villages) and Hegebe (1 village).

FIGURE 1: The Lusikisiki project

2. Large communal fields

Giyani (Mopani District, Limpopo)

- Fields of 1–12 ha in five villages since 2004
- Added training in production of paw-paw by ARC-ITSG

ARC SHORT TERM PROJECTS

These projects involve training in the production of β-carotene-rich crops and nutrition education only. The implementation of the projects is the sole responsibility of the collaborating institutions.

The training process has four phases, namely:

1) A workshop (1-2 days) that focuses on production of orange-fleshed sweetpotato and β-carotene-rich vegetables, nutrition education and implementation of the crop-based approach.
2) Training in production of orange-fleshed sweetpotato and β-carotene-rich vegetables at demonstration plots.
3) Establishing nurseries with orange-fleshed sweetpotato, and demonstrating rapid multiplication of sweetpotato.
4) Follow-up on-farm training at demonstration plots: compost making, water saving techniques and household pest and disease management, processing products of orange-fleshed sweetpotato

1. School gardens

North West Province

This project falls under "Sustainable Food Production in Schools", which is a sub-programme of the National School Feeding Programme of the Department of Education (school gardens within the National School Nutrition Programme are described on pages 1 - 3)

In 2005, training in orange-fleshed sweetpotato production was provided in 5 regions, and 20 cuttings per school were distributed to 200 schools. In 2006, orange-fleshed sweetpotato and crop-based training workshops were held in 6 regions (Hebron, Lichtenburg, Orkney, Vryburg, Kuruman, Rustenburg) and were attended by approximately 300 teachers).

Gauteng (Malekgere, Foxstrot, Wagensdrift)

Demonstration gardens were implemented at schools as part of creating awareness to the environment.

2. Clinic gardens

Mpumalanga on regional level

In 2004 the Department of Nutrition requested a workshop on orange-fleshed sweetpotato. Orange-fleshed sweetpotato was introduced in clinic gardens in Witbank, Kromdraai, Tonga and Nelspruit. Cuttings are distributed from these clinic gardens to schools, other clinics and communities.

Umtata area, Eastern Cape

Orange-fleshed sweetpotato vine cuttings were distributed to Health Systems Trust in the Umtata area, Eastern Cape. More than 12 clinics and many

homesteads benefited from the orange-fleshed sweetpotato vine cuttings. This has won the hearts of the people.

3. Integration with other ARC programs

Mdantsane, Eastern Cape

β-carotene-rich vegetables were included in a project for sustainable use of natural resources of ARC-ISCW.

In 5 villages garden groups consisting of 15 to 20 members are involved in the project.

People like orange-fleshed sweetpotato most of the four β-carotene-rich vegetables.

Thaba Nchu (Free State) and Hoggsback (Eastern Cape)

Orange-fleshed sweetpotato was included in demonstration gardens of the "In-field Rainwater Harvesting programme" of ARC-ISCW.

Thoyandou area (Limpopo Province)

Project of ARC-PPRI in Dididi, Tshiulungoma and Tshikudini based on a study done by the University of Medunsa that reported protein, vitamin A and vitamin C deficiencies in men.

Added orange-fleshed sweetpotato and other β-carotene-rich vegetables to the training in the production of high-protein maize and legumes, conservation agriculture, pest and disease management, and maize storage facilities.

4. NGO's

- Abalimi: orange-fleshed sweetpotato in their communal gardens in Cape Flats since 2001
- Health Systems Trust: orange-fleshed sweetpotato in their Integrated Nutrition Programme in KwaZulu-Natal and the Eastern Cape
- Africare: orange-fleshed sweetpotato gardens in Queenstown
- Cotlands: orange-fleshed sweetpotato in community training gardens to address household food insecurity in informal settlements in Gonubie and Reeston; Aug 2006 – supplied 65 families

IMPACT ASSESSMENT OF THE LUSIKISIKI PROJECT

A survey was conducted in Lusikisiki four years after implementation to determine the impact of the vegetable garden project with orange-fleshed sweetpotato on nutritional knowledge, dietary intake and gardening practices.

Methods

Project households were identified from the attendance register of monthly growth monitoring sessions. For each project household, the closest non-participating neighbouring household with a <5-y-old child was selected as control household. Information was collected by questionnaire by interviewing the caregiver. Differences between the project and control households were determined using analysis of variance and the χ^2-test.
Twelve project health volunteers participated in group discussion to obtain the opinions of the project, constraints & successes.

Results

The questionnaire was completed for 219 project and 223 control households. The average household size was 8 people for both project and control households.

Nutritional knowledge

More caregivers from project households than control households

- thought yellow fruits and vegetables are good for their children (73% versus 45%; P<0.001)
- were familiar with the term vitamin A (89% versus 63%; P<0.001)
- could indicate that vitamin A is a nutrient in food (83% versus 53%; P<0.001)
- could name 3 food sources rich in vitamin A (56% versus 27%, P<0.001).

Child morbidity

A favourable effect on child morbidity, as reported by the caregivers, was observed (figure 2)

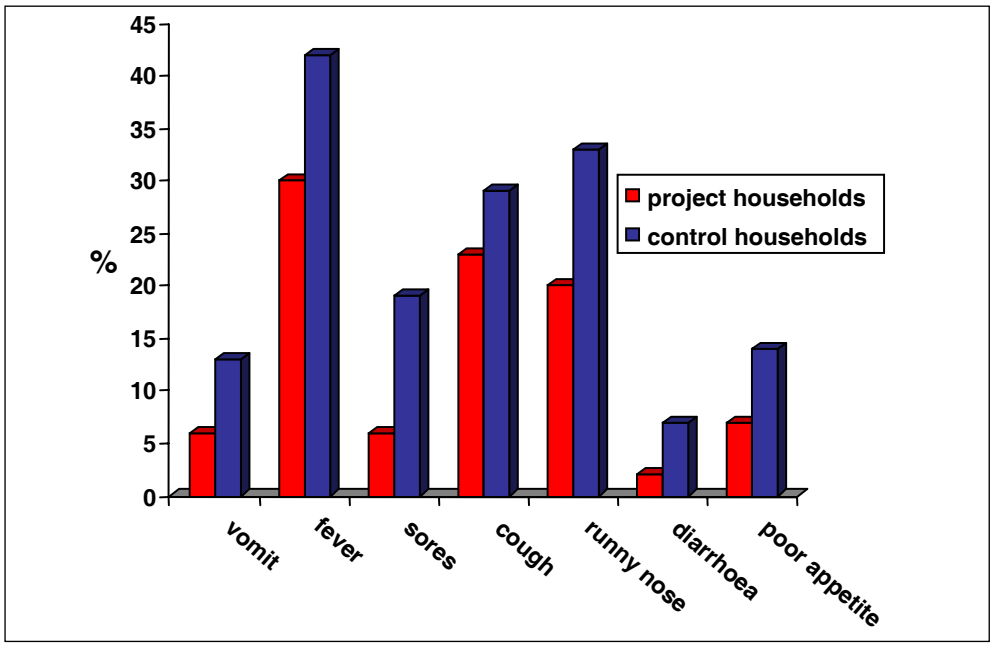


FIGURE 2: Child morbidity as reported by the caregivers (during 2 weeks prior to survey)

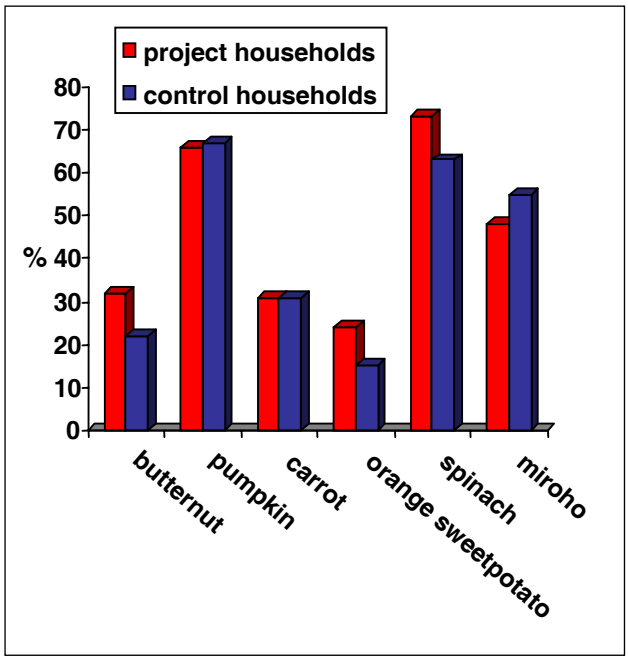
Caregiver's perceptions

- 96% of project households believed their children were growing well (versus 71% of the control households; P<0.001).
- The majority (95%) of those attending monthly sessions were happy about it.

Dietary intake

More children in project households consumed orange-fleshed vegetables (particularly butternut and orange-fleshed sweetpotato) the day before the survey (see figure 3). Frequency of consumption the previous month also showed a more frequent consumption for project households (see figure 4).

FIGURE 3: Percentage of children who ate β-carotene rich vegetables the day before



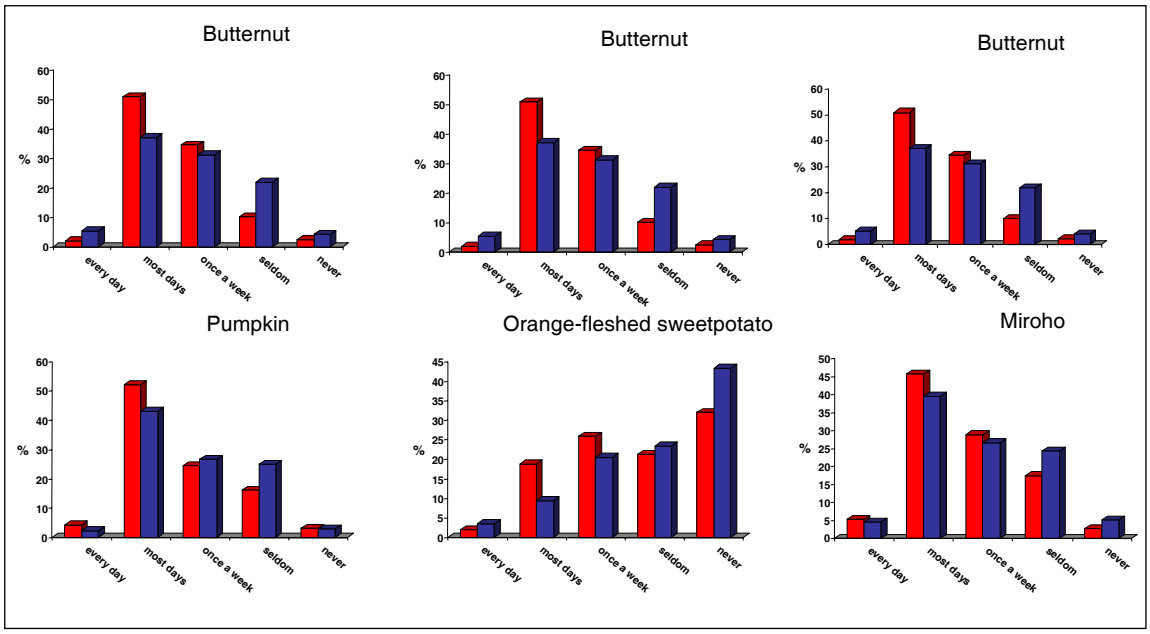


FIGURE 4: Frequency of consumption of β-carotene rich vegetables during the past month

Crop production

Looking at all the households included in the survey, more project than control households cultivated spinach, butternut and carrot (see table 1).

TABLE 1: Percentage cultivation of β-carotene rich crops

	Project households	Control households	P-value
	n=219	n=223	
Household grows vegetables	48	37	0.025
Grow pumpkin	39	36	ns
Grow swiss chard / spinach	33	24	0.028
Grow sweetpotato	27	22	ns
Grow butternut	25	15	0.014
Grow carrot	24	16	0.037

Group discussion with project health volunteers

The project health volunteers valued the project for the following reasons:

- The training capacitated them - previously they only planted maize and beans and bought β-carotene-rich vegetables.
- The are now knowledgeable as how to cultivate β-carotene-rich vegetables and do not have to buy these vegetables
- They are able to provide for the nutritional needs of their children
- They have additional income to buy other commodities
- The project introduced them to orange-fleshed sweetpotato, which was unknown to them before. In some areas, up to 1 hectare are cultivated by the project health volunteers.
- The project taught them about mother-child caring practices.

Conclusion: Survey

- Vegetable and orange-fleshed sweetpotato gardening in the Lusikisiki community had a favourable affect on:
  - health status of children aged 5 years and younger as reported by the caregivers
  - awareness of nutritional aspects
  - dietary intake of β-carotene-rich vegetables
- The crop-based approach developed in Ndunakazi can be duplicated with success in other areas with less input from research team, focus on technology transfer and mobilization of local organizations

OVERALL CONCLUSIONS

- ARC-VOPI conducted several inventions based on Ndunakazi approach
- Food-based approach with emphasis on orange-fleshed sweetpotato can be implemented on wider scale
  - various entry points
  - various role players
  - building on existing structures.
- A publication by the ARC and MRC will assist organizations in this task (Faber et al., 2006).

ACKNOWLEDGEMENTS

Co-authors: Musa Mtileni, Sharon Mphaphuli, Sidwell Tjale, Julia Domola
The collaborators in these projects are local departments of Agriculture and Health; Department of Health Mpumalanga; Department of Education North West; ARC institutes; UNISA; Cotlands; Health Systems Trust; Africare; Medical Research Council

Report on the Lusikisiki project: Laurie S, Mphaphuli S, Faber M, Mtileni M and Domola J. Technical Report: Vegetable garden project integrated with nutrition education and community-based growth monitoring to address vitamin A deficiency in Lusikisiki, Eastern Cape, South Africa. ARC - Vegetable and Ornamental Plant Institute, Pretoria, South Africa. 2007

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MSINGA ORANGE-FLESHED SWEETPOTATO JAM PROJECT BASED ON MARKET RESEARCH

Presented by: H.T. Ngubane
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INTRODUCTION

- In South Africa, including KwaZulu-Natal research has taken a production approach, which assumes that market demand exists for increased production and not based on market research.
- Many farmers are experiencing stagnation in their production systems because the research, for the development of the technology was not market driven.
- More focus has been on production and less focus on adding value on agricultural products.
- In KwaZulu-Natal, including Tugela Ferry (Msinga) the cultivation of sweetpotatoes is more common.
- Sweetpotatoes play an important role as a food security crop for small scale and subsistence farmers.
- Sweetpotato processing is vital important to ensure that sweetpotato products are available throughout the year for better health benefits.
- The research started by identifying market opportunities.
- The sample size of 17 was randomly chosen. The sample population was made up of respondents from prisons, hospitals, shops, supermarkets and individual households.

- Jam – is made by boiling together fruit pulp, finely cut fruit or vegetables and sugar. Jams are solid gels made from fruit pulp, sugar and pectin. It can be of a single fruit or in combination with other fruits. The fruit content of jams should be at least 40 %. In mixed fruit the first named fruit should be at least 50 % of the total fruit added.

IMPORTANCE OF SWEETPOTATO PROCESSING

- The largest portion of sweetpotato is marketed raw to local supermarkets in KwaZulu-Natal.
- There is a large potential market to expand for home and industrial processing.
- Sweetpotatoes are used extensively in households.
- The ARC-VOPI has developed a number of recipes in which sweetpotatoes can be used i.e. baked products, fried products, bottled products and cooked products.
- Recipes were tested in all provinces including KwaZulu-Natal
- KwaZulu-Natal departmental staff was trained so as to train the farmers.

IMPACT OF ORANGE-FLESHED SWEETPOTATO PROCESSING TRAINING

KwaZulu-Natal DAE declared 2004 to be sweetpotato year.

- The aim was to promote research, production, marketing, processing and home consumption of orange-fleshed sweetpotato.
- To create awareness, product development and nutritive value of orange-fleshed sweetpotato.
- Information days were held at different Districts Municipalities and as a result of this initiative farmers from the Tugela Ferry Irrigation Scheme at Msinga became very interested in value adding and making sweetpotato jam.
- This necessitated market research to be conducted with an overall objective of assessing the potential market for sweetpotato jam.
- This is considered to be a good niche market for sweetpotato jam since it is not currently available in the market.
- As part of ARC's follow up to their training, they learned that KwaZulu-Natal Province made more progress with regards to sweetpotato processing

MARKET SURVEY

Seventeen respondents were chosen randomly from individual households (n=7), local retail stores (n=6), government institutions namely hospitals and prisons (n=3), and an orphanage (n=1). Each respondent tasted samples of the sweetpotato jam.

Survey results

Consumption of jam

- All respondents indicated that they use jam in their organizations or households.

Suppliers and sales arrangements

- Most retailers preferred Aheers (located at Greytown) and Metro (located at Dundee) where they buy in bulk.
- Most households purchased jam from Spar.
- Sixteen respondents indicated that they purchase through direct sales with only one respondent using a contractual arrangement.

Taste and preference of the product

- All respondents responded positively to the taste of the product (delicious n=12; good n=3; normal n=1).
- All respondents indicated a strong belief that consumers would like the product and that they will be willing to do business with the project once it is fully operational.

LIMITATION OF THE RESULTS

- The results from this survey could not be regarded representative of the whole population.
- The sample size was very small and did not represent the whole population of the study area.

OTHER INSTITUTIONAL ISSUES

- ARC has provided assistance with regards to processing equipment.
- The Department will still provide other equipment which will enable the business to expand.
- A feasibility study of the project will be conducted to evaluate the profitability of the project.
- The project has been registered as a legal entity, as a Co-operative.
- Farmers will be supported on product development as this will increase the utilization of sweetpotatoes thus increasing profit margin of the business.

MSINGA SWEETPOTATO JAM LAUNCH

- The Msinga Qinisela Sweetpotato Jam Cooperative was officially launched on the 7th of July 2005 (see figure 1)
- This one way of exposing the project to the potential customers.

FIGURE 1: Official launch of the Msinga Qinisela Sweetpotato Jam Cooperative

SUMMARY AND CONCLUSION

- The overall response of potential customers was positive for sweetpotato jam.
- The project has a great potential to expand since the large quantities of sweetpotatoes are produced
- Farmers should take note of the areas of improvements on sweetpotato products marketing.
- Marketing is a critical area in their farming business and improvement on this could positively affect their businesses.
- The establishment of sweetpotato jam project at Msinga is going to change the lives of people.

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CONSUMER ACCEPTABILITY OF ORANGE-FLESH SWEETPOTATO PRODUCTS

Presented by: Ina van Heerden
Sensory Analysis Unit, Agricultural Research Council, Pretoria

OBJECTIVE

To determine in six regions in South Africa consumer acceptability of four products made of orange-fleshed sweetpotato.

METHODS

The following four products were prepared by ARC-Roodeplaat:

Orange-fleshed sweetpotato juice	*Orange-fleshed sweetpotato chips*	*Orange-fleshed sweetpotato doughnuts*	*Orange-fleshed sweetpotato leaves, cooked as a green vegetable dish*
			

The products were tested in six regions, namely (i) Ditshilo near Mafikeng (North West); (ii) Thembalethu KwaMhlanga (Mpumalanga); (iii) Bushbuckridge north of Hazyview (Limpopo); (iv) Tompi Seleka College near Marble Hall (Limpopo); (v) Tshiombo near Thohoyandou in Venda (Limpopo); and (vi) Vulindlela near Pietermaritzburg (KwaZulu-Natal).

Consumer panel

- Was of the middle and lower income groups.
- Recruited on the basis of regular consumers of vegetables.
- The aim was to include 50 males and 50 females each in three different age groups (>50 years, 20-49 years and 10-19 years) per region.
- The panellists tasted the products in the following order:
  1st orange-fleshed sweetpotato juice (50 ml)
  2nd orange-fleshed sweetpotato chips (25 g)
  3rd orange-fleshed sweetpotato doughnuts (±30 mm - size of a walnut)
  4th orange-fleshed sweetpotato leaves (50 ml)

RESULTS

TABLE 1: The percentage of panellists who responded positively when tasting the orange-fleshed sweetpotato products, for the total group and per age group.

	Total group	Age group		
		10-19 years	20-49 years	50+ years
Orange-fleshed sweetpotato juice				
Liked the taste	87	74	89	96
Liked the colour	93	86	96	99
Will by the product	81	68	87	93
Will make the product	84	73	89	97
Orange-fleshed sweetpotato chips				
Liked the taste	90	84	91	99
Liked the colour	89	80	93	97
Will by the product	85	81	87	90
Will make the product	86	79	66	94
Orange-fleshed sweetpotato doughnuts				
Liked the taste	95	92	96	97
Liked the colour	95	92	97	99
Will by the product	96	91	96	97
Will make the product	94	90	96	99
Orange-fleshed sweetpotato leaves				
Liked the taste	93	84	91	99
Liked the colour	92	79	95	100
Will by the product	88	82	92	93
Will make the product	93	81	96	100

Region 1 and 3 scored the lowest for the juice, chips and doughnuts and green leafy vegetables (region 3 only).

CONCLUSIONS

- The four products were liked by most of the panellists.
- Doughnuts were liked the most.
- Older consumers liked the 4 products more than the younger group.
- Orange-fleshed sweetpotato based products could be considered as an additional means of consuming orange-fleshed sweetpotato, thereby adding variety to the form in which it can be consumed.

ACKNOWLEDGEMENTS

ARC-VOPI
ARC-ANPI Sensory team
All the participants

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RETENTION OF β-CAROTENE IN BOILED ORANGE-FLESHED SWEETPOTATO AND DURING STORAGE: IMPORTANCE OF NUTRIENT CONTENT FOR NUTRITIONAL IMPACT

Presented by: Paul van Jaarsveld
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BACKGROUND

β-carotene is produced in plants, whereas vitamin A is produced in animals (including humans)

Dietary vitamin A is available as:

- preformed vitamin A, commonly found in foods of animal origin (e.g. liver, egg yolk, dairy products), and
- provitamin A carotenoids, primarily derived from yellow-orange colored fruits and vegetables or dark-green leafy vegetables.

Recommended Dietary Allowance (RDA)

The average daily dietary intake for vitamin A to meet the requirement of 97-98% healthy individuals in a life stage or gender group (maintain normal vitamin A status), expressed as Retinol Activity Equivalents (RAE).

Estimated Average Requirement (EAR)

The daily intake value estimated to meet the requirement in half of the apparently healthy individuals in a life stage or gender group, expressed as RAE.

1 RAE = 1 μg Retinol = 12 μg β-carotene

Source: Food & Nutrition Board, Institute of Medicine, The National Academies, Washington, DC (2001)

How much β-carotene is needed to fulfill daily (d) requirements for different age groups and gender?

Children (years)	RDA/day μg RAE	EAR/day μg RAE
1 to 3	300	210
4 to 8	400	275
9 to 13 b/g	600	445 / 420
14 to 18 b/g	900 / 700	630 / 485
19 to 30 m/w	900 / 700	625 / 500

RDA: 300 – 900 μg RAE x 12 = 3600 – 10800 μg β-carotene
EAR: 210 – 630 μg RAE x 12 = 2520 – 7560 μg β-carotene

How much β-carotene is needed to fulfill daily (d) requirements for a life stage group?

Pregnancy (age years)	**RDA/day μg RAE**	**EAR/day μg RAE**
14 to 18	750	530
19 to 30	770	550
31 to 50	770	550
Lactation (age years)		
14 to 18	1200	885
19 to 30	1300	900
31 to 50	1300	900

RDA: 750 – 1300 μg RAE x 12 = 9000 – 15600 μg β-carotene
EAR: 530 – 900 μg RAE x 12 = 6360 – 10800 μg β-carotene

Resisto variety provides: 9 980 μg β-carotene / 100g cooked OFSP = 832 RAE

Much more than 100 g is usually consumed. Resisto can easily provide vitamin A requirement for life stage and gender groups.

Based on its agronomic, technological, and local preference and acceptability performance the high β-carotene Resisto variety of sweetpotato with storage root flesh colour of dark orange was chosen for the efficacy trial (described on pages 29-32) and the present study.

Resisto was originally developed in the USA through conventional breeding; used by ARC-VOPI since 1995 in the sweetpotato breeding programme.

Factors influencing carotenoid composition e.g. are:

- Cultivar/variety
- Stage of maturity
- Climate/geographic site of production
- Harvesting and postharvest handling
- Processing and storage

Studies evaluating the retention of nutrients in cooked foods can be flawed if raw and cooked samples are not equivalent:

- extraction efficiency for the raw and cooked samples differs.

- enzymatic oxidation occurs in the raw sample.
- calculation of retention is not corrected for weight loss or gain during cooking.

AIM OF THE STUDY

1 Establish and evaluate the analytical method.
2 Assess the natural variability of the β-carotene content of orange-fleshed sweetpotato.
3 Determine the retention of β-carotene in boiled, mashed orange-fleshed sweetpotato under:
   (a) different home-cooking conditions,
   (b) institutional feeding conditions as was done for the school study (see pages 29-32).
4 Determine changes in β-carotene content of orange-fleshed sweetpotato during in-ground and room storage.
5 Determine β-carotene content in sun-dried and oven-dried orange-fleshed sweetpotato chips.

True retention (TR) was calculated as follows:

%TR = (carotenoid content per g of cooked food x g of food after cooking) / (carotenoid content per g of raw food x g of food before cooking) X 100
(Source: Murphy et al., 1975)

Concentration changes due to loss or gain of water and soluble solids during cooking is compensated for.

TABLE 1: Natural variability in β-carotene content of raw medium-sized orange-fleshed sweetpotato (OFSP), variety Resisto, from same harvest batch

Individually analyzed OFSP	Intact raw OFSP weight (g)	β-carotene content (μg/g)[a]	Vitamin A value (μg RAE[b]/100g)
OFSP 1	352	132	1 100
OFSP 2	373	146	1 220
OFSP 3	364	161	1 350
OFSP 4	329	179	1 500
OFSP 5	352	194	1 620
OFSP (n = 5)	354 ± 16		

[a] Mean of duplicate samples.
[b] RAE (Retinol activity equivalents): 12 μg β-carotene = 1 μg retinol = 1 μg RAE

TABLE 2: Retention of β-carotene in boiled, mashed medium-sized OFSP, variety Resisto, from same harvest batch using different cooking conditions

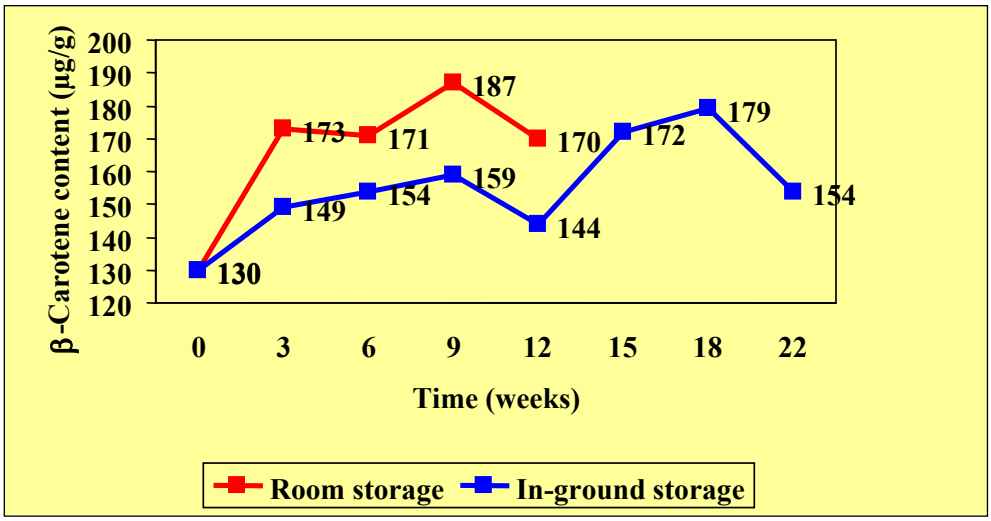
Cooking condition	β-carotene content[a] (μg/g)	% TR[b]
OFSP covered with water, open pot, boiled 30min		
Raw sample	156	
Boiled sample	147	88
OFSP covered with water, closed pot, boiled 20min		
Raw sample	173	
Boiled sample	170	92
OFSP half covered with water, closed pot, boiled 20min		
Raw sample	155	
Boiled sample	137	83

[a] Mean of triplicate analyses of a composite sample of 5 medium-sized OFSP obtained by pairing opposite quarters from each sweetpotato.
[b] Percent true retention.

TABLE 3: Retention of β-carotene in boiled, mashed orange-fleshed sweetpotato, variety Resisto, of different sizes from same harvest batch

Sample[a]	β-carotene content[b] (μg/g)		% TR[c]
	Raw	Cooked	
Sample A	153	121	76
Sample B	167	124	70
Sample C	156	136	81

[a] Cooking condition: sweetpotato covered with water and boiled 30 min in a pot with the lid on.
[b] Mean of triplicate analyses of a composite sample of 2 small, 2 medium and 1 large orange-fleshed sweetpotato obtained by pairing opposite quarters from each sweetpotato.
[c] Percent true retention.



Means of six subsamples of a composite sample of 4 small, 4 medium and 1 large orange-fleshed sweetpotato. Significant difference between room and in-ground storage, as well as over time ($P < 0.001$).

FIGURE 1: Changes in β-carotene content of orange-fleshed sweetpotato, variety Resisto, during room and in-ground storage

TABLE 4: β-carotene content of dried chips of orange-fleshed sweetpotato, variety Resisto, of three different harvest batches

	β-carotene content (μg/g)					
Chips[a]	Batch 1	% TR[b]	Batch 2	% TR[b]	Batch 3	% TR[b]
Raw[c]	182		166		162	
Sun 1-3 mm	64	10	98	15	163	22
Shade 1-3 mm	159	23	114	18	160	22
Room 1-3 mm	144	21	131	18	116	15
Oven 1x1 cm	287	37	223	31	208	27
Oven 3 mm	274	37	238	34	170	23
Oven 6 mm	388	48	338	47	253	33

[a]Drying conditions.
[b]Percent true retention.
[c]Mean of triplicate analyses of a composite sample of 5 medium-sized OFSP.

CONCLUSIONS

- Appreciable differences in the β-carotene content between sweetpotatoes of the same size from the same harvest batch showed that retention studies must be done with quartering rather than pairing by size.
- Retention of β-carotene varies with root size and cooking conditions – some degradation occurs – trans-β-carotene of boiled and mashed sweetpotato is still substantial.
- Resisto variety has the advantage of containing very high amounts of β-carotene in the trans configuration (cis-isomers have lower provitamin A activity).
- After 12 weeks of room storage and 22 weeks of in-ground storage the β-carotene content of orange-fleshed sweetpotato was still substantial but declining.
- Considerable degradation of β-carotene occurred in making dried chips; since Resisto variety has very high β-carotene content, substantial amounts still remained, showing the importance of choosing β-carotene-rich raw material in processed products.
- Results showed that drying conditions must be optimized so that maximum retention is achieved when processing orange-fleshed sweetpotato roots into dried chips for longer storage and extended use.

PRACTICAL APPLICATIONS

- β-Carotene is retained better when sweetpotatoes are boiled intact covered with water in a pot with the lid on at shortest possible time, i.e. cooking to just doneness.
- Orange-fleshed sweetpotato roots can be processed into dried chips for longer storage and extended use; thick slices retain more β-carotene.
- Orange-fleshed sweetpotato, variety Resisto, is an excellent food source of provitamin A and can contribute significantly to the daily RDA (~2 times) for vitamin A in young children (832 μg RAE/100g cooked).

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Results published in: Van Jaarsveld PJ, Marais De Wet, Harmse E, Nestel P and Rodriguez- Amaya DB. Retention of β-carotene in boiled, mashed orange-fleshed sweet potato. *Journal of Food Composition and Analysis* 2006; 19:321-329.

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SENSORY EVALUATION OF SWEETPOTATOES

Presented by: Christine Leighton
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The project had three components, namely: (i) nutrient analysis (not presented in this paper), (ii) sensory evaluation, and (iii) consumer acceptability of orange-fleshed sweetpotato.

The following varieties were evaluated:

SHEAR FORCE

Cooked sweetpotatoes were cooled and then cored. One shear value for each core was obtained using an Instron Universal Testing Machine (Model 4301) (Instron Corporation, 1990), with a Warner Bratzler shear device mounted on a Universal Instron apparatus (eight cores per cultivar). The reported value in kilograms represented the average peak force measurement. The results showed that no significant differences were found for the shear force measurement of the different sweetpotato cultivars. The average measure was 0.35 kg

SENSORY EVALUATION

This was done by a trained panel. A trained panel is:

- An analytical instrument, consisting of 10 - 15 trained panel members
- Perform quantitative descriptive analysis
- Usually four training sessions are applied (2h daily)
- Evaluation is done in individual sensory booths, using white or red light conditions
- Four repetitions are conducted over four days

The following flavour and texture attributes were identified in the different sweetpotato cultivars:

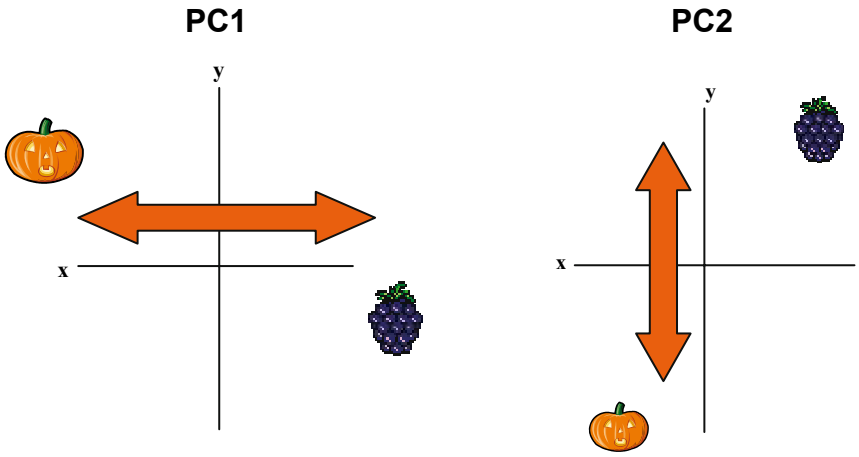
AROMA	earthy, sweetpotato & burnt
TEXTURE	moistness, firmness
	First bite: denseness, moistness
	Mastication: fibers, adhesive, grainy
FLAVOUR	Vegetables sweet, sweetpotato, yellow vegetable
AFTERTASTE	Vegetable sweet

Data analysis

ANOVA was used to test the main effect of sample, panellists and sample-by-panellist interactions at 5% level of significance. The results of the ANOVA showed that

- All attributes differed significantly from each other
- Sweetpotatoes differed in aroma, texture, flavour and aftertaste

Principal Component Analysis (PCA) was applied on the mean values of attributes per sweetpotato sample. Results are further discussed by using the results obtained from the Principal Component Analysis



PC1: Compares extreme left product/s with product/s on extreme right
PC2: Compares product/s on extreme top with product/s on extreme bottom

FIGURE 1: Multivariate statistical analysis - Principal Component Analysis.

Figure 2 shows that the first principal component (PC1) accounted for 72.9% of the total variation in the data. It was characterised by the sweetpotato aroma, sweetpotato flavour, moist texture on appearance and moist texture on first bite with positive loadings, while the earthy aroma, yellow vegetable flavour, vegetable sweet aftertaste, dense and adhesive texture attributes displayed a negative loading. Resisto and W119 (orange-fleshed) contrasted with Blesbok (white-fleshed) the strongest with regard to the attributes identified in PC1.

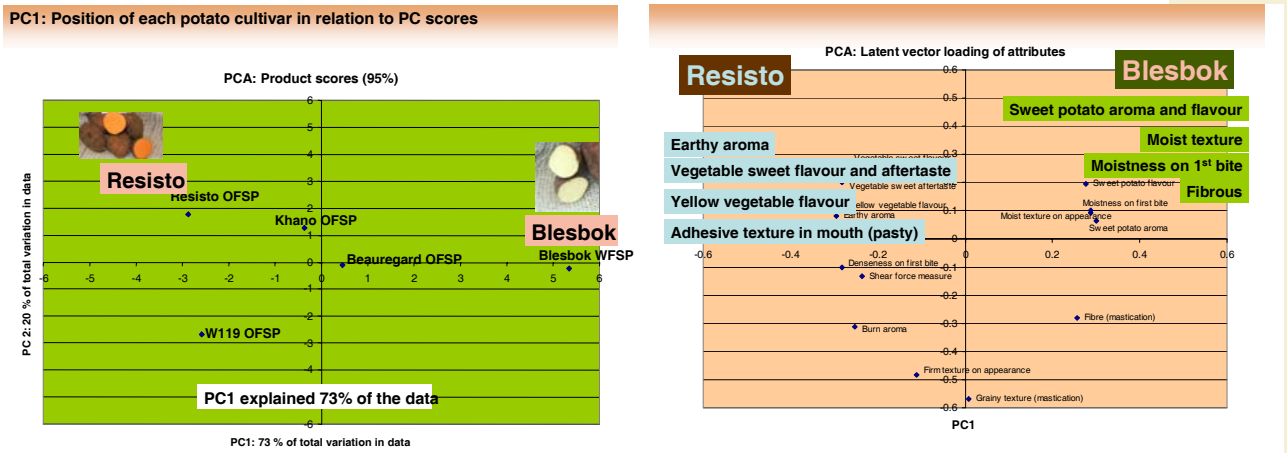


FIGURE 2: Results of the first principle component analysis

Figure 3 shows that for the second principal component (PC2), the grainy texture on chewing and the firm texture on appearance, showed a negative loading. W119 contrasted with Resisto and Khano.

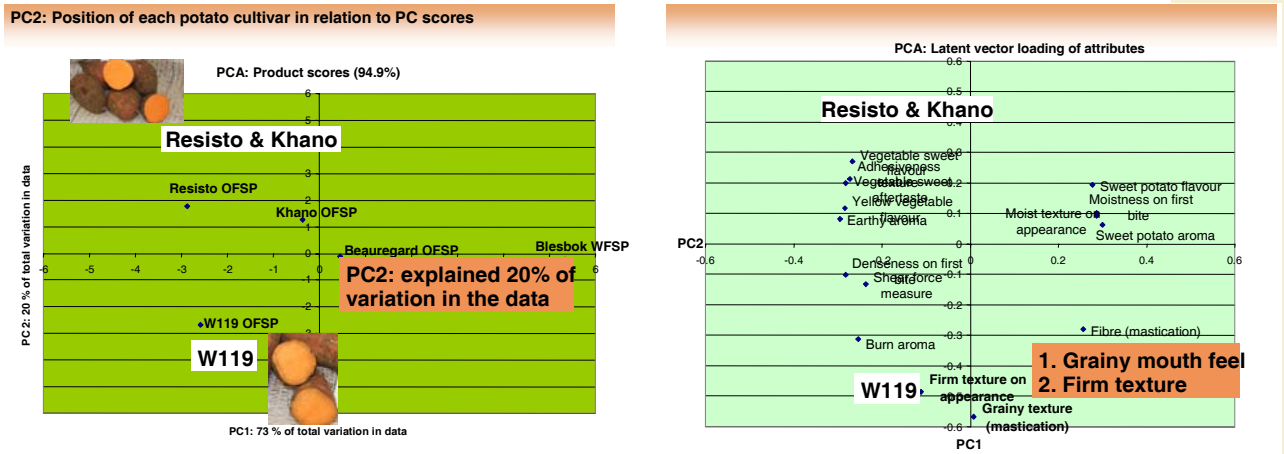


FIGURE 3: Results of the second principle component analysis

The first two principal components therefore explained 94.9% of the total variance.

Summary of sensory evaluation

- Cooked sweetpotatoes display diversity in flavour and texture.
- Orange-fleshed sweetpotato is less moist and fibrous than white-fleshed sweetpotato. Orange-fleshed sweetpotato has an earthy, sweet, yellow vegetable flavour with texture attributes that are more pasty (particularly Resisto), and somewhat more dense than white-fleshed sweetpotato.
- Orange-fleshed sweetpotato varieties differ among each other on flavour and texture.

Consumer acceptability of an orange-fleshed sweetpotato (Resisto) and a white-fleshed sweetpotato (Blesbok) was evaluated
The 180 panellists were representative of the South African Population (Census in Brief, Stats SA, 2003) and consisted of Black (n=144), Coloured (n=2), Indian (n=2) and White (n=34) members.
The sweetpotatoes were tested for colour preference, taste preference, and willingness to buy. Paired preference tests were applied.

RESULTS

TABLE 1: Consumer preference in terms of taste, colour and willingness to buy for the total group of panellists (n=180).

Taste preference	
Orange-fleshed sweetpotato	85 % preference
White-fleshed sweetpotato	15 % preference
Colour preference	
Liked colour a lot	53%
Liked colour a little	25%
Neither liked, or disliked colour	22%
Willingness to buy	
Will buy	86.3 %
Will not buy	5.5%
Might buy	8.2%

Focus group interviews

Three focus group interviews were conducted with (i) black females; (ii) black females and males; and (iii) white females.

Main findings of the focus groups discussions

- All members in the family eat sweetpotato
- Men are less partial to sweetpotato than women
- Consumers liked to grow their own sweetpotato if and where land is available
- Sweetpotato is boiled in skin or cooked in hot coals
- Sweetpotato is eaten hot or cold
- The white respondents viewed the orange-fleshed sweetpotato as a new vegetable that could add variety to diet
- Majority of the respondents had not been exposed to orange-fleshed sweetpotato previously
- When told that orange-fleshed sweetpotato is highly nutritious they reacted positively and indicated that they would be willing to buy it
- Some concerns were voiced about the deep orange colour
- Sweetpotato is consumed differently by different cultural groups

CONCLUSIONS

- Orange-fleshed sweetpotato differs from white-fleshed sweetpotato on sensorial attributes such as flavour and texture
- Consumers liked orange-fleshed sweetpotato in taste and colour and indicated a willingness to buy it

RECOMMENDATIONS

- Cultivars that show potential for commercialization should be evaluated for textural differences that may exist among the different cultivars
- Consumer liking should be tested based on texture preferences (i.e. dry matter content)
- Willingness to buy should be investigated based on actual costs
- In-house testing should be conducted where consumers prepare and consume orange-fleshed sweetpotato in their own home and then complete a questionnaire
- Awareness campaign of nutrient value of orange-fleshed sweetpotato should be introduced in order to encourage the consumption of orange-fleshed sweetpotato

ACKNOWLEDGEMENTS

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OPTIMIZING NUTRITION INTERVENTION: SCOPE FOR IMPROVEMENTS AND INTERSECTORAL COLLABORATION

Presented by: Pauline Kuzwayo
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COMPLEXITIES OF NUTRITION

- "Nutrition is not a discipline to be studied but a problem to be solved"
- Nutrition solutions often lie outside the domain of "nutrition"
- "Nutrition is everyone's problem and no one's business: a complex cross-sectoral issue that routinely slips through the cracks"

NUTRITION IS A CROSS-CUTTING ISSUE

- To achieve nutrition improvement active collaboration is needed from a range of sectors such as health, agriculture, education, social development, trade etc as well as within sectors
- Collaboration with civil society, NGO's, international agencies, research and training institutions are also very important.

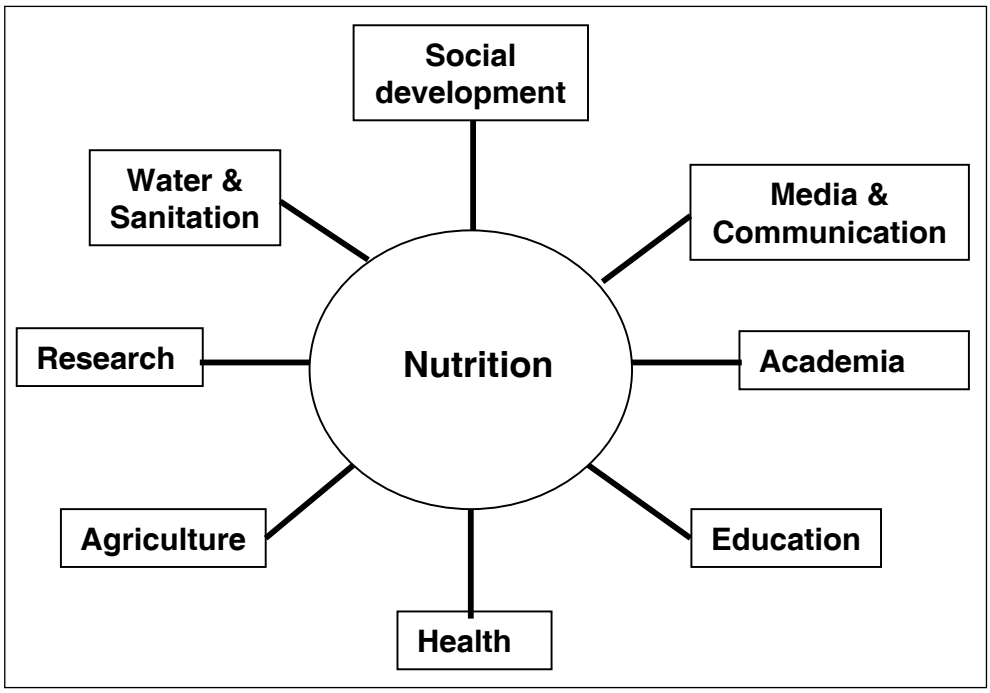

FIGURE 1: The interdisciplinary nature of nutrition

- Nutrition crosses boundaries from basic and laboratory science to global economic and political interactions
- Nutrition falls in the economic, social, cultural, behavioural, economic and political context

- Nutrition in health often gets medicalized
- Agriculture may be marginalized
- Nutrition in education
- Nutrition in social development is often regarded as just welfare
- Solution to nutrition problems requires integrated approaches – from government, bilateral and international agencies, non-government agencies, academia, researchers, private sector, civil, religious, lay organization, communities

EFFECTIVE COLLABORATIVE NUTRITION

- Shared vision, trust and needs a convener
- Clear goals, good strategy and programme management
- Recognition of nutrition as an essential indicator of national development/ Human Rights
- Political commitment
- Adequate funding for nutrition
- Mechanism for collaboration – intersectoral committee or council
- Civil Society and Community participation

HIGHLIGHTS OF NUTRITION SITUATION IN SOUTH AFRICA

- South Africa is not only food secure, but it is food sufficient
- 50% of South Africans are vulnerable to food insecurity
- High prevalence of nutritional problems
- Stunting levels as high as 25%
- 1 in 3 children aged younger than 5 years suffer from vitamin A deficiency

SCOPE FOR NUTRITION IMPROVEMENT IN SOUTH AFRICA

South Africa has the opportunity to significantly improve nutrition of its population. There is a clear political commitment to ensuring all people in South Africa have access to basic social needs, from food, water, good sanitation, education, housing, social development.

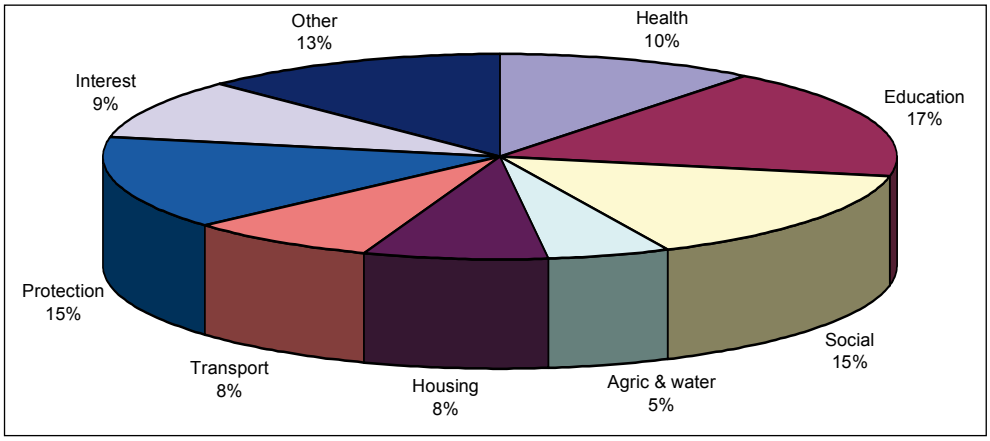

FIGURE 2: 2007 Budget - A significant proportion is on social spending

Constitution - Bill of rights

Chapter 2 on the Bill of Rights of the Republic of South Africa's Constitution enshrined the right to food and nutrition.

Section 27 (1) states that everyone has the right to have access to –

Health care services, sufficient food and water and social security,

Section 28 (1) every child has the right

to basic nutrition, shelter, basic health care services and social services

Nutrition Indicators

- Trends of severe malnutrition under five years is included as an indicator of development

Multidisciplinary/Intersectoral

- Social Clusters
  - Ministries of Health, Education, Social Development
  - Director Generals
  - Directors – members of the Food Security and Nutrition Task Teams
  - Similar Task Teams at Provincial and local levels

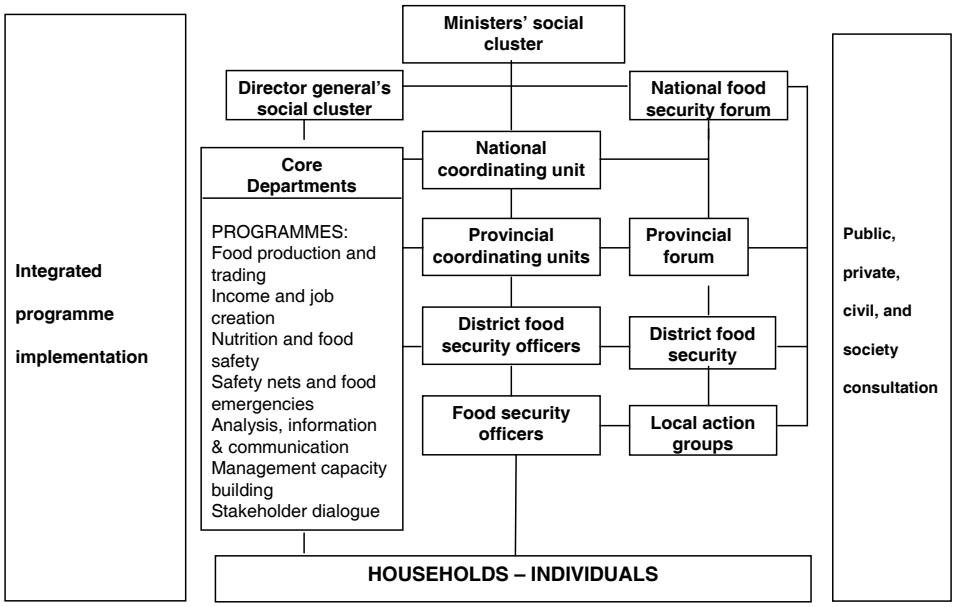

FIGURE 3: Schematic overview of the Social Cluster

CHALLENGES

- Translate the political commitment into practical realities
- No clear feasible action plans
- Insufficient human resources
- No integration even within one sector
- Unemployment and poverty
- No inclusion of civil society, researchers, academics, NGO

- No monitoring and evaluation
- Under spending (see figure 4)

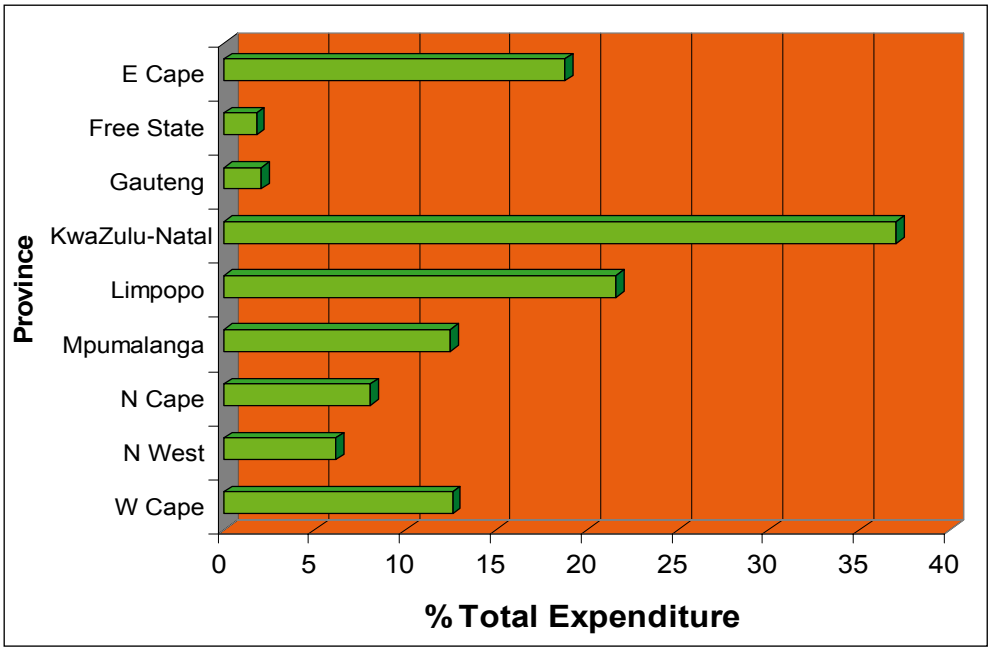

FIGURE 4: Percentage expenditure of Agriculture Programme

What is required?

- I do not know

- Partnerships
- Collaborations
- Coordination
- Networking
- Capacity Building, skills development

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