Vegetable Research and Development in Malawi

Review and Planning Workshop Proceedings

Lilongwe, Malawi
23-24 September 2003

M.L. Chadha, M.O. Oluoch, A.R. Saka, A.P. Mtukuso, and A.T. Daudi, editors

Organizers:
AVRDC - The World Vegetable Center
Regional Center for Africa

and

Ministry of Agriculture, Irrigation and Food Security
Department of Agricultural Research Services

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The World Vegetable Center

AVRDC – The World Vegetable Center is an international nonprofit organization committed to ensuring the world’s food security through research, development, and training in the production and consumption of safe vegetables.

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Welcome address and official opening

The Master of Ceremonies, Mr. M.N. Nsanjama; the Director of the AVRDC- World Vegetable Center, Regional Center for Africa (AVRDC-RCA), Dr. M. L. Chadha, based in Arusha, Tanzania; The Director of Agricultural Research Services, Dr. A.P. Mtukuso; the Heads of Department, Ministry of Agriculture and Irrigation; the Chairman of the Conference Organizing Committee; Program Managers of all ADDs or their representatives; the Principals of the Colleges of the University of Malawi; the Members of the Donor community; FAO Country Representative; Our Partners in Agricultural Research and Development; the Representatives of the Nongovernmental Organizations; Resource persons; Participants; Invited Guests; Ladies and Gentlemen:

I feel greatly honored to officiate the opening of the First Review and Planning Workshop on Vegetable Research and Development in Malawi here at the Malawi Institute of Management this morning. As we all know, Malawi’s economy is entirely dependent on agriculture. Currently, agriculture accounts for 40% of the gross domestic product, over 80% of export earnings, and 85% of all employment in Malawi. It is expected that agriculture will continue to be a dominant force in Malawi’s economy for many years to come. Let me take this opportunity to remind you that my Ministry’s policy objectives for agricultural development in Malawi are to:

- improve and maintain food self-sufficiency and nutrition
- expand and diversify agricultural exports while conserving natural resources
- raise farm incomes and promote economic growth
- improve the social welfare of all Malawians

Agricultural research has a crucial role to play in the Ministry’s ability to implement these policy objectives. As you may be aware, several Ministry initiatives aim to improve agricultural productivity in Malawi. Among these are:

- winter and summer Targeted Inputs Program (TIP)
- APIP
- The Sasakawa Global 2000
- The Chinese Maize Productivity Project
- input loan scheme for those who are working in civil service and private companies
- Tractor hire scheme
- Chinese Vegetable Production Program
- JICA-Lobi vegetable program
- Horticulture and Food Crops Development Project (ADB funded)
- GTZ-assisted Horticulture Development of Malawi (HODOM) program

All these programs rely on the application of appropriate and improved agricultural technologies generated by the Department of Agricultural Research and Technical Services. However, the unlike the initiatives for maize production, vegetables have not gained much impetus.

The need to diversify agricultural production to other crops such as vegetables is recognized as a crucial issue in the development strategy of our country. Therefore I want to express my sincere pleasure and appreciation to preside over this function, which is being attended by officers from my Ministry and also officers from the Ministry of Health.
and Population, the University of Malawi, the University of Mzuzu and nongovernmental organizations.

It is gratifying to note that AVRDC-World Vegetable Center, Regional Center for Africa, has provided some funds to sponsor the attendance of many participants. I would like to thank you, Dr. Chadha, for considering Malawi for the workshop. It is not easy these days with donor fatigue to get funds for such training. I must say that some of the funds for the workshop also have come from my Ministry. It is also gratifying to note that most of the resource persons are Malawi nationals. This emphasizes the importance of sustainable vegetable production in the country.

I am glad that AVRDC has recognized the importance of vegetable research and development in our country. We do hope that after the workshop, with the knowledge gained and the action plans developed, vegetable research and development will be improved to answer the needs of the farmers, particularly in vegetable crop management.

The vegetable research program at the moment mostly emphasizes the introduction of exotic lines and conducts screening and agronomic studies. To obtain the benefits of improved varieties introduced to different agroecological zones, there is a need to provide adequate inputs such as organic and inorganic fertilizers, pesticides, water and good quality seeds. At the moment, little research is done on postharvest processing.

All of us gathered here are faced with considerable challenges in crop production:

- The first challenge is that our population is growing at a very fast rate. It is estimated that by the year 2020 there will be about 18 million people in Malawi. All these people will need to be fed with food produced from the same land resource base that we have today. Yet, we are facing tremendous problems of land and environmental degradation, including a decline in soil fertility. Compared to other crops, vegetables do not require as much land, and can significantly improve household incomes and nutrition.

- The second challenge is the HIV/AIDS epidemic. This epidemic is affecting the demographic dynamics of our population. In the rural farming communities that are the beneficiaries of our research technologies, it is now a common sight to see a large number of households headed by women, children or aged grandparents. Technologies in vegetable production must be developed to assist these vulnerable groups.

- The third challenge concerns globalization. Malawi has liberalized its economy; therefore, it must compete and survive in the harsh and competitive global environment. Presently, an influx of agricultural produce is entering Malawi from other countries. Most of these products can be produced locally, such as poultry, milk products, meat products and horticultural products such as fruits and vegetables, particularly tomatoes, onions, cabbage, beans and potatoes. I challenge our scientists to do more to reverse this trend and ensure Malawi is able to compete efficiently in regional and global markets.

Dr. C.J. Matabwa  
Permanent Secretary  
Ministry of Agriculture, Irrigation and Food Security
Introduction

This paper is intended to highlight pertinent issues that could stimulate discussion, not only at this forum, but also at other fora concerned with vegetable research and production. The key notes discussed will focus on information; policy; conservation and use of indigenous vegetables; indigenous knowledge; and promotion of vegetable production. The list of key notes is by no means exhaustive. Other important issues will be covered by other presentations during this workshop.

National horticultural policy

The Government of Malawi recognizes the importance of vegetables for human nutrition. The Guide to Agricultural Production (1995-96) stipulates that the national aim for vegetable production is to increase the vegetable supply to meet domestic demand and export any surplus.

The development of the National Horticultural Strategic Plan is a commendable action on the part of the government and the horticulture industry. The strategic plan contains action plans for all horticultural commodities, including vegetables. It addresses major issues, including extension, research, marketing, agroprocessing and many others.

Despite the existence of the plan, there is no bona fide national horticultural policy to back it up. Currently, horticultural production in Malawi appears to be guided by other policies in the Agricultural Sector, such as the Crop Diversification Policy, the amended Seed Act, the Irrigation Policy, etc. Whether horticulture, including vegetable production, is being promoted adequately under these policies is subject to evaluation and discussion.

Vegetable research and development policy

The vegetable research and development policy is highlighted in the Agricultural Research Master Plan (1995). Vegetable research ranks high on the priority list of commodities, not only within the Horticultural Commodity Research Group, but also nationally. Research in vegetables is geared to overcome the following technical constraints:

- limited availability of high yielding, adaptable, post and disease resistant varieties
- high incidence of pests and diseases
- poor soil fertility and cultural practices
- limited sources of high quality seeds
- heavy post-harvest losses

Considerable progress has been made in testing and releasing improved vegetable varieties, and disease control regimes. However, much still needs to be done to supply high-quality seeds and stem postharvest losses.
Limited information on vegetable production and marketing in Malawi

The National Crop Estimates (NCE) has done a commendable job in providing production data for a variety of crops in Malawi. However, the NCE falls short when it comes to reporting on vegetable production. Currently, only Irish potato is considered (MAIFS 2003). Yet, the vegetable list includes cabbage, tomatoes, onions, garlic, leafy vegetables, okra, carrot, eggplant, lettuce, cucumber and many others, including indigenous vegetables (DAR 1995; MOA 1996). Marketing information is also scant. To develop the vegetable sector in Malawi, timely and accurate information is vital.

Conservation and use of indigenous vegetable germplasm

It has been stated that the Malawian is a vegetarian by default, due to the nation's low per capita intake of animal products. Indigenous vegetables constitute a significant portion of the Malawian diet. Research data indicate that indigenous vegetables are more nutritious than exotic vegetables. The Malawi National Genetic Resources Conservation Center, based at the Chitedze Agricultural Research Station, has collected more than 2,500 germplasm samples, of which 46 are samples from 17 species of indigenous vegetables. Scientists at Bunda College of Agriculture have evaluated several species of indigenous vegetables up to the production stage. Currently, AVRDC is coordinating a regional research program involving indigenous vegetables. All these efforts are commendable and must be encouraged. It is important that indigenous vegetables find their way into crop improvement programs so that we can encourage their production and consumption. Indigenous vegetables can help improve food security, incomes, and diets, especially for resource-poor Malawians.

Applying research and promoting best practices

Much useful research in vegetables has been undertaken in Malawi over the past years. Such work should be reviewed, and successful innovations identified and promoted in selected areas. Indeed, recognition must be given to vegetable production schemes that have registered notable impact, such as the Ngolowindo Scheme in Salima. Such efforts must be expanded to cover the entire country, using a variety of “best practice” packages suited to different localities.

Indigenous knowledge in vegetable processing and presentation

Postharvest handling and agroprocessing are vital components in the development of the horticultural industry in Malawi. This is amply highlighted in the National Horticultural Strategic Plan. Often, agroprocessing is viewed in reference to sophisticated processes like canning, or juice extraction using machines. However, there is a wealth of valuable indigenous knowledge in vegetable processing and presentation. For example, the technique of making of mfutso with indigenous vegetables and mushrooms appears to have been ignored. Indigenous knowledge needs to be harnessed, evaluated and promoted.

Conclusion

These key points -- policy, information, conservation and use of indigenous vegetables, indigenous knowledge and use of best practices -- are meant to stimulate discussion which, in turn, may stimulate development of the vegetable industry in Malawi.
References


The role of the Department of Agricultural Research Services in vegetable research and development in Malawi

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Abstract

Agricultural research in the Department of Agricultural Research Services is divided into seven Commodity Groups, one of which is the Horticulture Commodity Group. The group has several commodity teams, including the Vegetable Commodity Team. Serious research in vegetable production and development started in the late 1960s and early 1970s at Bvumbwe Agricultural Research Station in Southern Malawi. Both government and donors have funded research in vegetables. Research is conducted over three seasons on-station and on-farm, in rainfed conditions and under irrigation. Promising varieties are then tested on-farm for another 2 to 3 seasons before they are officially released for commercial production through the Agricultural Technology Clearing Committee (ATCC) of the Ministry of Agriculture, Irrigation and Food Security. Bunda College of Agriculture is responsible for indigenous vegetable research and promising indigenous varieties are released for production through the ATCC. Cabbage, tomato, Brussels sprouts, Chinese cabbage, celery, carrots, eggplant, okra, and asparagus varieties have been released to farmers. The research program has concentrated on variety screening, plant populations, spacing, pests and pathogens, fertilizer use, heat tolerance and storage. No work has been done in breeding new vegetable varieties. Little research has been conducted on processing to add value and improve storability. Producing seed is a big challenge for the Department because the country relies on imported seed. The Asian Vegetable Research and Development Center has assisted the Department in providing vegetable seed for research and training for most of the scientists and technicians. The Chinese Agricultural Mission also has assisted the Research Department to produce seed of selected vegetables and develop vegetable production technology. The JICA project complemented our research efforts by releasing some vegetable production technologies to farmers with limited resources. The FAO project helped the Department understand the need for vegetable seed production. This paper highlights the Agricultural Research Department’s current status, achievements, challenges and future areas of research.

Introduction

Malawi, in southeast Africa, has a typical sub-Saharan climate, with one major rainfall season between October and March and a dry season from April to October. The country’s weather varies from hot and dry to moist and cool, depending on the elevation. Lake Malawi is part of the Great Rift Valley floor. The lake supports tourism, a fishing and aquarium industry, and provides fresh water for industrial and agricultural use.

Malawi’s population is around 11 million and the average growth rate is 2.3%. The nation is struggling to provide the necessary hospitals, schools, food, infrastructure and water to improve the standard of living and achieve economic growth. Currently, Malawi is one of the least developed countries in the world; nearly 70% of the population lives on less than 1 US $ per day.
Due to the diverse nature of the climate, Malawi is able to grow a variety of horticultural crops including vegetables. In areas such as Dedza, Ntcheu, Chiradzulu, parts of Dowa, Mzimba and and Nkhata-Bay highlands, vegetables are greatly valued for their nutritional properties and for the income they can bring to farmers.

There are two distinct types of vegetable producers in Malawi: smallholders and commercial horticultural farms. In both cases, production is intensive. Smallholders have between 1 to 4 hectares per farmer and sell their produce mostly to local markets. Commercial farmers have much larger holdings and their production is mostly sold for export. The export trade has been unsuccessful due to high transportation costs, which have caused several commercial farms to close.

There is little organized marketing of horticultural products, especially vegetables. Earlier efforts to establish smallholder vegetable growers’ associations to streamline the marketing process have been unsuccessful. A GTZ-sponsored project attempted to develop marketing associations in major vegetable growing areas, but the results were disappointing. Market buildings were constructed at Njolomole area in Ntcheu district and elsewhere, but farmers did not use the structures. Individuals still sell vegetables at roadside along the M1 Road. Marketing studies have revealed that roadside sellers are not actual producers. The farmers sell their produce at the farm gate to first-level middlemen, who then sell to second-level middlemen. These second-level middlemen sell the produce at roadside to buyers from towns, mostly Lilongwe and Blantyre, and to a lesser extent Mzuzu. The buyers (third-level middlemen) transport their purchases to the major cities, where the fourth level of middlemen purchase the produce at wholesale prices and finally sell it to consumers. So, there are at least four levels of middlemen before the vegetables reach the consumer. The final purchasers include hospitals, schools, colleges, prisons, homes, military units and hotels. Vegetable prices are high due to the long chain of middlemen.

During the winter and summer various vegetables are produced in large quantities. Malawi agricultural production estimates do not provide or attempt to collect data to estimate production in the country. It is important to estimate production levels of various vegetables to determine the economic contribution of vegetables to Malawi’s economy.

Andrew Spurling, a horticulturist at Bvumbwe Research Station, was a pioneer of vegetable research in Malawi in the 1970s. Since the 1970s efforts to intensify vegetable research have continued. Bunda College of Agriculture concentrates on indigenous vegetables and the Department of Agricultural Research focuses on exotic vegetables. In the early 1990s a FAO Technical Cooperation Partnership (TCP) was instituted and was based at Bvumbwe Research. Its objective was to identify vegetable varieties and cultivars that could flower without very low chill requirements. Other organizations such as Chinese Agricultural Mission and Asia Vegetable Research and Development Center have contributed to vegetable research and development in Malawi by providing vegetable seed, training, literature, and the financing for research experiments. The Japanese International Cooperation Agency (JICA) and the Crop Production Department recently started a vegetable improvement project to test new production technologies (such as protected production) and introduce them to farmers.
Implementation of vegetable research

The Department of Agricultural Research Services (DARS) has three major research stations, one in each region, and some trial sites located throughout the country. The center for horticultural research including vegetable research is at Bvumbwe Agricultural Research Station. All the planning, design and initial implementation of vegetable research is conducted at Bvumbwe Research Station. Currently the Department has two full-time scientists and one part-time scientist working on vegetable research. There are about six experienced diploma-level technicians assisting the researchers.

Work on vegetable research follows statistical designs according to basic principles of experimental design and analysis. The Department’s Biometric Unit assists in developing experiments to fit the type of research being pursued. Through mean separations, scientists have identified the lines of indigenous and exotic vegetables that performing well. The high performing cultivars are recommended for use by farmers and other stakeholders.

Vegetable research is conducted during summer rains and in winter under irrigation. The Department uses Kasinthula Research Station for most of its irrigation research. At Kasinthula, various vegetable cultivars are handed over to irrigation agronomists, who study the vegetables’ heat tolerance under different water regimes and supply systems. The agronomists research how planting times, fertilizer regimes and water amounts affect vegetable productivity.

As no actual breeding is done in the country, research work concentrates on screening available varieties (DARS 1998). The varieties are tested for plant population, spacing, fertilizer rates, days to maturity, harvesting intervals, pesticide tolerance, processing qualities, storage, heat tolerance and whether or not people will consume and buy them.

Research is conducted for three seasons on-station and on-farm. When data has been collected and analyzed, promising technologies are approved for use in Malawi. At annual planning meetings in July, August and September, researchers identify promising technologies, present results and decide which technologies are most useful. Superior technologies are recommended for release through the agricultural technology cleaning committee (ATCC) of the Ministry of Agriculture, Irrigation and Food Security (MOAIFS).

Achievements of vegetable research in Malawi

Previous research done in the 1970s produced specific recommendations for fertilizer rates, irrigation regimes, time of planting and plant populations, and pesticide formulations for specific varieties. However, over time these varieties have fallen behind in yield, and pest and disease resistance. Recent research has produced new superior tomato varieties (such as Romitel, Rodade and Mbambande). Some high-yielding varieties of onions, cabbages and sweet corn have been released. Scientists based at Bvumbwe Research have worked tirelessly to identify these new varieties. Bunga College identified, characterized, and popularized a few indigenous vegetables. The Kwenengwe Horticultural Farm was a direct output of research and development work conducted at Bvumbwe Research.

During the 1970s a canning factory for tomato and some fruits was established in Mulanje district. This factory has closed. A local company (Nali) produces tomato sauce. This factory uses tomatoes approved for production by the Bvumbwe Research Station. Research results from Bvumbwe enabled smallholder farmers and other stakeholders to
expand vegetable production, making produce available for local industries and direct sales by farmers.

Through technical cooperation with donor partners, the country now has a good pool of scientists and technicians knowledgeable about vegetable production. The Chinese Agricultural Mission of the Republic of China Taiwan, the Japanese government through JICA, the Malawi- Germany plant protection project (MGPPP), and the USAID-funded project have helped to build Malawi’s human capacity for vegetable production. Malawian students have been attached to the vegetable research program for their Bachelor’s and Master’s degrees. Training in vegetable production methods has been conducted for farmers. Extension circulars, handbooks on pest control, and leaflets and posters about vegetable production have been produced and circulated among all stakeholders in the country. Occasionally, research scientists have given lectures to students at various institutions, including the universities of Malawi and Mzuzu. Policies have been developed and advice given to policymakers regarding vegetable production.

Challenges to vegetables research in Malawi

Vegetable research is constrained by limited financial resources. Government funds and donor contributions are declining. Extra effort should be made by vegetable scientists in universities and government to sustain the research and development activities at the present level. It is unlikely that extra personnel will be made available in the near future. Therefore, we must maintain and develop the existing pool of scientists. Expertise in vegetable research can be achieved through short- and long-term training at institutions of higher learning. Financing advanced education remains a hurdle.

The lack of good quality seeds further hampers vegetable production in Malawi. No breeding is done in the country, so farmers depend on imported seed. It is important for Malawi to begin seed production, multiplication and distribution. Furthermore, no one has conducted research on the longevity of various vegetable seeds under normal temperatures in the country.

There is no ongoing research on vegetable irrigation practices. A concerted effort in irrigation research must begin soon. At present there are only two irrigation agronomists with a lot of research assignments. This trend has to be reversed.

Market research on vegetables is scarce in Malawi. Good market research will reveal the true economic importance and value of vegetables to farmers and the economy. This work should also include investigations into the contributions made by middlemen and women.

Finally, our scientific capacity for vegetable research is small in terms of the number of scientists fully devoted to the task. If we can increase the number of scientists dedicated to vegetable research some of the challenges highlighted earlier might be mitigated. Training in vegetable research, production, and marketing should be imparted to all stakeholders, including farmers, extension staff, middlemen and women, and transporters.

Future research activities in vegetables

The following areas need special attention if vegetable production is to increase:

- breeding for higher yields, pest and disease resistance/tolerance and heat tolerance
• postharvest processing research
• introduction and testing of new varieties
• further research on fertilizer and agronomy for new varieties
• environmentally friendly pesticides to control pests and disease
• surveys of indigenous knowledge on pest and disease control
• research on vegetable seed production
• development of recipes using vegetables
• compilation of a booklet on all vegetable varieties released or officially known and grown in Malawi

Government funding alone cannot solve these problems. We need donor assistance for research expertise, training, vehicles, and computers.

Summary and conclusion

Although vegetable production has increased, no deliberate effort of initiating a vegetable breeding program has been developed. Capacity building in vegetable science remains weak despite earlier efforts. The number of scientists working on vegetables is still low compared to other crops. Therefore, there is a need to increase both human and financial resources for vegetable research. Stakeholders in vegetable production will still need donor financing if the Department is to bridge the gap in terms of technology development.

Seed production and irrigation technologies stand out as immediate research needs. Socio-economic research, including marketing research, should be instituted in the near future.

Vegetable research should take a multidisciplinary approach to address most of the production and marketing constraints identified. Vegetable production tends to have an economic advantage in that vegetables can be raised where field crops such as maize cannot easily grow. The development of vegetable recipes has been neglected, but should be addressed to help build market demand.

References

The status of the vegetable industry in Malawi: current and future prospects

C. Mwandira

Abstract

Malawi's economy depends mainly on agriculture, which generates 90% of the country's foreign exchange earnings, 70% of which come from tobacco alone. However, recent developments in the tobacco industry indicate that Malawi can no longer rely on tobacco as a sole source of foreign exchange. The recent development of a government strategy to diversify into high-value crops to achieve food self-sufficiency, and increase household incomes and foreign exchange earnings has created an opportunity for horticultural crops. Although horticulture has been neglected in the past in favor of field crops such as maize, substantial increases in production could contribute towards the country's goals of improving national and household food security, raising incomes of the farming community, increasing foreign exchange earnings from horticultural exports and realizing savings from import substitution. Despite the obvious potential, the sector remains small and unexploited due to a lack of essential support services such as credit, research, extension and agroprocessing. Disorganized production and marketing are major features of the sector.

Smallholders contribute in excess of 80% of the total horticultural production, mainly exotic and indigenous leafy vegetables. Production is low, scattered, and highly seasonal, with most taking place in winter. Mostly high-volume, low-value vegetables such as cabbage, tomatoes, leafy vegetables, and onions are produced; low-volume, high-value vegetables are also produced, but in very small amounts. Although vegetable production is practiced virtually everywhere, notable production areas include Dedza, Ntcheu, Mulanje, Thyolo and Mzimba. Production potential is high in Rumphi, Ntchisi, Dowa, Mchinji, Zomba and Mwanza. Vegetable export development potential exists in Kasungu, Lilongwe and Blantyre due to their proximity to international airports (Chongwe 2001).

Despite the numerous opportunities and potential for increased production and marketing, vegetable production in Malawi faces a number of challenges, which, if unresolved, will continue to suppress the sector's performance. This paper presents a picture of the past and present state of horticultural production, with an emphasis on vegetable production in Malawi. In view of the numerous challenges identified in the paper, some solutions are suggested for sector stakeholders.

Introduction

Malawi's economy depends mainly on agriculture, which generates 90% of the foreign exchange earnings, 70% of which comes from tobacco and the rest from tea, cotton and sugarcane. As a source of income, agriculture accounts for 63.7% of total income of the rural poor. It also supports over 87% of the country's labor force, contributes approximately 35% of the GDP, and supplies more than 65% of the manufacturing sector's raw materials. (MoAI 1999). Agriculture is the driving force behind the country’s socio-economic development.

A few field crops, especially maize and tobacco, have dominated Malawi's agriculture. However, in recent years, it has been recognized that per capita maize productivity is
decreasing due to high input costs and unfavorable weather conditions. The future of tobacco as a major export earner is also facing increasing challenges from the anti-smoking lobby, while adverse weather conditions experienced in recent years have further aggravated the situation. These challenges have shaken the country’s food and economic foundations and significantly contributed to food insecurity and poverty.

Although tobacco will continue to be the country’s main foreign exchange earner for some years to come, it is clear the country can no longer neglect alternative crops. The recent development of a government strategy to diversify to high-value crops to achieve food self-sufficiency and increase household incomes and foreign exchange earnings has brought an opportunity for horticultural crops. Horticulture is an important but much-neglected subsector of Malawian agriculture. Horticultural crops can complement tobacco and maize grown by smallholders and large estates. Despite a lack of reliable or complete data on the production volumes of most horticultural crops grown in Malawi, it is evident that within horticulture, vegetable production is by far the most widely practiced when compared to fruit, spice, herb, mushroom and flower production.

Substantial increases in horticultural production would contribute toward the country’s goals of improving national and household food security, raising farmer incomes, increasing foreign exchange earnings from horticultural exports and realizing savings from import substitution.

The horticultural sector has the potential to fetch considerably higher foreign exchange earnings compared to traditional cash crops. Improving the production of high-value horticultural crops would boost export revenues and reduce risks from the country’s heavy reliance on tobacco, tea and sugar. In addition to economic competitiveness, horticultural crops also offer other opportunities that make them more attractive than traditional cash crops. Traditionally, the rural areas have been bound to subsistence farming aimed at food security. However, after liberalizing the economy, more emphasis will be put on market-oriented production. Horticultural crops have the potential to generate increased income in the rural areas. Increased income will allow farmers to have access to inputs (fertilizers and chemicals) as well as food. The result will be improved outputs, increased profitability and increased food security.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Gross margin (MK)</th>
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<tr>
<td></td>
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<tr>
<td>Burley tobacco</td>
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<td>Cauliflower</td>
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</table>

Mechanisms for Privatization of Treadle Pumps (1999)
Table 1 shows gross margins for selected horticultural crops under treadle pump irrigation on one hectare of land, compared to burley tobacco, in which many smallholder farmers have been engaged in raising during the past 20 years as a sole cash crop.

**Vision and strategies on vegetable production**

**Vision**

By the year 2010 Malawi shall have sustainable, year-round market oriented production of a diverse range of high quality organically and conventionally grown vegetables to improve nutrition and food security, facilitate processing, generate employment, increase incomes, and earn foreign exchange through exports (APRU 1999).

**Strategies**

Strategies to accomplish this vision include:

- Development or introduction of better cultivars
- Initiation of seed production programs for indigenous and exotic vegetables
- Encouraging local partnerships with foreign companies
- Supporting small-scale seed production and marketing businesses
- Development of traditional technologies
- Improving methods of production through mechanization
- Researching simple equipment that is easy to use and maintain
- Developing postharvest handling technologies
- Intensifying the training of extension workers and producers in the production of high quality vegetables
- Developing capacity for small-scale producers for improved production and marketing
- Increasing manpower for horticultural extension, research and marketing of vegetables
- Creating public awareness on the importance and preparation of vegetables for nutrition
- Promotion of protected production in the rainy season
- Promoting small-scale irrigation and wetland drainage
- Introduction of other technologies for off-season production
- Promotion of low cost organic production
- Integration of vegetable production in other farming systems
- Promotion of Integrated Pest Management (IPM) in vegetable production
- Promotion of low cost technologies
**Actions to be undertaken for vegetable production**

Some of the action plans include:

- Develop strategies for potential vegetable areas in terms of production, marketing, availability of inputs and transport
- Demarcate horticultural zones based on climatic requirements for production of a wide range of vegetables e.g. rainfall, temperature, availability of underground aquifers, etc.
- Select crop cultivars suitable for each zone
- In liaison with the Department of Irrigation, promote simple and advanced irrigation technologies, such as gravity-fed systems, treadle pumps, drip irrigation, etc.
- Develop water harvesting techniques
- Design relevant rotation systems
- Research in biopesticides such as neem, garlic, aromatic plants, pyrethrum, etc.
- Promote production and use of organic fertilizers from hoofs, claws and horns, bones, blood, compost, mulch and animal manure
- Promote use of light media for vegetable nurseries e.g. sawdust, pine bark, etc.
- Promote use of proper land husbandry practices
- Develop an effective IPM in vegetable production
- Promote the selection and development of new and improved cultivars through research
- Initiate seed production programs for indigenous and exotic vegetables

**Existing opportunities for increased production**

Despite the numerous challenges facing horticulture, and in particular vegetable production, opportunities for increased production exist, such as:

- Abundant and relatively cheaper labor than neighboring competing countries
- Various agroecological zones with suitable weather for a range of crops
- Availability of local demand due to the growing population (demand growth rate in neighboring countries is 10% per annum)
- Availability of export market potential
- Existence of a number of bilateral and multilateral trade agreements
- Conducive government’s policy on imported horticultural inputs (duty free)
- Government’s recognition of horticultural crops as a thrust for diversification
- Positive support from all stakeholders
- Economic competitiveness of horticultural crops

Main features of the Malawi horticultural sector

The horticultural sector in Malawi is small and the potential for horticultural production and marketing still remains unexploited due to several factors outlined later in this report. Disorganised production and marketing are major features of the sector. Essential support services needed to develop the sector are inadequate. Therefore, although horticulture is currently among the fastest growing sectors in most sub-Saharan African countries, in Malawi, the volume of horticultural production is very low and does not exceed 5% of the total agricultural output. Much of this horticultural output comes from smallholder production under subsistence conditions.

Farming characteristics

Malawi has a dual horticultural sector characterized by the estate or commercial subsector and the smallholder or subsistence subsector. The smallholder subsector has been the major producer of food crops, especially maize, but it is also responsible for producing most of the horticultural crops, estimated to be in excess of 80% of all horticultural crops in the country, comprising mainly exotic and indigenous leafy vegetables. In addition to this, fruits like mango, guava, avocado and others are also produced. Smallholder horticultural land is less than 0.1 hectare per household and usually located along riverbeds and dambos (seasonal flood plains). Where dambo land can be used, many smallholder farmers intensively grow vegetables for sale during the dry season. The production period is limited to the time between the receding of floods and the time when the water table drops below the level reached by the shallow wells. In the Shire Valley, marshland and river banks also are used to produce winter vegetables.

In the rainy season, there is competition for labor between staple and horticultural crops. Pests and disease pressure and wet floodplains make production difficult without proper tools. There are a few irrigation schemes in operation during dry periods to ensure continuity of supply. Due to a lack of technical know-how and capital for investment in protected cultivation, out-of-season production is heavily compromised, with only a handful of farmers involved. Therefore, vegetable production in Malawi is highly seasonal in nature, resulting in peak demand in the rainy season when the supply is lowest.

Main areas of vegetable production

The varied relief in the country allows for the production of various horticultural crops throughout the country. Production is low, scattered, and highly seasonal, with most of it taking place in winter due to the prevalence of supportive weather, reduced field crop activities and reduced disease and pest populations. Although vegetable production is practiced virtually everywhere, notable production areas include Dedza, Ntcheu, Mulanje, Thyolo and Mzimba. Production potential is high in Rumphi, Ntchisi, Dowa, Mchinji, Zomba and Mwanza. Vegetable export development potential exists in Kasungu, Lilongwe and Blantyre due to their proximity to international airports (Chongwe 2001).
**Main characteristics of vegetable production**

A number of factors influence vegetable production in Malawi. To ensure a continuous supply of a range of vegetables, the aim should be to produce under both rainfed conditions and irrigation. The resurgence of upland and rainfed production of tomatoes, cabbage and other horticultural crops is a recently introduced cropping system that relies on proper selection of crops and timing of production to ensure crops mature within the rainy season. The following characteristics are typical of vegetable production in Malawi:

- Few growers grow low volume high value vegetables such as broccoli, cauliflower, asparagus, carrots, green beans, sugar peas and garlic due to existing low domestic market demand.
- The availability of vegetables fluctuates due to seasonal characteristics.
- Marketing problems are experienced in periods of abundant production, but high prices are obtained in periods of low production.
- Knowledge of production techniques is lacking, hence development of crop diversification and out-of-season cropping is slow.
- Inputs such as fertilizers, seed and pesticides are often inadequate, difficult to access and expensive.
- Credit facilities are almost nonexistent in this sector.
- Farmers face enormous marketing problems because they are disorganized, not mobile enough and rely mainly on vendors to buy from their farms.
- The majority of farmers work strictly as individuals; there are few cooperatives.
- A few commercial vegetable growers are emerging and supplying the top shops and catering companies in the cities.
- At present, no formal export of vegetables exists, although there is some informal cross-border trade with neighboring countries. No data is available to substantiate this activity.
- Tomatoes, onions, Irish potatoes and garlic are imported mainly from South Africa and to a lesser extent, Tanzania.
- Irrigation in vegetable gardens is usually by a watering can or bucket from shallow wells, while pesticide application, if any, is very often done incorrectly.

**Marketing of vegetables**

Production of all horticultural crops in Malawi depends on the establishment of a proper marketing system. To promote horticultural production, marketing improvements should be considered simultaneously with improvements in production. Several agricultural projects have in the past emphasized increasing production without regard to marketing
aspects; often, the results have been disastrous. The marketing aspect, particularly for horticultural produce with a characteristically short shelf life, is even more critical than for field crops.

The major constraints in marketing are:

- lack of organized markets
- poor rural road network
- lack of market information
- lack of storage infrastructure
- low and seasonal production
- lack of quality awareness

The domestic market is the most important one for the majority of producers in the country; it can be divided into formal and informal markets. The formal market includes supermarkets, hotels and institutions, while the informal market includes roadside markets, street vendors, city and assembly markets. The bulk of horticultural marketing takes place in the informal market sector and is characterized by poor quality produce, lack of grading, and little or no packaging. It is dominated by vendor marketing groups.

Although domestic trading in horticultural crops takes place throughout the country, the market is relatively small, focusing on urban centers of Blantyre, Zomba, Lilongwe Mzuzu and other smaller ones. Not only is the market size small, but it is also inefficient and unreliable. Infrastructure is generally poor.

**Demand for vegetables**

No studies have been conducted to ascertain national demand for vegetables. However, the local demand for horticultural crops is projected at 15,000 tonnes of assorted horticultural crops per year for the urban population of roughly 1,500,000 inhabitants (Chongwe 2001). This include oranges, mangoes, bananas, tangerines, avocado pears, water melons, cabbage, beans, lettuce, rape, mustard, onion, Irish potato, indigenous vegetables and other vegetable and fruit products. Based on this study, it can be projected that the national population of 10,000,000 would consume approximately 90,000 to 100,000 tonnes per year.

A survey on urban residents’ consumption and purchasing habits conducted in 2001 by People and Resources Consulting Services revealed that the most commonly bought vegetable is mustard (35%), followed by rape (31%), tomato (13%), Chinese cabbage (8%), pumpkin leaves (7%), and cabbage (6%). Because of the low purchasing power of Malawians, cheap vegetables are preferred, while quality remains a secondary issue. Despite this, quality products still have a market with the middle and upper classes as well as foreign communities living in the cities.
Status of horticulture with an emphasis on vegetable production

Status of the vegetable sector in 1998

In 1998, a study was conducted to assess the status of horticulture in Malawi. Several constraints were identified in three major areas: production, marketing and support institutions.

Production constraints

- Low yields and low quality products due to nonreplenishment of soil nutrients
- Inadequate agronomic and production knowledge
- Smallholders work alone and do not organize into larger cooperatives
- Seasonality in production due to reliance on rainfed production, underexploitation of the irrigation potential, diseases and pests during the rainy season, and inadequate moisture during the dry season
- No production, multiplication, and distribution system of horticultural seeds and other planting materials, hence a scarcity of good quality seed and planting materials
- Little or no technical knowledge and training offered to farmers and extension staff on production technologies
- Inadequate availability of inputs such as fertilizer, pesticides and farm machinery
- Inappropriate input packages especially for fertilizer

Marketing constraints

- Unorganized marketing system
- Poor roads, cooling facilities, appropriate transport, processing and storage facilities
- Low prices offered due to poor quality products
- Lack of market information due to limited training on marketing offered to farmers and extension staff
- Entrepreneurs lack business skills
Support institution constraints

- Limited government and private sector support for production, marketing and processing
- Absence of clear policy and strategy on horticulture
- Inadequately trained staff lack special skills in horticultural research and extension
- Limited and in some cases lack of access to financial credit by entrepreneurs in the horticulture sector
- Ineffective and inefficiently managed farmer associations due to poor leadership and management skills of executive members
- Insufficient extension services
- High interest rates

Following the 1998 study, a stakeholders' workshop was organized to map the way forward in the horticulture sector. A detailed strategy paper was written for implementation by the Ministry of Agriculture and Irrigation and other stakeholders in the sector. It is by far the most comprehensive strategy document for the entire sector with clear visions, strategies and actions for all commodities as well as the support services required to achieve progress.

Status of the vegetable sector in 2003

Following a recent study on the status of the horticulture sector conducted in 2003, the following issues have emerged:

Introduction of improved technologies

The period between 1998 and 2003 witnessed the introduction and adoption of several technologies. Such technologies have resulted in increased yields and production, increased availability of horticultural commodities and in some cases reduced incidence of pests and diseases. The following are examples:

- Protected cultivation in greenhouses
- Rainfed upland tomato production
- Improved fruit and vegetable varieties
- Use of various forms of irrigation and farm machinery

Despite these developments, a number of issues arising from the introduction and adoption of these technologies must be addressed, such as scarcity and cost of greenhouse materials, lack of reliable supply sources for improved seeds and spare parts for irrigation and mechanization machinery. Since all of these technologies are imported, the devaluation of the Malawi Kwacha, coupled with a scarcity of foreign exchange, cause concern among producers who have adopted such technologies.
Increased levels of production

Production statistics for most of the horticultural crops are difficult to come by because of scanty information on production data. The Ministry of Agriculture and Irrigation conducts annual assessments on the production of different crops from both the estate and smallholder subsectors. Some of the horticulture crops are included in this exercise and the general trend over the years shows there has been an increase in production of most of the horticultural crops. There are increasing numbers of horticultural farmers, increased area under cultivation and an increase in the production of “exotic vegetables” such as broccoli, cauliflower, green beans and green pepper.

Training and extension services

Efforts have been made in recent years to train farmers in various aspects of horticulture. Through the GTZ-PH Project, some farmers have been taken for education tours/visits outside the country (Zimbabwe, South Africa and Kenya).

The Horticulture Development Organisation of Malawi (HODOM) also has developed a training program for extension staff and horticulture farmers. Training modules have been developed and more than 400 farmers already have received instruction on various topics. The MoAIFS has also provided refresher courses to its field extension staff.

To formalize and standardize horticultural training in Malawi, HODOM has initiated the formation of an advisory committee on horticultural training in collaboration with the national training authority (TEVETA). This committee will be responsible for the formulation of training standards in the sector. The training itself will be competence-based and will focus on the skills required in the sector.

To strengthen extension and training services, 10 subject matter specialists have been trained through the GTZ-PH Project in commercial nursery management, establishment of orchards, budding and grafting technologies, general nursery management and entrepreneurship skills.

In addition to training, the horticulture sector also has witnessed the launch of a quarterly magazine called *Horticulture in Malawi*. Initially published by the GTZ-PH project, it was later taken up by HODOM. The magazine serves as a channel for communication on developments that are taking place in the horticulture sector, as an awareness tool of what is happening elsewhere (outside Malawi), and as a marketing tool for various horticultural products, including inputs. The magazine enjoys wide readership among producers and other interested parties. In addition to this, HODOM has produced newsletters that discuss topical issues such as prices of various horticultural commodities.

Marketing

The marketing side of the horticulture sector still faces enormous constraints, although there are a few individual entrepreneurs who have been able to find new markets. For example, in 1998, almost all of the fresh produce sold in supermarkets such as Shoprite, Seven-Eleven, Foodworths and other shops was imported, now, more locally produced fresh products, especially vegetables, have found their way into these supermarkets.

Shops selling only horticultural products are another notable development. These shops sell fresh and/or processed products, and horticultural inputs such as seed, pesticides
and some farm tools/implements. Examples of such shops are: the Green Shop; Salem Fruit, Flower and Vegetable Shop; and Seed and Nursery Services in Mzuzu City.

The volume sold to supermarkets is steadily increasing, and presentation is fast improving. Improvements in quality and presentation of the products have enabled a few individuals to penetrate what was otherwise an exclusive import-oriented market. Despite such advances a lot more needs to be done, especially in the areas of infrastructure development and postharvest handling.

Support institutions

Since 1998, not much improvement has occurred with respect to support services such as extension services, provision of credit, roads and communication. However, one of the areas worthy of mention is the increasing interest and recognition that the sector has managed to attain. The government, through the Ministry of Agriculture, Irrigation and Food Security, recognizes the sector as one with high potential to complement the tobacco industry, which at the moment is the major sector of the economy in terms of foreign exchange earnings. The private sector, including NGOs, have also shown keen interest in horticulture; some NGOs have supported communities in establishing fruit orchards and vegetable gardens to contribute to food security, nutrition and increased household incomes of rural people. Some achievements that have occurred in the area of support services include:

Establishment of HODOM and other farmer organizations

The establishment of an umbrella body in the name of Horticulture Development Organisation of Malawi (HODOM) in the year 2000 was a turning point for the horticulture sector. The organization is facing serious problems in terms of financial support, but yet there seems to be increasing interest among individual farmers and associations to register under this umbrella body. Currently, HODOM has a total of 100 registered members, out of which 13 are associations, 4 are corporate, and the remainder registered as individuals. The establishment of HODOM should be considered to be one of the milestones in the sector because of the role the organization should play in the sector, which includes:

- Regulating activities in the industry by setting standards and ensuring that those standards are adhered to for Malawi's horticulture sector to be competitive in the region and globally
- Organizing training programs to link its members to other training institutions
- Regulating and coordinating research programs within the horticulture sector
- Lobbying with government and other stakeholders for a conducive environment within which the horticulture sector is to operate. For instance, lobbying for the removal of duties and taxes on horticultural inputs, lobbying for reduced interest rates or better lending conditions, also lobbying for removal of any tariff or non-tariff barriers.

So far, some of the achievements that HODOM has made include:

- Increased number of members at individual, club and association level
• Organizing and conducting training programs for its members in production, marketing and entrepreneurship

• Publishing *Horticulture* magazine, which is an extension tool for production technologies, market and marketing information, entrepreneurship and general information on horticulture, including the contribution of the sector to food security and nutrition

• Engaged consultants to carry out studies on marketing

• Conducting training on consultancy for a number of organizations for income generation

• Opened up credit facilities with INDEFUND for HODOM members

• Participated in two international trade fairs

• Visited neighboring countries on study tours

Financial services

Some financial institutions such as IndeFund have shown interest by giving out loans to some of the entrepreneurs in the horticulture sector. For instance, Freedom Farms and Maravi have benefited from the lending institutions. However, a few of those that have accessed the loans have not fared well because of high interest rates and charging of interest during the grace period before enterprises start producing for the market. The financial sector has supported the construction of cooling facilities for some entrepreneurs.

Research and phytosanitary services

The status survey of 2003 has revealed that research in horticulture has declined due to limited funding. For instance, most of the research activities at Bvumbwe Research station, which is the major research station for fruits and other horticulture commodities, are at a standstill due to a lack of funding. Some of the structures, e.g. mushroom houses, have collapsed. In addition to limited funding, a shortage of professional and technical staff has also crippled research activities in horticulture within the Ministry of Agriculture, Irrigation and Food Security.

Phytosanitary services are also a cause of concern within the horticulture sector. Malawi lacks a strong mechanism on the ground to perform activities such as quarantine and screening of materials that come into the country. The situation needs to be reversed to ensure planting materials and products are clean and healthy.

**Existing constraints based on the 2003 status study**

Despite the developments that have occurred in the sector during the past five years, several constraints still exist in the three areas of production, marketing and support institutions. Some of the major constraints identified through consultations with various stakeholders are as follows:
Production constraints

From the production side, the problem of low yields still exists; in most cases this is attributed to diseases and pests that attack high yielding vegetable and fruit varieties. Seasonality in production is still common due to poor planning and lack of irrigation technology.

Some farmers have complained of poor inputs supplied by the local dealers. For instance a number of complaints were raised about the poor germination for seed obtained from local suppliers. Plastic greenhouse sheeting has to be imported from South Africa and it is relatively expensive. There have been efforts by a local manufacturer to produce a similar material, but the quality is substandard compared to the imported sheet.

The low horticultural skill level of the labor force makes it difficult to properly manage newly introduced varieties, which require higher levels of management for better quality products. Production remains labor intensive, with limited use of labor-saving technologies.

Marketing constraints

Marketing is still a serious problem facing the horticulture sector. Major contributing factors include:

Lack of organized marketing in terms of wholesale and retail markets

Few smallholder farmers have organized groups to market their produce. As a result, the majority of smallholders are at the mercy of vendors when it is time to sell their produce. Vendors at city markets intimidate the smallholders. Incidents of vendors entering into cheap contractual agreements with producers such that the smallholder producers are obliged to sell all their produce to vendors at very low prices are common. The reality on the ground is that an informal but organized cartel of vendors prey on small-scale producers. Because of the long chain involved in marketing vegetables, the final consumer pays a higher price than necessary. Marketing channels involving up to five or six middlemen (vendors) were discovered in a study on the feasibility of wholesale marketing in Malawi in 2000.

Poor marketing infrastructure

Another problem confronting the horticulture market is that of poor infrastructure, such as roads, telecommunications, power supply and cooling facilities. Roads in rural areas are in poor condition and are sometimes impassable during the rainy season. Smallholder farmers often sell horticulture products in the open with no proper shelters to protect the products from the sun.

Poor processing and packaging

Processing and packaging of horticulture products needs considerable improvement. Attempts have been made in some areas to process horticultural products such as tomato sauce, banana wine, dried banana chips, mango pickles, etc. One aspect that requires attention is packaging and labeling; it is not proper to package locally processed products in containers used by other manufacturers who already are established in the industry. Quality and sanitary measures should be taken for processed products.
The way forward

As a way forward to improve and increase performance in the horticulture sector, the 2003 status of horticulture study suggested the following in each of the areas of production, marketing and support institutions:

**Production**

Targeted interventions

Horticulture requires some specialist skills and considerable investment to be competitive on world market. It is important to focus on commercially oriented, large-scale production, rather than concentrating on small-scale farming. To ensure that smallholder producers are not left out, they should be encouraged to operate in groups, such as HODOM. Alternatively, smallholder producers should be encouraged to participate in horticultural production through contractual arrangements with commercial farmers. Appropriate support in terms of financial, human and capital investment should then be directed towards identified entrepreneurs.

**Strengthening of support services**

Support services such as research, extension, agroprocessing and phytosanitary services need to be strengthened to support entrepreneurs in the sector. There is a need to direct financial and capital resources to these areas. Delivery should be demand-driven.

Another area that requires deliberate intervention in the horticulture sector is that of financial services. There is a need to inject into the sector considerable financial resources with better credit terms, such as lower interest rates and reasonable grace periods within which interest should be waived. Such interventions, either through government or donors, will be more meaningful if the sector earmarks the export market to take advantage of the stronger currencies on the world market.

**Marketing**

The area of marketing requires serious attention if the horticulture sector is to improve and contribute effectively to the economy of the country. The current system is unorganized, with no clear outlets for wholesale and retail markets. Distortions in the current marketing of horticultural products means prevailing prices do not reflect the real value of the services being rendered. Furthermore, marketing of most of the horticultural products in most markets seem to be controlled by ordinary street vendors organized into cartels that prevent producers from accessing lucrative markets. The vendors offer very low prices to smallholder producers and sell at high prices to the consumers. Involvement of middlemen and/or vendors is not bad as long as they deploy professional marketing ethics in their transactions with the smallholder farmers on one hand, and the consumer on the other. Formal wholesale and retail horticultural markets are part of the solution to this problem, but it would require government action to improve of some of the basic infrastructure such as roads, power supply and telecommunication.

Adding value in processing, packaging, grading and sorting is also very limited and this contributes to the price distortions in the marketing chain. Lack of value adding prevents the nation from realizing the real value of horticultural produce because the country
cannot penetrate export markets with inferior products. There is a need to invest in proper marketing infrastructure, which must include pack houses and refrigerated vans.

**Intrasectoral coordination**

Unlike other sectors such as tobacco, tea and coffee, which are among the lead sectors of the economy, the horticulture sector is unique in that it involves several commodities/products within the sector. Good coordination is required to maximize resource use and exploit the market potential that exists domestically, regionally and internationally. This requires the formation of commodity-based associations to develop specific crops.

Associations will be responsible for coordinating activities such as training, procurement of inputs, access to markets and establishing a well organized information system.

Associations would form the building blocks of the Horticultural Development Organisation of Malawi. As the apex body, HODOM would still perform the coordinating role, ensuring that the various commodity groupings perform their activities according to the norms and standards of the sector. HODOM should perform the following roles:

**Quality assurance code of conduct**

HODOM in collaboration with other players will have to set standards for the sector and ensure that such standards are adhered to. Thus, there must be a clear code of conduct for the sector, which will include issues of phytosanitary services, chemical registration, training and extension messages, and marketing ethics, including storage and handling, and monitoring of transport services.

**Intra- and extrasectoral coordination**

This would entail coordinating activities of various players within and outside the sector. In this regard, HODOM would ensure the activities of government, donors, NGOs, farmers and the private sector are coordinated well. HODOM should have the mandate to advise stakeholders in the sector (including government) on what is right for the sector and even guide government- or donor-funded horticulture projects.

**Management information system**

One of the critical success factors is an organized information system. HODOM should strive to build a comprehensive and easily accessible information system for the sector. This should encompass production, marketing, research and training, financial services and other information relevant to the sector. This task would be made easier through collation of information from the various commodity-specific groups.

These are challenging responsibilities for HODOM to assume. There is a need for capacity building in HODOM; support is required in the areas of finance, material (own office premises, office equipment, transport, etc.) and human resources. Seed money for the organization to invest in other ventures without contradicting or conflicting with its mandate, would help ensure its sustainability.

**Conclusion**

The horticultural sector in Malawi is small and the potential for horticultural production and marketing still remains unexploited. Disorganized production and marketing currently are
major features of the sector. Essential support services needed to develop the sector are inadequate. Services such as research, extension, agroprocessing and phytosanitary services need to be strengthened to support entrepreneurs in the sector. There is a need for deliberate financial and capital interventions in these areas.

Despite current efforts and some achievements, more still needs to be done to support the horticultural sector and make an impact on vegetable production in Malawi. As long as the constraints remain unresolved, there can be very little progress in vegetable production.

A concerted effort from public and private stakeholders can create a conducive environment for vegetable production. Government can develop a horticultural policy and ensure that infrastructure such as roads, telecommunications, and electricity spread out to areas of production. The private sector can seize the opportunity to develop the sector together with government.

HODOM should be strengthened to lead, be the mouthpiece, and coordinate the various aspects and activities of the sector for improved performance. HODOM should ensure that efforts by all stakeholders are complimentary, and ultimately benefit the sector.

References


Present status and future scope of vegetable processing, preservation, and use in Malawi

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Abstract

Vegetables form a major component of the diet of most Malawian households because they are readily available and affordable. Vegetables also add color, flavor and texture to meals, improve digestibility, and provide nutrients to the body. However, the availability of nutrients depends on how vegetables have been processed, preserved and used by consumers.

In Malawi, vegetable processing and preservation is done on a small scale by both communities and industries. Little processing technology is available in the country, technology developers do not promote what they have developed, available technologies are too expensive for most farmers, and agricultural research is focused on production, not processing and preservation.

Lack of intensification in vegetable processing and preservation contributes to more vegetable wastage at peak periods. It also prohibits consumer access to a wider choice of products. To improve the situation, vegetable processing and preservation should be intensified by improving existing technologies to ensure nutrient retention and bioavailability; having specific researchers deal with vegetable processing, preservation and use; promote the establishment of more cottage industries for vegetable processing and preservation; source processing and preservation technologies from other countries within the region; producing an inventory of the available vegetable processing and preservation technologies; and communicate with appropriate institutions to promote processing in Malawi.

Introduction

Vegetables form a crucial component of the diet because they are readily available and affordable. Vegetables also add color, flavor, and texture to meals, and improve digestion. Vegetables are a major source of vitamins and minerals, which perform vital functions in the body. For example in a study carried out by the Home Association of Malawi in Dowa (Chimwaza), it was observed that vitamin A and C intake was always low when vegetables were excluded from diets.

Optimal nutrient intake depends on how the vegetables have been processed, preserved and used. This paper will look at the present status of vegetable processing, preservation and use, and offer suggestions for a way forward for vegetable processing in Malawi.

Current scope of vegetable processing and preservation in Malawi

Vegetable processing and preservation include: refrigeration, freezing, drying, canning, pickling, packaging, radiation, storage, and ultimately, cooking. In Malawi, vegetable processing and preservation are conducted on a small scale as follows:
Vegetable processing and preservation at the community level

In communities, vegetable processing and preservation is done at household and group level.

Vegetable processing and preservation at the household level

In households, vegetables including pumpkin leaves (nkhwani), cow pea leaves (mtambe), jute marrow (denje) and also tomatoes, small pumpkins (nyenyero) and mushrooms are processed and preserved. Some vegetables such as pumpkin leaves, tomatoes, and cow peas are blanched first before drying, while others like jute mallow, small pumpkins, and mushrooms are dried without blanching.

Blanching

Parboiling is the method of blanching used by households. Vegetables are boiled for a short time to inactivate enzymes and to kill microorganisms.

Sun drying

Most households use direct sun drying. Vegetables are spread on raised mats or racks in the sun. To preserve nutrients, households are advised to dry the vegetables in the shade, but do not adopt this method because vegetables take a long time to dry.

Solar driers are also used by a few households. About half the population is aware that solar driers prevent the loss of vitamin A, maintain vegetable flavor and color, and keep vegetables free from dust and dirt. However, most of the population cannot afford the price of a drier.

Use of dried vegetables

Dried vegetables are cooked and eaten as a relish with the main staple -- Nsima, rice, green bananas, etc.

Cooking

Most households cook vegetables by boiling. The vegetables are prepared with or without groundnut powder. Adding groundnut powder adds nutrients, enables the availability of fat-soluble vitamins, and improves taste and palatability.

Disadvantages to household processing and preservation

Vegetable processing and preservation at the household level is not reliable because:

- No specific time is allocated for blanching. This causes a high rate of nutrient loss, especially when the vegetables have been overcooked. The cooking water, which contains the nutrients, is usually thrown away at the end.
- Direct sun drying destroys vitamin A in vegetables.
- Direct sun drying exposes vegetables to dirt and insects.
Vegetable processing and preservation by groups

Vegetable processing is done in Njolomole EPA in Ntcheu district by a group started in 2001 with two solar driers bought through HIPC funds. Later credit was obtained from a microfinance institution other solar driers were purchased. In total, the group has four solar driers but this is still not adequate. It has a membership of ten; nine women and one man. The group process and preserve both indigenous and exotic vegetables such as green leaves from pumpkins (nkhwani), cow peas (mtambe), jute mallow (denje), mpiru, and rape. Sun drying, with or without blanching, is the method used. Vegetables that are blanched and dried include green leaves from pumpkins, cow peas, mpiru, and rape. Leaves from jute mallow are dried without blanching.

Blanching

The vegetables are boiled for a short time to inactivate the enzymes and to kill microorganisms.

Drying

Blanched or unblanched vegetables are sun dried using solar driers.

Use

Dried vegetables are packed in plastic bags. The packed vegetables are sold locally within the district and other surrounding districts at k15 per packet of 100 g. The vegetables dried by the group do not reach districts further away from Ntcheu. The small number of solar driers do not allow for large-scale production.

Vegetable processing and preservation is not done systematically at the group level. No specific time is allocated for parboiling. This may cause vegetables to lose nutrients to cooking water, especially when the vegetables have been cooked for a long time.

Vegetable processing and preservation at the industry level

Only one industry (Nali) processes and preserves vegetables, but on a small scale.

The industry processes and preserves tomatoes into tomato sauce. The tomato sauce is then packed in bottles and sold locally or for export. Processing and preservation is reliable in terms of nutrient retention, produces a high-quality products. However, industrial processing does not benefit Malawians. The tomato sauce is sold at higher prices; most households can not afford to have vegetables in the form of tomato sauce in their diets. If more industries were engaged in tomato sauce-making, there would be market competition, which would result in affordable prices for most of the people.

Discussion and conclusion

Little is being done to process or preserve vegetable processing and preservation by groups or industry in Malawi. Small-scale vegetable processing results in more vegetable wastage, especially at peak periods, when small operators cannot handle the quantities involved. Consumers miss out on a choice of products. The overall nutritional status of Malawians remains poor, due to the unavailability of a better range of vitamins and minerals.
Recommendations for future action

The country should aim to intensify vegetable processing at the community and industry levels. Processing and preservation enables seasonal availability of vegetables; prevents vegetable wastage at peak periods; creates jobs; gives consumers a wider choice of products at affordable prices; and improves nutritional status due to the availability of better range of vitamins and minerals. Value is also added to primary production products, which will increase local incomes and alleviate poverty.

Processing and preservation can be intensified by doing the following:

- Improving technologies that already exist in the country to improve nutrient retention and bioavailability;
- Promoting the establishment of more cottage industries for vegetable processing and preservation in the country;
- Sourcing vegetable processing and preservation technologies from other countries within the region;
- Making an inventory of the available vegetable processing and preservation technologies and promoting them to appropriate institutions in Malawi;
- Having specific scientists research vegetable processing and preservation.

Acknowledgements

It is my pleasure to acknowledge the critical assistance provided by Mr. W. Kasapira Bunda College of Agriculture Nutrition Dept.; Mrs B. Chavula, ACB; and Mrs. V.N. Kamvazina (DDAES FNO) MOAI, FS. I also wish to thank Mr. A. Chibwana, Ms. M. Pullu, Ms. M.B. Lwanda MOAI, FS for their suggestions.

References


Appendices

Table 1. Prevalence of vitamin A deficiency

<table>
<thead>
<tr>
<th>Age group</th>
<th>% Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preschool Children</td>
<td>59.9 %</td>
</tr>
<tr>
<td>Women of child bearing age</td>
<td>57.4 %</td>
</tr>
<tr>
<td>School going children</td>
<td>38.3 %</td>
</tr>
<tr>
<td>Men</td>
<td>36.9 %</td>
</tr>
</tbody>
</table>

Table 2. Prevalence of iron deficiency

<table>
<thead>
<tr>
<th>Age group</th>
<th>% Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preschool Children</td>
<td>64% Zinc, Proto porphyrin (Z P )</td>
</tr>
<tr>
<td></td>
<td>61 % by transferring receptor (TRF)</td>
</tr>
<tr>
<td>School going children</td>
<td>13.9 % by ZP, 23% TFR</td>
</tr>
<tr>
<td>Non pregnant women</td>
<td>18 % by ZP and 32 % TFR</td>
</tr>
<tr>
<td>Men</td>
<td>5 % by ZP and 2 % TFR</td>
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</tbody>
</table>


Table 3. Nutrient composition of some fresh and dried vegetables

<table>
<thead>
<tr>
<th>Product</th>
<th>Water (g)</th>
<th>Protein (g)</th>
<th>Carbohydrates (g)</th>
<th>Fat (g)</th>
<th>Ash (g)</th>
<th>Iron (mg)</th>
<th>Riboflavin (mg)</th>
<th>Vit C (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet potato</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>leaves Fresh</td>
<td>84.2</td>
<td>4.6</td>
<td>9.1</td>
<td>0.2</td>
<td>2.2</td>
<td>5.8</td>
<td>0.4</td>
<td>120.1</td>
</tr>
<tr>
<td>Dried</td>
<td>9.2</td>
<td>36.4</td>
<td>39.6</td>
<td>2.6</td>
<td>12.4</td>
<td>24.2</td>
<td>0.4</td>
<td>42.3</td>
</tr>
<tr>
<td>Okra (therere)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fresh</td>
<td>74.5</td>
<td>4.9</td>
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<td></td>
<td></td>
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<td>121.2</td>
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<tr>
<td>Dried</td>
<td>10.1</td>
<td>28.8</td>
<td>61.5</td>
<td>2.4</td>
<td>5.5</td>
<td>12.4</td>
<td>4.5</td>
<td>22.7</td>
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<tr>
<td>Amaranth (Bonongwe)</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Fresh</td>
<td>-</td>
<td>4.6</td>
<td></td>
<td>0.2</td>
<td></td>
<td>8.9</td>
<td>-</td>
<td>50</td>
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<tr>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Pumpkin leaves (nkhwani)</td>
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<td></td>
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<td></td>
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<tr>
<td>Fresh</td>
<td>89.2</td>
<td>4.0</td>
<td>4.4</td>
<td>0.2</td>
<td>1.7</td>
<td>1.2</td>
<td>0.1</td>
<td>140.4</td>
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<tr>
<td>Dried</td>
<td>19.0</td>
<td>34.4</td>
<td>32.4</td>
<td>2.4</td>
<td>12.4</td>
<td>27.8</td>
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<td>47.5</td>
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<td>Cowpea leaves</td>
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</tr>
<tr>
<td>Fresh</td>
<td>-</td>
<td>4.7</td>
<td></td>
<td>0.3</td>
<td>-</td>
<td>5.7</td>
<td>-</td>
<td>56</td>
</tr>
<tr>
<td>Dried</td>
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</table>

The role of the University of Malawi in vegetable research

M. Kwapata and G. Dawa  
*University of Malawi*  
*Bunda College of Agriculture*

**Introduction**

*The university and its research mandate*

The University of Malawi has 5 constituent colleges: Bunda College of Agriculture, Chancellor College, Kamuzu College of Nursing, College of Medicine, and the Polytechnic College. Since opening its doors in the mid-1960s, the University's mandate has been to conduct research and development in a range of fields and disciplines. Research on vegetables has been carried out at Bunda College since the early 1970s. Vegetables play very important roles in human diets by providing essential micronutrients such as vitamins, iron, calcium, fiber, protein and carbohydrates needed for human body growth, development and protection from disease. Vegetables generate income and provide employment for many women and children who have no formal jobs and are disadvantaged in society.

*Earlier research work*

The research focus in the earlier years was on variety evaluation and agronomical studies on fertilizer types, application rates, on methods and time of application, planting time and densities, weed, diseases and pest control. Many of these early studies were done mainly on exotic vegetables such as tomato, cabbage, chinese cabbage, rape, broccoli, onion, carrots, cucumber, snap beans and peas (Kwapata, Kalua, Zambezi). In the early 1980s, research interest at Bunda College shifted to indigenous vegetables. The focus was on documentation of different indigenous vegetables used by local communities, assessment of the range and status of indigenous (traditional) vegetables in local diets, and conservation, cultivation and commercialization (Thomo and Kwapata 1984). The research work done on vegetables complemented the effort from government research stations and resulted recommendations on suitable varieties and agronomical packages for smallholder farmers.

**Discussion**

*The university’s major contribution to vegetable research*

**Early 1980s**

The university's major contribution to vegetable research has been in the area indigenous vegetables. The indigenous vegetable research started in the early 1980s with a survey in villages surrounding the Bunda College of Agriculture. The survey revealed the following:

- many villagers consumed indigenous vegetables most days of the week
- the villagers did not cultivate the indigenous vegetables they ate, but gathered them from the bush
• many villagers grew exotic vegetables for sale
• the villagers felt indigenous vegetables were for the poor and not for the affluent or educated people
• young families were less knowledgeable of many of the species used as vegetables as compared to older families
• many villagers wished they had seed and agronomic packages to grow their own indigenous vegetables
• many indigenous vegetables were also used for traditional medicine

The results of the study clearly demonstrated indigenous vegetables had a significant role in the villagers’ diets, but not in income generation. Furthermore, the knowledge of different plant species used for indigenous vegetables was being lost due to lack of interest from young people. It also revealed many of indigenous vegetable species were on the verge of extinction due to cultivation of their natural habitat, fires and lack of programs to conserve them (Thomo and Kwapata 1982).

Mid-1980s

A follow-up survey was carried out in the Central Region with the support from the International Foundation for Sciences (IFS) in 1983-4 to develop strategies for more detailed countrywide research. The results obtained from this study confirmed earlier results. Many villagers indicated they needed information on seed availability, agronomical packages and extension advice on cultivation of indigenous vegetables. During the survey, seed samples were collected to be used for preliminary field screening, nutritional analysis and plant growth and development studies. From the analysis and plant growth, it was found that many of the indigenous vegetables had very high amounts of essential micronutrients and did not require high levels of production inputs such as fertilizers and pesticides.

Early 1990s

In the early 1990s more comprehensive studies were conducted with the support from the World Bank and the government of Malawi. The first study covered most of the districts in the three regions of Malawi. The study documented all the plant species used as vegetables and collected information on local names, growth habits, parts of the plant that are eaten, how it is prepared for table, other uses (e.g. medicine), ecology, time available for harvesting as a vegetable, and whether the plant was cultivated or wild. During the field documentation, seeds were collected for station agronomical studies, nutritional analysis and organoleptic tests.

The results of the documentation study indicated over 100 different plant species were widely used as vegetables in all districts of Malawi. Many species were common, but a few were specific to the districts and in some unique habitat. No indigenous species were cultivated and many were collected from the bush and in crop fields after crop harvests. The natural habitats of these species are threatened by cultivation and fires.

The study also revealed the elderly were more knowledgeable on different plant species used for vegetables than the young family members. The majority of the indigenous vegetables were annuals available during the rainy season and in the dambos during the dry season. The nutritional analysis revealed many indigenous vegetables were nutritionally superior than most of exotic vegetables, especially vitamin A, iron and calcium. Organoleptic tests revealed many indigenous vegetables were bitter or sour; a few were sweet or bland in taste. It was noted that the degree of taste depended on
where and how the plant was grown, leaf age, and preparation. People preferred different
tastes, and most of the young children preferred the sweeter taste.

On the basis of the nutritional analysis, organoleptic tests and countrywide use, a few
species were selected for screening and advance agronomical trials with financial support
from the government and the World Bank under the Agricultural Sciences Contract
research program. The selected species for intensive study included: *Amaranthus* spp.,
*Cleome* spp., *Hibiscus* spp., *Cloteria* spp., and local mustard. These species have higher
vitamin A, iron and calcium than most indigenous and exotic vegetable species. The
agronomical studies were conducted in three different agroecological zones: hot
lowland, warm midland and cooler highlands. The studies included growth analysis,
fertilizers, density, establishment methods, seed dormancy, harvesting methods and seed
production potential. These studies have resulted in recommendations for breaking seed
dormancy, producing seed, and for agronomical practices for smallholder farmers.

Based on the long-term research results, a nationwide campaign on production,
consumption and marketing of indigenous vegetables has being undertaken by Bunda
College to inform the public about the nutritional superiority of indigenous vegetables, the
micronutrients they add to people’s diets, and why micronutrients promote health and
help prevent disease. The College also trains farmers in the production of local
vegetables. Many individuals, farmers, NGOs, churches, and government departments
involved in nutrition, health and welfare have sought information on production of
indigenous vegetables, been trained, and purchased seed from BAC. The university has
considerably contributed to the research and development of indigenous vegetables. The
major contributions include:

- documentation of countrywide indigenous vegetables species
- shown indigenous vegetables are nutritionally superior than most exotic
  vegetables
- developed agronomical packages for smallholders
- make available indigenous vegetables seed for farmers
- popularized indigenous vegetables to the public
- demonstrated that indigenous vegetables can be grown like any other
  vegetables
- increased the marketing of indigenous vegetables at local markets
- developed other alternative uses for indigenous vegetables, such as bread
  and other bakery products

**Future plan of action**

There is a need to conduct research in the following areas:

- A countrywide survey to assess the status of indigenous vegetables ten years
  after the first survey was done. The study will reveal the changes/losses of
  species in different districts.
- Assess the quantities of indigenous vegetables now being grown, cultivated,
  consumed and marketed following BCA promotion and seed supply.
- Seed production, storage and supply
- Preparation and preservation methods
- Agronomical studies on other indigenous vegetables not being promoted
Table 1. Indigenous vegetable research

<table>
<thead>
<tr>
<th>DISTRICT: Lilogwe</th>
<th>T.Z: Chadza</th>
<th>VILLAGE: Chamadenga</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Local name</th>
<th>Ecology</th>
<th>Morphology</th>
<th>Color</th>
<th>Part eaten</th>
<th>Preparation</th>
<th>Preparations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mlozi</td>
<td>lowland clay</td>
<td>vine</td>
<td>-</td>
<td>-</td>
<td>First cooked, water discarded</td>
<td></td>
</tr>
<tr>
<td>Kasungwi</td>
<td>mountain clay loam soil</td>
<td>herbaceous</td>
<td>green/green</td>
<td>leaves</td>
<td>Cooked fresh, add g/nuts, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Dede</td>
<td>uplands clay soil</td>
<td>tree</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh/dried, add g/nuts, soda, tomato, e.g. Therere</td>
<td></td>
</tr>
<tr>
<td>Baye</td>
<td>uplands/ mountains</td>
<td>herbaceous</td>
<td>white</td>
<td>root</td>
<td>Cooked fresh, add g/nuts, soda, tomato</td>
<td></td>
</tr>
<tr>
<td>Katambala</td>
<td>uplands/dambo clay loam</td>
<td>herbaceous</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh, add g/nuts, soda, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Mtambethongo</td>
<td>mountains clay soil</td>
<td>vegetable</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh, add g/nuts, soda, tomato, onion</td>
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</tr>
<tr>
<td>Kalisuka</td>
<td>dambo sand soil</td>
<td>herbaceous</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh, add g/nuts, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Chitata</td>
<td>uplands/dambo sand clay soil</td>
<td>tree</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh, add g/nuts, tomato, onion</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISTRICT: Lilogwe</th>
<th>T.Z: Chadza</th>
<th>VILLAGE: Mphonde</th>
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</thead>
</table>

<table>
<thead>
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<th>Local name</th>
<th>Ecology</th>
<th>Morphology</th>
<th>Color</th>
<th>Part eaten</th>
<th>Preparation</th>
<th>Preparations</th>
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</thead>
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<tr>
<td>Chigendere</td>
<td>uplands clay soil</td>
<td>vine</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, soda, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Luni</td>
<td>uplands clay loam soil</td>
<td>vegetable</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh first water discarded</td>
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</tr>
<tr>
<td>Chewu</td>
<td>uplands clay soil</td>
<td>herbaceous</td>
<td>Purple/green</td>
<td>leaves</td>
<td>Cooked fresh add g/nuts, soda, tomato, onion, oil</td>
<td></td>
</tr>
<tr>
<td>Chinikhowe</td>
<td>lowlands/dambo sand soil</td>
<td>vine</td>
<td>green</td>
<td>fruit</td>
<td>Cooked fresh add tomato</td>
<td></td>
</tr>
<tr>
<td>Tikikhowe</td>
<td>uplands clay soil</td>
<td>herbaceous</td>
<td>green</td>
<td>leaves flowers</td>
<td>Cooked fresh or dried add soda, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>(Therere)</td>
<td>loam soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mandolo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pigeon peas</td>
<td>upland/lowlands clay</td>
<td>tree</td>
<td>Brown</td>
<td>fruit</td>
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</tr>
<tr>
<td>Limande (Red)</td>
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<tr>
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<td>pod</td>
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<td>Cooked fresh or dried add g/nuts, tomato, onion</td>
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<td>Chithanda</td>
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<td>green</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, tomato, onion</td>
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</tr>
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<td>Cooked fresh or dried add g/nuts, tomato, onion</td>
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<tr>
<td>Chidefe</td>
<td>upland clay/loam soil</td>
<td>vegetable</td>
<td>Purple</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, tomato, onion and oil</td>
<td></td>
</tr>
<tr>
<td>Mphulu</td>
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<td>vegetable</td>
<td>Green/green</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, tomato, onion</td>
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</tr>
<tr>
<td>Chioso</td>
<td>upland/lowland dambo clay</td>
<td>herbaceous</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh or dried add tomato and onion</td>
<td></td>
</tr>
<tr>
<td>Local name</td>
<td>Ecology found</td>
<td>Morphology</td>
<td>Color</td>
<td>Part eaten</td>
<td>Preparation</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>-------------</td>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Chewe</td>
<td>upland/lowland sand clay soil</td>
<td>herbaceous</td>
<td>purple/fruit</td>
<td>leaves</td>
<td>Cooked fresh add soda tomato and onion</td>
<td></td>
</tr>
<tr>
<td>Chidede</td>
<td>upland/lowland clay soil</td>
<td>herbaceous</td>
<td>red/purple</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, soda, tomato, onion</td>
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<td>Mwana mzuulo</td>
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<td>vegetable</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh add g/nuts, tomato, onion, oil</td>
<td></td>
</tr>
<tr>
<td>Mpululukwa</td>
<td>lowland dambo sand soil</td>
<td>vine</td>
<td>green/green</td>
<td>leaves</td>
<td>Cooked fresh add g/nuts, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Chigmwa</td>
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<td>tree</td>
<td>green/green</td>
<td>leaves</td>
<td>Cooked fresh add g/nuts, tomato, soda, onion</td>
<td></td>
</tr>
<tr>
<td>Limanda</td>
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<td>green</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Chioso</td>
<td>upland/lowland/dambo sand loam soil</td>
<td>vegetable</td>
<td>green/green</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Tiu (zilu)</td>
<td>upland/lowland/dambo clay loam/sand soil</td>
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<td>purple/red</td>
<td>leaves</td>
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<tr>
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<tr>
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<td>upland/lowland/dambo sand clay soil</td>
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<td>green/green</td>
<td>leaves</td>
<td>Cooked fresh add tomato, onion and oil</td>
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<tr>
<td>Mundechele</td>
<td>sand loam rivers with clay soil</td>
<td>vine</td>
<td>purple</td>
<td>leaves</td>
<td>Cooked fresh add g/nuts, tomato, onion</td>
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</tr>
<tr>
<td>Zikho</td>
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<td>vine</td>
<td>brown/green</td>
<td>leaves</td>
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<td>fruit seed</td>
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<td>yellow/green</td>
<td>fruit</td>
<td>Fruit water discarded mixed vegetable, common beans</td>
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<td>dambo/clay</td>
<td>shrub</td>
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</tr>
<tr>
<td>Chingendere</td>
<td>uplands/loam</td>
<td>herbaceous</td>
<td>brown/green</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Mswola</td>
<td>uplands/sand</td>
<td>vine</td>
<td>pink/green/white</td>
<td>root/leaves</td>
<td>Cooked fresh or dried add g/nuts, tomato, mixed vegetable, phwekere</td>
<td></td>
</tr>
<tr>
<td>Limanda (White)</td>
<td>upland/lowland clay loam soil</td>
<td>herbaceous</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh add g/nuts/tomato and onion</td>
<td></td>
</tr>
<tr>
<td>Mpaku</td>
<td>upland/lowland/dambo loam clay soil</td>
<td>vegetable</td>
<td>green</td>
<td>leaves</td>
<td>Cooked fresh or dried add g/nuts, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Mapapaya</td>
<td>upland/lowland/dambo sand/clay soil</td>
<td>tree</td>
<td>green</td>
<td>fruit</td>
<td>Cooked fresh add g/nuts, tomato, onion</td>
<td></td>
</tr>
<tr>
<td>Chaumalaw</td>
<td>upland/lowland loam sand soil</td>
<td>herbaceous</td>
<td>green</td>
<td>leave</td>
<td>Cooked fresh or dried add g/nuts, soda, tomato, onion</td>
<td></td>
</tr>
</tbody>
</table>

**Mzamba village**

| Lokwani         | upland/lowland/dambo sand/clay/loam | vine | leaves | Cooked fresh or dried, add g/nuts, tomato, onion |
| Rayimbwe        | upland/lowland sand/loam soil       | vine | green | fruit | Cooked fresh or dried add g/nuts, tomato, onion |
| Bobongwe        | upland/lowland/dambo clay/loam      | vegetable | red/red | leaves | Cooked fresh add g/nuts, tomato, onion |

**Sonkwe village**

| Bonongwe         | upland/lowland sand/clay/loam soil  | herbaceous | purple | leaves | Cooked fresh add g/nuts, tomato, onion |
| Kaloko         | upland/lowland loam soil            | vine       | green   | leaves | Cooked fresh add g/nuts, tomato, onion |
| Bosongwe woyera | upland/lowland/dambo sand loam/clay soil | herbaceous | white | leaves | Cooked fresh add tomato, onion and oil |
| Chimbamba       | upland/lowland/dambo sand loam/clay soil | vine | green/green | seed | Cooked fresh or dried add tomato, onion and oil |
The role of the Horticulture and Food Crops Development Project in vegetable production, marketing and export

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Ministry of Agriculture and Irrigation, Department of Irrigation

Abstract

The Horticulture and Food Crops Development Project is a five-year ADB financed project that has been implemented since 2001 under the Malawi Ministry of Agriculture, Irrigation and Food Security in the Agricultural Development Divisions of Mzuzu, Kasungu, Lilongwe and Salima. Its objective is to increase irrigated land by 3400 ha and increase agricultural productivity and farm income from USD156 to USD1288 per hectare per annum through intensive cropping and marketing of fruits and vegetables for 8500 smallholder farmers.

To fully exploit Malawi’s potential and comparative advantage in horticultural production, this project aims to create a conducive environment for increased vegetable production, marketing and export. This will be achieved by providing capacity, incentives, extension and credit support, capital to purchase inputs, implements and irrigation equipment, organized marketing and marketing information systems, an adequate supply of seeds of improved varieties, improved pest and disease control practices, improved irrigation water management practices, wholesale markets and produce collection centers, adequate transportation, and small-scale agroprocessing industries. Through the project, international, regional and local buyers will be linked to smallholder producer associations and cooperatives in the project area to stimulate vegetable production.

The project is currently in its infancy. Procurement of goods and services is in progress. To date, staff and farmers have been sensitized about the project. Participatory rural appraisal, site verification and farmer needs assessment were completed. Site-specific horticultural business plans have been initiated and the process is continuing. Farmers from the project sites already have started making contractual arrangements with local supermarkets and other local private buyers for vegetable crops such as European potato, ginger, onion, shallots and garlic.

These efforts will eventually make Malawi one of the major exporters of vegetables in the region and increase foreign exchange earnings.

Introduction

The Horticulture and Food Crops Development Project is a five-year project financed by a loan from the African Development Fund (ADF) of the African Development Bank (ADB), the Government of Malawi and the beneficiaries. The project is being implemented under the stewardship of the Malawi Ministry of Agriculture, Irrigation and Food Security (MOAIFS) in the districts of Rumphi and Mzimba in Mzuzu Agricultural Development Division (MZADD); Kasungu, Mchinji and Dowa in Kasungu Agricultural Development Division (KADD); Lilongwe and Dedza in Lilongwe Agricultural Development Division (LADD); and in Salima and Nkhotakota in Salima Agricultural Development Division.
(SLADD). The project was approved by the ADB in 1998 and was declared effective in 2000; implementation began in 2001.

Background

Malawi has a strong economic comparative advantage in many horticultural crops, especially fruits and vegetables. The abundant water resources in lakes, rivers and dams, and land resources in both floodplains and upland wetlands coupled with reasonably cheap labor and low-cost irrigation technologies give Malawi an advantage in horticultural production compared to other neighboring countries. The country’s agroecological zones make the production of a range of high value horticultural crops possible. These crops include vegetables such as cabbage, tomato, onion, mustard, strawberry, shallots, snap beans, asparagus, baby carrot, sweet corn, baby corn, runner beans and mangetout; fruits such as cashew nuts, macadamia, peaches, apples, plums, citrus, bananas, pineapple, mango, guava, and pawpaw; and cut flowers such as rose, asclepias, eupatorium, helenium, and photinian (Kachule et al. 1998; Tchongwe 2001).

The potential for vegetable production, marketing and export in Malawi still remains under developed. Vegetable production is predominantly under the smallholder subsector and it is generally characterized by unimproved varieties, poor quality, seasonal gluts and low production levels. The marketing of vegetable crops is divided between domestic and export markets. Formal markets such as supermarkets and informal markets such as local produce and roadside stalls are the main outlets for vegetables at the domestic level for smallholder farmers, while the export market is largely dominated by large-scale, high-capital farmers. Most vegetable sold in informal markets are low quality, unwashed, ungraded and unpacked produce. As a result, smallholder farmers get low prices. Smallholder farmers are deterred from entering the export market by the heavy paperwork, poor access to information, high market overheads, lack of cooling facilities, and strict quality, grading and packaging requirements.

Studies carried out by the Planning Division in 1998 (Kachule et al. 1998; Tchongwe 2001) revealed that smallholder vegetable production has been constrained by the lack of a clear and specific policy for the horticulture subsector; inadequate incentives and extension support to produce vegetables as cash crops; lack of capital to purchase inputs and equipment; lack of organized markets; few marketing channels and marketing information systems; inadequate supply of seeds of improved varieties; high input costs; and pests and diseases, especially during the rainy season. This is further exacerbated by poor water management practices, poor road networks, lack of produce collection points, lack of capacity in vegetable production and handling, inadequate agroprocessing industries and a lack of policy and machinery to enforce sanitary and phytosanitary methods as required by international horticultural markets.

Nevertheless, the horticulture subsector is developing gradually, with production and cultivated area slowly increasing. Pauer (2003) reported that smallholder farmers in Mzuzu realized higher yields and income by growing vegetable crops such as tomato, green beans, cucumber, green pepper and zucchini squash during the cold season under small greenhouses.

estimated the demand for fruit and vegetable consumption to be in the range of 88,200 to 117,600 tonnes based on an estimated per capita fruit and vegetable consumption of 9-12 kg for Malawi’s 9.8 million population.

In 1995, MOAIFS developed an Agricultural and Livestock Strategy and Action Plan (ALDSAP) that alluded to the development of high quality horticultural products in adequate quantities to maintain a regular flow to export markets and to meet domestic requirements. According to the MOAIFS horticultural development strategy, by the year 2010 Malawi shall have sustainable, year-round market-oriented production of a diverse range of high quality organically and conventionally grown vegetables to improve nutrition and food security, facilitate processing, generate employment, increase incomes and earn foreign exchange through exports (MoAIFS/GTZ 1999). To achieve this vision, a number of strategies were outlined including promotion of horticultural production in strategic areas, promotion of irrigation, promotion of low cost organic production, promotion of integrated pest management, promotion of seed production and marketing, capacity building, promoting participatory research and promotion of farmer organizations. The strategy further outlines a horticultural marketing vision: By the year 2010, the horticulture industry should have a well-developed, efficient marketing system. At the domestic market level the vision is to have three wholesale markets and six collection centers organized in the major horticultural producing areas in the country. These markets would include the improvement of all market utilities, such as price, product, time and place. For the domestic, regional, and international markets, the vision is to have a range of horticultural produce and to increase the volume of horticultural commodities with reduced trade barriers.

The project

The Horticulture and Food Crops Development Project was designed in line with the Government’s objective of poverty alleviation and food security to create a favorable environment and eliminate constraints to horticultural production, marketing and export.

Objective

The global objective of the project is to contribute to the agricultural sector goal of improving the well-being of Malawians through poverty alleviation, especially among rural people, by promoting broad-based, accelerated agricultural development. Specifically, it aims to contribute to food security by increasing the irrigated land by 3400 ha and increase agricultural productivity and farm income through intensive cropping and market development for 8500 smallholder farmers.

Project components and activities

The project has five main components:

(i) Capacity building in irrigation, horticulture and research

(ii) Establishment of a microfinance credit system

(iii) Establishment of small-scale irrigation schemes and rehabilitation of small earth dams

(iv) Establishment of a market structure for horticulture and food crops

(v) Project management office
Capacity building

To ensure sustainable irrigation and horticultural development both in selected project areas and at the national level, the project will strengthen the capacity of MOAIFS in irrigation, horticultural and marketing technologies and related areas, as well as strengthen the capacity at the grassroots level through a sustainable training program. A total of 644 trainees comprising 166 front-line staff, 108 subject matter specialists in the departments of Irrigation, Crop Production, Agricultural Research and Agricultural Extension Services, and 370 farmer group leaders will be trained in short-term local, regional and overseas courses; filed study tours in irrigation and horticultural technology; and marketing, credit, environment, and water management. In addition eight fruit tree nurseries will be rehabilitated at Chitedze and Mkondezi Agricultural Research Stations and in the ADDs to supply planting materials to smallholder farmers.

The microfinance credit system

Horticultural production and marketing are capital intensive commercial activities. On this basis, the project will provide UA 2.6 million for credit and credit management. Farmers including women and youth who do not have their own capital will get funds from this credit facility to invest in horticultural production, marketing, and other related income-generating activities.

The project will engage a Microfinance Intermediary (MFI) and a Nongovernmental Organization (NGO) to administer and manage the microfinance credit system and farmer organization and training. The MFI will assist farmers in establishing 12 legally registered savings and community based credit unions (SCCBUs) owned and managed by the farmers themselves. The NGO will assist farmers to form legally registered horticultural production and marketing associations or cooperatives. Farmers will manage the SCCBUs by requesting that interested farmers pay an entrance fee to confirm their membership and develop a sense of ownership. Participating farmers will be encouraged to save with the SCCBUs and buy shares on a regular basis until they have the required minimum shares, to be agreed upon by union members, to become a full member. Shareholders will share dividends at the end of the year.

Small-scale irrigation schemes

Three thousand four hundred hectares will be developed using simple, low-cost technologies such as river diversions, treadle pumps and small motorized pumps as the main water extraction technologies. These will be set up in simple water distribution irrigation and drainage canal networks under surface irrigation and simple sprinkler irrigation systems under overhead irrigation. Lake Malawi, rivers, shallow and deep wells and small earth dams will be the main water sources. Twenty-five small earth dams will be rehabilitated.

Farmers will acquire the irrigation technologies through the credit facility described in the previous section.

Marketing of horticultural crops

To facilitate the production and marketing of horticultural crops the project will provide four marketing depots and 25 collection centers (CCs) in the project area. The depots will have a wholesale market, washing, grading and packaging facilities, and a cold room for storage of horticultural produce. CCs will be established nearer to the producers. The project will provide materials for the construction of the CCs. Members of FCs or
SCCBUs will select strategic locations and provide labor for the construction of the CCs. The project will also provide four refrigerated trucks (one per ADD) and a flatbed lorry for seed distribution. Through the credit facility, farmer groups will purchase ox-drawn carts and bicycles for transporting produce to the collection centers or the main depots. Each market depot will be managed by a Local Marketing Board (LMB). A Central Marketing Board will be established in Lilongwe to coordinate local, regional, and international marketing activities.

A marketing information intelligence system will be established for use by local and international buyers and producers. To promote the private sector, marketing agents will be allocated marketing stands at the depots on rental basis. These agents will facilitate the linkage between producers and suppliers by purchasing the produce from farmers on a wholesale basis.

The project will conduct a marketing study to explore regional marketing potential and to better assess the export problems and quality standards for horticultural produce. The study will assist the marketing office to setup an export strategy in the region. In addition, a food processing study will also be conducted to determine appropriate small-scale food processing equipment to support microenterprises in Malawi. The study will include market prices as well as technical and financial viability for different types of food processing equipment. Promising food processing equipment will be introduced in the project area for farmers to adopt.

It is proposed that the management of the market structures will be tendered to the private sector after project year three on a rental basis. The modalities of the management of the market depots will be agreed upon between the farmer associations/cooperatives, the Government, and the private sector.

**Project management**

The project is being implemented within the existing institutional framework of the Ministry of Agriculture, Irrigation and Food Security. A project management office with a locally recruited project manager, accountant and a government appointed assistant manager was established in Lilongwe. The international marketing manager, not yet recruited, will also be part of the PMO. The MOAIFS has provided counterpart staff to the PMO consisting of two civil engineers and one economist. At the ADD level the project is being implemented by the ADD subject matter specialists and front-line staff.

**Project cost**

The total cost of the project including physical and price contingencies is estimated at UA 9.67 million (US$12.96 million), which is approximately MKw 1,296 million. The cost estimates summarized by component were based on prevailing prices in September 1998 (Table 1).
Table 1. Project Costs by Component

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Total Cost (million)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>UA</td>
</tr>
<tr>
<td>1</td>
<td>Capacity Building and Training</td>
<td>1.78</td>
</tr>
<tr>
<td>2</td>
<td>Rural Microfinance Credit System</td>
<td>2.29</td>
</tr>
<tr>
<td>3</td>
<td>Small Scale Irrigation Schemes</td>
<td>2.16</td>
</tr>
<tr>
<td>4</td>
<td>Establishment of a Market Structure</td>
<td>1.28</td>
</tr>
<tr>
<td>5</td>
<td>Project Management</td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td><strong>Total Base Costs</strong></td>
<td><strong>8.63</strong></td>
</tr>
<tr>
<td></td>
<td>Physical Contingency</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>Price Contingency</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td><strong>Total Project Cost</strong></td>
<td><strong>9.67</strong></td>
</tr>
</tbody>
</table>

UA = Unit of Account, a currency unit used by the African Development Bank; US = United States Dollar

Out of these funds a total of UA55.4 (US$74,000) shall be dedicated to the strengthening of technical and managerial capacity in fruit tree management and seed production at agricultural research stations.

**Environmental impact assessment**

To mitigate against the potential negative environmental impacts associated with irrigation schemes, the project will encourage communities to protect river reserves, construct retention ponds to trap upstream silt before the river enters a dam, protect dam and canal embankments with vegetation, maintain a minimum flow of water in the perennial rivers to protect the breeding grounds of migrating fish, and conduct close and regular monitoring of the application of fertilizers and pesticides.

**Project benefits**

At national and community levels, the project will contribute significantly to food security and poverty reduction for 8500 families, out of whom 40% will be women in the 25 EPAs. Capacity of the beneficiaries in irrigation, horticulture, marketing, and credit management will be increased, and the socioeconomic status of the beneficiaries will improve.

**Crop production**

Project farmers will switch to more productive and profitable cropping systems and increase the irrigated area under maize, cabbage, chilies, sweet potato, carrots, tomato, onion, paprika and green maize. The project’s benefits arise principally from the introduction of more high value food crops as well as from the improvements in the productivity of horticultural crops. It is estimated that at full development there will be significant incremental crop production as shown in Table 2.

Table 2. Expected incremental production of selected horticultural crops after the project period

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production Tonnes per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>8000</td>
</tr>
<tr>
<td>Chinese cabbage</td>
<td>9900</td>
</tr>
<tr>
<td>Cabbage</td>
<td>20,950</td>
</tr>
<tr>
<td>Chilies</td>
<td>3300</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>8800</td>
</tr>
<tr>
<td>Carrots</td>
<td>5950</td>
</tr>
<tr>
<td>Tomato</td>
<td>7600</td>
</tr>
<tr>
<td>Onion</td>
<td>8400</td>
</tr>
<tr>
<td>Paprika</td>
<td>1600</td>
</tr>
<tr>
<td>Green maize</td>
<td>8450</td>
</tr>
</tbody>
</table>

Source: Appraisal Report No. MAI/PAAC/98/01

**Financial and economic justification**
A project financial analysis shows the annual gross revenue from crop and horticultural production under irrigated cropping by the target group is expected to rise from the present level (rainfed cropping) of MKw7.900 million (US$0.30 million) to MKw359.53 million (US$13.60 million) at full development. Net revenue, at constant prices, will increase from MKw4.35 million (US$0.16 million) to MKw 287.98 million (US$10.88 million)

The average farm income per person-day under rainfed conditions for an average holding area of 0.40 ha is expected to increase from MKw 16.5 (US$ 0.62) to MKw 70 (US$ 2.65) under irrigated conditions. The average net family farm income for smallholder beneficiaries under irrigated conditions is estimated to increase from MKw 4,127 (US$ 156.00 to MKw 34,102 (US$ 1288) per annum for a householder of one ha at full development

It was estimated that the project would have an internal rate of return of 23%.

**Current status of the project**

The project is currently in its infancy. It is procuring goods and services. To date, staff and farmers have been made aware of the project. Through participatory approaches, site verification and farmer needs assessment were completed. Site-specific horticultural business plans have been initiated and the process is continuing. Farmers from the project sites already have started making contractual arrangements with local supermarkets and other local private buyers for vegetable crops such as European potato, ginger, onion and garlic. Staff and farmer training and credit system management will commence in 2003; physical implementation in terms of irrigation and marketing infrastructure will commence in 2004.

**Implementation difficulties**

The project has faced the following implementation difficulties:

**Delay in setting up the project implementation office**

It took 22 months from the project’s date of loan signature (May 1999) to set up the Project Implementation Office. Furthermore, it took seven months for the PMO to receive the first loan disbursement for the PMO operational revolving fund. This took place in March 2002.

**Delay in procurement**

The procurement of vehicles and office equipment had to be re-tendered because the Government and the ADB could not agree on the procurement process resulting from the inconsistencies in the procedures. This made the PIU and the project field offices operate without vehicles, office equipment and other facilities. There have also been delays in the procurement of consultancy services for the NGO, MFI and civil works design firms.

**Appointment of counterpart staff**

The appointment of counterpart staff consisting of two civil engineers, one horticulturist, one environmentalist, and one Participatory Rural Appraisal Expert to be stationed at the PMO, took too long; to date it is still incomplete.
Uncertainty of the Japan International Cooperation Agency (JICA) contribution

Although JICA was expected to provide a grant amounting to UA 580,000 towards the capacity building component of the project according to the Appraisal Report, there exists no JICA signature in the Protocol Agreement to validate JICA’s contribution. As such JICA was and is still unable to participate in the project.

Lack of ADB country office

The lack of an ADB country office in Malawi contributed to unnecessary delays on issues that could have been quickly resolved by simply holding discussions with ADB officials within Malawi. PMO staff did not receive orientation to ADB procurement and disbursement rules and procedures.

Immediate and future plans

There is a need to conduct a midterm review before December 2003 despite the low disbursement level. This will help to review the project outputs, activities, inputs, and a procurement and implementation plan that will focus on realistic dates of completion. The Government needs this revision to begin negotiating with the Bank for an extension of the project before it is too late to allow the project to reap its benefits as designed. A comprehensive training program is planned to begin in November 2003. In 2004, the project will intensify construction of irrigation schemes and the market structures.

The project will shortly undertake a vegetable and fruit production and marketing study at local, regional and international levels to establish the market demand for the various horticultural crops. Through the project, international, regional and local buyers will be linked to smallholder producers in the project area to stimulate the production of vegetables.

Conclusion

This project will certainly enhance vegetable production, marketing and export in Malawi by providing capacity, incentives and extension support, capital to purchase inputs and farm implements, organized marketing and marketing information systems, an adequate supply of seeds of improved varieties, improved pest and disease control practices, improved irrigation facilities, wholesale markets and produce collection centers, adequate transportation, and small-scale agroprocessing industries. It will eventually make Malawi one of the major exporters of vegetables in the region and increase foreign exchange earnings.

Through increased production of food and horticultural crops and higher income accrual at the household level, the project will directly improve food security for the beneficiaries, especially rural women farmers, youth and children. This will result in better nutrition and health.

The involvement of the farmer clubs and the SCCBUs in planning, implementation and management, especially for the credit component with a built-in-mechanism for credit recovery, will sustain project benefits after the project implementation period. Beneficiaries that contribute to the construction of on-farm irrigation canals will develop a sense of ownership in the project, which will enhance the maintenance of infrastructural facilities and add to the sustainability of the project.
Participation of rural women smallholder farmers who form 70% of the agricultural labor force (JICA 2003) and youth in training, farmer clubs and credit unions will empower them to assimilate higher levels of farming technology and also create a sense of involvement, confidence and self-respect. This will assist rural women in achieving higher social status, which is vital for the success of any development effort.

References


The national vegetable seed programs: present status and future prospects

Dr. J. H. Luhanga
Department of Agricultural Research Services, Lilongwe

1. Introduction
   - Vegetables and the national diet
   - Livelihoods
   - Untapped potential

2. Constraints to production
   - Diseases
   - Agronomic practices
   - Preservation
   - Markets
   - Information
   - Tradition/Fashion
   - Seed

3. Major aspects related to seed
   - Unsuitable varieties
   - Inadequate quantities
   - Quality – 1994 study
   - Cost

4. Major sources of seed
   - Farm-saved
   - Neighbors
   - Village markets
   - Shops

5. Major seed supply systems
   - Imports
   - Local production – indigenous species

6. Major national initiatives
   - Horticultural Associations
   - Research program

7. National research efforts
   - DARS -- New varieties tested and released (tomato, cabbage, etc.)
   - Indigenous varieties – DARS/Bunda College. Pioneers: Prof. Kwapata and the late Mr. Zulu of Seed Services
   - Result
   - Varieties available – no seed systems
8. Challenges of seed imports
- Free for all
- No mechanism of monitoring
- Knowledge – base of imports/users
- Storage
- Distribution network

9. Positioning for change
- Re-organize the seed production system through the evolution of a vegetable seed policy within the framework of the national horticultural crops policy

10. Major elements
- Immediate horizon
- Regulate imports
- Provision of stipulated and coordinated import requirements
- Communication with industry/consumers
- Re-training
- Monitor the market
- Revisit the Seed Act

11. Local production system
- Engage seed associations/private individuals
- Adopt the model for the ASMAG here/
- Develop markets
- Revisit seed import regulations/stimulate local investment
- Hold Seed Fairs
- Linkages/partnerships
- NGOs/trades/distributors/producers/private companies
- Establish seed association/networks
- Information sharing
- Training

12. International aspects of the seed industry
- Certification system
- International Seed Testing Association
- GMO
- Harmonization of regulations

In conclusion, vegetables can and will feed the nation – there is no choice.
An overview of major pests affecting vegetable crops in Malawi

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Abstract

The major insect pests that affect vegetable production in Malawi are described. Losses caused by these pests to various vegetable crops are also highlighted. These major insect pests include: Diamondback moth, Plutella xylostella; Cabbage aphid, Brevicoryne brassicae; Cabbage sawflies, Athalia spp.; Tomato Red Spider Mite, Tetranychus evansi; Tomato fruit worm; African Bollworm; Cutworms; Agrotis spp.; root-knot nematodes; and Onion Thrips, Thrips tabacci. For other vegetables such as cowpeas and pigeon peas the major pests include the pod borers, Helicoverpa armigera and Maruca testulalis; Termites (Macrotermes michaelseni and Odontotermes spp.) have recently become serious pests of some vegetable crops such as cowpeas and pigeon peas.

In an effort to curb these complex pest problems Malawi has adopted some integrated crop production and pest management (IPPM) strategies. These include good crop management practices; early pest surveillance methods; participatory pest control approaches through farmers’ field, schools; use of botanical pesticides, such as neem (Azadirachta indica), fish beans (Tephrosia vogelii), sweet basil, and tobacco extracts; and judicial use of organic pesticides. Recommendations on the use of these IPPM strategies are outlined. Some action plans for improved vegetable production with an emphasis on pest control are given.

Keywords: Major insect pests, vegetable production, diamondback moth, Tetranychus evansi, Maruca testulalis, botanical pesticides, integrated crop production and pest management

Introduction

The importance of vegetable production in Malawi lies in the fact that vegetables form an important side dish for a majority of Malawian house holds. Vegetables are an important source of minerals and vitamins vital for good health. Many small-scale farmers in developing countries grow vegetables for both cash and consumption. Traveling along the Ntcheu – Dedza road one can observe many people, both men and women selling or buying cabbages, tomatoes, onions, carrots, ginger, rape and other types of vegetables. Although vegetables are widely grown in Malawi, the supply of vegetables is not adequate, especially during the rainy season (Malawi Government 1995). Therefore, there is a need to encourage farmers to grow more vegetables to meet the ever-increasing demand.

The production of vegetables in Malawi faces several constraints. Major production constraints include unfavorable weather conditions such as drought, too much rainfall and frost, deteriorating soil fertility, and outbreaks of insect pests and diseases (Talekar et al. 1990).
This paper discusses the occurrence of various insect pests that affect vegetable production. It also focuses on ways of tackling the pest problem. Some action plans to improve vegetable production are given, with the main emphasis on integrated pest management strategies.

The insect pest problem

Most vegetables are attacked by insect pests that cause severe reduction in yields. Pests also cause blemishes that render the crop unattractive and decrease its value. In some cases, insect pests such as aphids also transmit viral diseases. Because such a large number of insect pest species attack vegetables, only those major pests that cause economic damage will be discussed.

Aphids (several species)
Description: Small pear-shaped bodies, about 2 mm long. Some adults may have wings, which are transparent. The insects may be green reddish, or black in color. Aphids live in colonies on different parts of the plant, mostly on young shoots and leaves. Honeydew may be produced.

Damage: Extraction of plant sap. Some aphids may inject toxic saliva, and may transmit diseases. Symptoms of damage are yellowing of leaves, leaf spotting, leaf curl, stunted growth, and stagnation of flowers and fruit production.

Host: Cabbage, lettuce, Chinese cabbage, leaf mustard, rape, tomato, eggplant, carrot, okra.

Control: Dimethoate (Rogor) 40 EC
Cypermethrin (Ripcord) 20 EC
Malathion 25 WP
Metasystox 25 WP
Pirimiphos-methyl (Actelic) 50 EC

Where more than one chemical is listed a choice of one can be made by the user depending on availability or cost.

Beanfly (Melanagromyza phaseoli)
Description: The larvae (maggots) are small, white, and measure 3 mm long when fully grown.

Damage: Leaf blades are eaten away with the exception of the main veins.

Host: All cabbages, including rape and leaf mustard.

Control: Malathion 25 WP
Carbaryl 85 WP
Dichlorvos 50 EC
Cypermethrin 20 EC
**Cabbage Looper** (*Trichoplusia* spp.)
Description: The caterpillar is pale green with light stripes down the back. It is usually known as the “measuring tape” because it doubles up or loops when it crawls. It is about 35 mm long when fully grown.

Damage: Young caterpillar feed on underside of the leaves producing ragged holes. Large loopers burrow into the cabbage head.

Host: Cabbage, tomato, rape.

Control: Malathion 25 WP  
Dichlorvos 50 EC  
Pirimiphos-methyl 50 EC  
Cypermethrin 20 EC 

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**Cabbage Sawfly** (*Athalia* spp.)
Description: Larvae (maggots) are green to bluish in color, with rows of fleshy warts along the body, and measure about 2.5 mm long. They fall to the ground when the plants are slightly shaken.

Damage: Leaf blades are eaten away with the exception of the main veins.

Host: All cabbage including rape and leaf mustard.

Control: Malathion 25 WP  
Carbaryl 85 WP  
Dichlorvos 50 EC  
Cypermethrin 20 EC 

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**Cabbage Webworm** (*Hellula* spp.)
Description: Caterpillars are grayish-yellow and fat with five brownish-purple stripes down the back. When fully grown they measure 15 mm in length.

Damage: Caterpillar bore into buds and stems killing the plants. Attacked leaves are spun together by a web of silk under which the worms feed.

Host: All cabbage including rape and leaf mustard.

Control: Malathion 25 WP  
Dichlorvos 50 EC  
Pirimiphos-methyl 50 EC  
Cypermethrin 20 EC 

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**Cottony Cushion Scale** (*Icerya purchasi*)
Description: These scale insects have a reddish-brown body that is covered with a layer of wax. They measure about 3.5 mm. The most conspicuous part of the insect is a large white (cottony) fluted egg sac, which is secreted by the female. Together with the egg sac the insect measures about 10 mm. Considerable quantities of honeydew are secreted.
Damage: Damage is caused by injection of toxic saliva, extraction of plant sap, and honeydew in association with sooty mold. Symptoms of attack are discoloration, malformation, leaf and fruit fall, and retarded growth.

Host: Chilies

Control: Fenitrothion 50 EC  
Dimethoate 40 EC

**Cutworm (Agrotis spp.)**

Description: Caterpillars are large and vary in color from dull grey, brown to black. They may be striped or spotted. Mature caterpillars measure about 25-35 mm long. They are stout, soft-bodied and smooth, and curl up when disturbed. They feed at night, hiding just below the soil surface near the plant during the day.

Damage: Caterpillar cuts off young plants above or at soil surface.

Host: Almost all vegetable crops, including tomato, pepper, eggplant, Chinese cabbage, leaf mustard, lettuce, rape, peas, onion, carrot.

Control: Cypermethrin 20 EC  
Malathion 25 WP

**Diamondback Moth (Plutella xylostella)**

Description: Diamondback moth (DBM) is a serious pest of the crucifers, one of the most important vegetable families. The caterpillar is pale green, widest in the middle of its body and about 12 mm when fully grown. It wriggles rapidly when disturbed and often drops from the plant and hangs by a silk thread, which it produces.

Damage: Caterpillars feed on leaves, cutting round holes or more often scratching off the tissue leaving the upper epidermis untouched. This pest can cause 100% loss if left uncontrolled (personal observation; Talekar et al. 1986, 1990).

Host: Cabbage

Control: Dichlorvos 50 EC  
Malathion 25 WP  
Carbarly 85 WP  
Cypermethrin 20 EC

**Epilachna Beetles (Epilachna spp.)**

Description: Adult beetles are 6-8 mm long, red in color with a number of black spots surrounded by a light zone on the wing cover. The grub (larvae) is 7-9 mm in length. The body is covered with dark-colored spines.
Damage: Both adults and larvae feed on leaves, skeletonizing them in a characteristic manner by leaving the fine network of veins. The leaves shrivel and dry.

Host: Cucumber, pumpkin, squash, watermelon and beans.

Control: Dichlorvos 50 EC
Carbaryl 85 WP

**Melon Fly (Dacus cucurbitae)**
Description: The headless and legless larvae (maggots) are whitish and yellowish in color and about 9 mm in length when fully grown.

Damage: They feed inside the fruit causing sunken discolored patches and cracks. The cracks allow fungi and bacteria to enter, which cause fruit rot.

Host: Cucumber, watermelon, pumpkin and squash.

Control: Dimethoate 40 EC as directly spray
Malathion 25 WP baited in sugar

**Red Spider Mite (Tetranychus spp.)**
Description: The minute reddish mites are found mainly on the underside of the leaves. They are visible to the naked eye as tiny reddish dots.

Damage: Attacked leaves assume a stippled (dotted) appearance, turn yellowish to whitish, and dry up. Often young plants are entirely destroyed. Under heavy attack, older plants growth can be severely stunted and fruits set may decline.

Host: Tomato, cucumber, watermelon, squash, beans, amaranth (*bonongwe*).

Control: Dimethoate 40 EC
Malathion 25 WP
Metasyztox 25 EC

**Spiny Brown Bugs (several species)**
Description: The bugs are 8-10 mm long, grey, brown or black in color. Their body is covered with more or less conspicuous short hairs, the thorax bears two spines.

Damage: Dimpling of the seed coat, browning and shrivelling of the seeds, wrinkling of the seed coat. Germination ability of the seed is impaired.

Host: Beans, peas.

Control: Fenitrothion 50 EC
Dichlorvos 50 EC
**Thrips** (several species)

**Description:** Small slender insects 1-2 mm long, light grey to brown in color. Adults have two pairs of fringed wings. Nymphs may be whitish or pale yellow.

**Damage:** The characteristic symptom attack of both adults and nymphs is a silverying of the infested plant tissue, which turns brown and dries up when damage is severe. A further indication of attack by thrips is small black shining spots of excreta on the infested plant.

**Host:** Beans, onions and pepper.

**Control:**
- Malathion 25 WP
- Metasytox 25 EC
- Fenitrothion 50 EC
- Carbaryl 85 WP

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**Tomato Fruit Worm** (*Helicoverpa* spp.)

**Description:** Larvae are green, brown or pink, with stripes along the sides and on the back. They can measure up to 40 mm. Also referred to as American Bollworms (now African Bollworm).

**Damage:** They cause heavy damage to fruits and buds. They bore into the fruit with the hind part of the body to feed on the contents of the fruit, which is marked by large bore holes.

**Host:** Tomato, beans, okra and peas.

**Control:**
- Carbarly 85 WP
- Cypermethrin 20 EC
Major insect pests and damage caused to vegetables in Malawi

- Legume pod borer
- Root-knot nematode
- Tomato fruit worm
- Cabbage aphid infestation
- Cutworms
- Cabbage damaged by DBM
- DBM adult, larva & cocoon
- Effect of DBM on tomato
- Onion thrips
- Termite damage on pigeon pea
Use of integrated pest management in vegetable production

The use of synthetic pesticides against DBM and other vegetable pests is the major control method in the developed countries where these chemicals are produced. However, this has led to the development of pesticide resistance. DBM also has developed resistance to the recently created synthetic pyrethroids. When these were introduced, they became popular because of their quick action, but DBM developed resistance more quickly than expected (Satro dihardjo 1986). Similarly in Malawi, the red spider mite (*Tetranychus evansi*) attacking tomatoes developed resistance to such an extent that it became almost impossible to grow tomatoes in most parts of the country. Scientists had to toil to make a breakthrough. Mtambo (1999) recommended the use of a concoction of ash and nicotine extracts to control the pest.

In developing countries, synthetic pesticides are very expensive; few farmers can afford them. In addition, technical knowledge and equipment for the application of these synthetic pesticides is lacking, and poses a threat to human health and the environment. The use of synthetic pesticides during the last century has in most cases been careless and indiscriminate, and led to a number of well-known problems. Some of these problems include contamination of food, soil, groundwater, rivers, lakes, oceans, air, etc. With toxic residues, side effects on nontarget insects and other organisms, the increase of the number of pest species resistant to pesticides, pest resurgence, and high costs inhibit their use by resource-poor farmers (Schmutterer et al. 1995). These reasons have prompted the smallholder farmer to use available traditional botanical extracts.

Among those chemicals that are traditionally used by small-scale farmers are neem (*Azadirachta indica*) and *Tephrosia vogelii*. Many studies have indicated the use of neem against DBM but relatively few have investigated the use of *Tephrosia vogelii* and sweet basil.

Chemical control has been cited not because it is the only means of control for these pests, but rather because it offers a fast check to a pest population when a crop is under a severe infestation.

An integrated approach to pest control or management should be encouraged at all times. Under this approach all possible means of control are considered, including nonchemical ones such as cultural and physical methods, or planting resistant varieties either singly or in combination. For instance, on smallholdings it is possible and advisable for the farmer to hand-pick and destroy larger insects. In this way a pest population may be controlled or kept in check.

The idea is to reduce use of pesticides as much as possible and use them only when necessary. Prolonged use of most pesticides, especially at very high rates or dosages, may result in resistance. Furthermore, many pesticides may also be harmful to man or the environment if used incorrectly.

There is a need to develop action plans to combat ever-increasing pest problems. This should be done by adopting a participatory approach to pest control. This calls for the involvement of all key players in vegetable production; farmers, researchers and technology dissemination specialists need to develop these action plans together. For increased and successful vegetable production the IPM approaches described above ought to be implemented.
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Introduction

Nearly every meal in Malawi has a vegetable component as a spice, relish or appetizer. Demand for vegetables is rising as our population and rate of urbanization increase. As the population increases, there are more people to feed and thus an increased need to produce more vegetables. Those areas that cannot produce enough vegetables for themselves end up importing some vegetables to satisfy demand. Vegetable production has of late become a very lucrative farming venture with very reliable financial returns.

Those vegetables that were used by our ancestors in the 16th century such as Amaranthus, Black Jack, Cat Whiskers and several others are considered indigenous vegetables. Brassicas, tomatoes, onions, beans, and others are non-indigenous vegetables. Non-indigenous vegetables are in high demand and are used in most eating places in Malawi.

Constraints that affect the production of these vegetables are a major hurdle to farmers. This document will look at some major crops and their disease and nematode problems. It will also show some activities that were conducted to overcome these problems. The analysis is from the data we have collected from our disease clinics over the past 25 years.

Cabbage and other Brassicas

The most common Brassica grown in Malawi is Brassica olerancea, also named drumhead cabbage. There are other species in this family such as B. napus (mustard) and B. chinensis (Chinese cabbage). All these varieties suffer from diseases.

Plasmodiophora brassicae Wor. (Club Root)

This is a fungal disease and is the most common problem in Ntcheu RDP. The disease is recent in our country on this crop. It was confused with nematode problems earlier on in especially in the late 1980s, but it was finally identified in 1995.

The average soil pH is below 7.0 in this RDP and this is the most favorable pH for this pathogen to multiply. The pathogen causes root enlargement in the host plant and the host fails to absorb water and nutrients. This results in wilting, stunting, no head formation, and the eventual death of the plant.

Recommended control measures

The Department of Agricultural Research Services embarked on a research program to develop recommended control methods. They are:
Use of agriculture lime
Adding lime is the easiest way to raise soil pH in agricultural soils. A rise in pH of 0.2 thus raising pH from 7.0 to 7.2 was adequate to reduce the disease pressure.

Solarization
Soil temperatures that are above 31°C and 32°C are lethal to the spores of the pathogen. So the use of solar heat in the hot months of the year destroys pathogens in the field and nursery beds. This method is very effective in hot areas and can provide very effective coverage for six to eight weeks.

Flusulfamide (Nebijin)
This chemical is a fungicide and it usually comes as a suspension concentrate. It is applied at 6 litres per hectare in 200 to 600 litres of water. Seedlings are planted the third day after application of the fungicide.

*Alternaria brassicae (Leaf Spot)*

The pathogen produced distinct spotted concentric rings on the leaves of the cabbage plant. The spots render the crop nondesirable to prospective buyers.

*Peromospora parasitica (Downy Mildew)*

This disease likes moist conditions and most favorable temperatures are between 10°C to 15°C. The disease is most common during rainy season or in areas where there is a lot of watering, because the zoospores are water-borne. This pathogen is not as destructive as *Plasmodiophora brassicae*.

**Recommended control options**

Using resistant varieties or an appropriate fungicide could control both *Alternaria* and *Peronospora*.

*Pythium and Rhizoctonia (Damping Off)*

This is a seedling disease and it favors wet conditions in seedling nurseries. Seedlings with no damping off signs could carry the disease into the planting beds. Since this problem mainly starts in the seedbed, it can be managed from the seedbed. Fungicide-treated seeds, use of clean, sterilized or solarized soil and an appropriate fungicide are the best control options.

*Erwinia carotovora (Bacterial Soft Rot)*

This makes the plant extremely soft and mushy. It is also insect transmitted in the field. The rotting is either in the field or in storage. During storage it is so fast that within 48 to 72 hours a whole consignment can produce a foul sulfurous odor and total loss may occur while waiting for transportation or in transit. It is easier to control spread on the cabbage heads in the field rather than in storage. A resistant variety (Hercules) was
identified; with other resistant varieties, it could be used to control the spread of the disease. Produce should be stored in a dry place and injured or cut produce should not be mixed with clean heads.

**Xanthomonas campestris pv. Campestris (Black Rot)**

This bacterial disease is different from *Erwinia* in that it produces black vascular tissues in older plants and the rots are not soft and mushy. The older plants show yellow wedge-shaped areas at leaf margins while seedlings turn yellow and die.

**Tomato**

Tomato is an integral part of the Malawian diet. It is attacked by many diseases and nematodes.

**Phytophthora infestans (Late Blight)**

This fungal disease is the biggest bottleneck to tomato production during the rainy season in Malawi. The disease shows grayish patches on leaves and these spread very rapidly in damp conditions. Sometimes mouldy patches appear at the margin of affected areas. The pathogen can attack any above-ground part of the tomato plant. This pathogen can bring about 100% loss. This disease determines the price of the tomato crop during the rainy season and anyone that has a good crop at this time makes a lot of money.

**Recommended control options**

Tengeru 97 was developed as resistant variety to control this disease. This variety was completely resistant when assessed in Tanzania, but this is not the case in Malawi. This is a clear indicator that there may be more virulent strains of *P. infestans* here.

Fungicides such as Dithane M45 are very effective at controlling the pathogen and are recommended for that use. Burning of infected debris and solarization are recommended to kill spores in the soil that would produce zoospores during the wet season.

**Alternaria solane (Early Blight)**

This fungal pathogen is spread through seed, volunteer crops, weeds and debris. This pathogen is not as important as *P.infestans* and therefore does not cause a serious threat to tomato production in Malawi.

**Fusarium oxysporum f.sp.lycopersici (Fusarium Wilt)**

This is a soil borne fungal pathogen that enters the root system through cracks and wounds on the plants. It could be localized in the field. It is most apparent during blossoming to fruit maturation when older leaves turn yellow prior to wilting.

**Verticillium dahliae (Verticillium Wilt)**
This fungal pathogen shows the same visual symptoms as *Fusarium oxysporum f.sp.lycopersici*. The differences appear during diagnostics.

**Recommended control options**

Most soil born fungal pathogens that cause wilt are best controlled with resistant varieties because chemical control is very difficult. There are tomato varieties resistant to particular races of *Fusarium*, which should be planted where appropriate. Increasing soil pH has shown a good response in terms of disease progression.

**Pseudomonas syringae pv. Syringae & Pseudomonas syringae pv. Tomato**  
(*Syringae Leaf Spot & Bacterial Speck*)

The first pathovar produces spots on leaves and sometimes on the stem. The second produces specks or spots on the fruit. The area around the specks stays green and does not ripen; this results in the fruit showing green areas next to very well ripened tomato fruit. Buyers do not prefer these fruits and the farmer loses business.

**Recommended control options**

Practice crop rotation and use disease-free seedlings. Buy seeds from good seed producers that treat their seeds.

**Meloidogyne spp (Root knot)**

These worms cause gall formation on the tomato root system. Severe gall formation end up in the plant showing sings of stunting. It is at this time that the farmer loses the crop because he cannot profit from his farming.

**Recommended control options**

Nematicides have been very effective in controlling the parasite. The DARS has come up with several control measures that we have recommended to farmers, including the use of neem cake in the planting stations, rotation with *Tagetes vogelli*, and sterilization of nursery beds.

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The role of women in vegetable production and use in Malawi

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Introduction

Women comprise 51% of the population of Malawi. Nearly 70% are full time farmers and contribute 71% to agriculture labor. Women dominate smallholder agriculture and are the main food producers. They are also responsible for food preparation and distribution within the household in both rural and urban areas.

Vegetables are a very important complement to Malawian’s staple food, nsima. A study done by Beatrice Mtimuni in Dowa East in 1982 revealed that households sleep hungry if they do not have relish in form of vegetables. This being the case, women are responsible for fetching and growing vegetables for home consumption. This makes most women start growing vegetables on a small scale, and then eventually on a larger scale. The vegetables produced for sale are mainly grown by men. The vegetables are mostly grown in dambo areas near water.

Vegetables include the dark green leaves of Mpiru (pumpkin leaves), Bonongwe (amaranth), and cabbage, carrots, tomatoes, and green and red peppers. Women use vegetables of all kinds at the household level, because of their ease of preparation. Vegetables require very little cooking time.

Vegetable production

Women are the primary producers of vegetables especially at subsistence farming levels. Women handle land preparation, garden preparation, application of manure, sowing, watering, harvesting, and marketing.

Watering is a very crucial need in vegetable growing; since drawing water is culturally and socially treated as a women’s activity, watering of vegetable gardens is mostly left to women.

In most cases nursery beds and the actual gardens are far from each other, and this requires transportation of the seedlings, usually by head. Traditionally, head loading is a considered women’s job in Malawi; thus transportation of farm produce is left to women. Even for the main food crops, transportation is the responsibility of women.

Women also collect and apply manure to fields and gardens to grow vegetables. Collecting manure involves head loading in most cases. Many women do not have the necessary manure available; if they do, they are too busy to apply it. Currently, the Ministry of Agriculture, Irrigation and Food Security is encouraging farmers to use composted manure instead of fertilizers, which are expensive. Animal manure is available to those with livestock. Most compost-making is is also done by women.

Vegetables are primarily used as a source of food in form of relish, and relish preparation is done by women. In times of plenty women process the vegetables by drying them and storing them in traditional storage bags called “zikwatu” for future use. Other vegetables
like tomatoes are processed into jam; some vegetables like garlic, green pepper and onions are dried and processed into spices. This adds value to the processed products and generates income for the household. If the household garden produces more fresh vegetables than the family can eat or process, community members will often buy the surplus. Most women also use vegetables to generate their own income by going to dimbas, buying vegetables in bulk, and selling them in the market.

Case study

A visit was made to a vegetable grower in Lilongwe to collect information on the role of women in vegetable production. The farmer visited was Ms. Hilda Savala, owner of Chitedze Evergreen Gardens along the Lilongwe–Mchinji Road, about 16 km from Lilongwe.

Background

Ms. Savala, originally from Zimbabwe, settled at her new place four years ago. She started growing vegetables for home consumption. When she started producing more than what she required, she began selling the surplus. She now produces vegetables on a commercial basis.

Types of vegetables grown

Ms. Savala grows cabbage, lettuce, Mpiru, spinach, broccoli, rape, pumpkin leaves, beans, mushroom, carrots, tomatoes, green and red pepper, Chinese cabbage, maize, and groundnuts. She grows all these through irrigation. She was using a water pump but no longer uses it because of the escalating price of diesel. She now uses watering cans and two treadle pumps. This has forced her to relocate the garden from near the house to the dambo land. Ms. Savala uses composted manure instead of organic fertilizers in her vegetable garden. She discussed vegetable production from nursery preparation to transplanting and crop care.

Problems

Ms. Savala's major problem in her business is availability of markets. She tried contacting major stores in town such as Shoprite, PTC and 7-11, but to no avail. Sometimes they buy, but not everything. The other problem is that some of the vegetables she grows are not known to most Malawians, such as broccoli and lettuce. Lastly, Ms. Savala lamented the lack of extension services from the Ministry of Agriculture, Irrigation and Food Security.

Benefits from vegetable growing

She said vegetables are a source of relish and provide vitamins, which reduce malnutrition and protect the body from disease. Vegetables also are a source of cash.

Future plans

She aims to expand the level of vegetable production. She would like to start packing and export her produce to other countries. She also wants to venture into production of other value-added products such as peanut butter and maize flour. She already has a peanut butter machine but she would like to acquire a maize mill for the production of maize flour.
Constraints to vegetable production and use

Women face a lot of problems when growing vegetables on a business basis. Chief among them are the gender issues of lack of control; lack of access to resources; and exclusion from the benefits of their effort. In Malawi, men control resources like land. Despite women playing a central role in the production of vegetables, they do not have much control over resources and do not benefit fully from their efforts.

For those that have managed to move from bare subsistence farming to growing vegetables as a business, market, extension services and exposure are other constraints. In terms of markets, Malawian Departmental Stores, Shoprite, PTC and other supermarkets opt for imported vegetables at the expense of locally grown vegetables.

Agricultural extension services are limited to major crops such as maize and tobacco. Women lack access to extension services to help them in vegetable production. Exposure to good vegetable growing techniques is also a problem. Field days and agricultural shows emphasize major crops and livestock; little attention is given to vegetable growing. This has a negative impact on the development of vegetable production in Malawi. Lastly, access to credit facilities is another constraint. Without credit, women cannot obtain inputs and use modern technology such as treadle pumps to grow vegetables.

Future plans

The Ministry of Gender and Community Services has two programs that have a direct impact on the growing and use of vegetables. These are the Economic Empowerment Program (EAP) and Food Use and Dietary Diversification (FUDD) Program. Both programs aim to intensify awareness campaigns on the importance of vegetable growing and the proper use and preservation of exotic and indigenous vegetables for consumption as well as for sale.

The FUDD program promotes efficient use and processing of food, dietary diversification, hygiene, and home management at the individual and household level. This includes messages on vegetable production.

The main goal is to promote equitable participation and benefit by all -- men, women, boys and girls -- in every aspect of development, including vegetable production. The Ministry will collaborate fully with all relevant institutions, including the Ministry of Agriculture, Irrigation and Food Security, to improve the production and use of vegetables in Malawi.

Conclusion

Vegetable production is the domain of women in Malawi, especially at the subsistence level. The production of vegetables at a large scale is affected by a number of factors such as a lack of markets, lack of extension services for vegetable production, and a lack of vegetable shows and displays. These factors are diverse and cut across a number of sectors. Therefore, there is a need for a concerted effort by all involved to improve the production and the proper use of vegetables. Simple technology to conserve water (such as placing eggplant seedlings under the drying rack for plates to catch the water) must be explored. When research is conducted in vegetable production methods, researchers should consider how women in particular can be assisted to grow vegetables for income generation as well as home consumption. Research should identify vegetable varieties that are nutritious and palatable.
Involvement of women in plant breeding and variety selection:

- Identify the socioeconomic and agronomic factors influencing women's selection of specific plants.

- Analyze women's role in the decision-making process within the household and in the community as they use, preserve and manage vegetables.

- Analyze the past, present and future factors that impact on women's agricultural working conditions and access to and control over resources.

- Participatory plant breeding through community managed gardens is an effective way of developing and selecting seed directly with farmers.

- Farmers select crops based on different criteria, such as yield, seed, size, disease resistance, cooking, and taste qualities.

References


Vegetables and health

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Abstract

The body needs vitamins and minerals to function properly. There are at least 7 different vitamins and 14 different minerals. Each one has a special use in the body. The body can not work properly if any one is missing. As the immune system weakens the body's need for vitamins and minerals increases. They clean and build the body and are easy to digest. You can not eat too many vegetables. Vegetables are healthy foods. Eat wild indigenous fruit and vegetables as well as those you buy in markets and shops.

Introduction

There are hundreds of common vegetables eaten in different parts of the world. Spinach, cabbage, and lettuce are leaves; onions, turnips and radishes are roots; eggplants (brinjals or aubergines), gourds, and marrows are fruits; celery is a stalk; and cauliflower and globe artichokes are flowers. Clearly there is great diversity in the biological structure of vegetables. Despite the great variety, vegetables all possess general nutritive properties.

Social factors

A regular supply of vegetables, fresh, frozen, or canned, should be an essential part of good living and a healthy diet. Vegetables add to the elegance and attractiveness of a meal. In many areas in Malawi, the need for people to eat vegetables for health is particularly important. Modern methods for growing and marketing vegetables should be developed on a large scale. The picturesque traditional vegetable market consisting of many vendors cannot be adapted to meet the needs of big cities.

Nutritive properties of vegetables

Vegetables contain valuable amounts of ascorbic acid, but the quantities are variable and much can be lost in cooking and preparation. However, a single daily serving of vegetables (30-90 g) even if it has been badly treated by the cook, will usually provide at least 10 mg of ascorbic acid, which will prevent scurvy (Ramsbottom 1953).

In Malawi major improvements in health are likely to arise from even a small increase in the vegetable supply. A poor woman with insufficient iron, vitamin A and ascorbic acid in her diet may find her health improving as a result of eating good garden vegetables daily. A single enthusiast in a village or small town giving instruction and encouragement to neighbors in the art of vegetable gardening can carry out preventive medicine in his spare time. Oomen and Gruben (1997) have produced a beautifully illustrated book to encourage consumption of leaf vegetables.

Green vegetables, although eaten throughout Malawi, are never a staple of the diet because leaves do not normally contain storage nutrients as starch, protein or fat. They contain high levels of water (80-90%) and are characterized by protoplasmic rather than
storage protein. The protein content is on the order of 1-4% and rarely as high as 5 to 6%. Fat content is 0.1-0.3%, total carbohydrate 3-10%, of which 0.5-1.0% is crude fibre. Ash content is usually less than 1% (Mtimuni 1986). Nutrient composition is affected by light, season, location, fertilization and genetic characteristics of the plant.

Leafy vegetables tend to wilt rapidly, particularly at high temperatures and low relative humidity. This presents a problem in transportation. Green vegetables are an important source of vitamin C and may suffer extensive losses during wilting. In one experiment, 40% of vitamin C was lost during a three-week storage period.

Leaves commonly eaten in Malawi are: sweet potatoes, pumpkin and okra, which tend to contain high levels of b-carotene. Pale cassava and pumpkin leaves contain much less b-carotene and very pale leaves may contain hardly any. Reduction in storage temperatures will reduce both wilting and loss of nutrients.

**Conclusion**

Vegetables provide a medicine that is cheap and easy to consume. It takes time and patience to see the benefits of good food. It is not an overnight cure. By eating vegetables, you are choosing to live a stronger, healthier life.

**References**


Status and limitations of vegetable marketing in Malawi

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Background

Agriculture is the mainstay of the economy in Malawi. Depending on climatic conditions and other factors, agriculture contributes about 37 percent of the Gross Domestic Product (GDP), employs over 80 percent of the country’s labor force, accounts for over 90% of the foreign exchange earnings and supplies more than 65 percent of the raw materials most needed by the manufacturing sector (Malawi Government 2002).

Three main crops dominate agricultural exports in Malawi: tobacco, sugar, and tea, which represent 59%, 11%, and 10% respectively of total export earnings. Other important export commodities with inherent potential for expansion include: coffee, cotton, rice, paprika, groundnuts, cassava, chilies, cut flowers, sunflowers, soybeans, beans, and pigeon peas. Cereals such as maize, and roots and tubers provide a major share of the food basket for the majority of Malawians. Other food crops with strong economic importance to the Malawi economy are cassava, sweet potatoes and pulses. Livestock also provide a considerable source of living for many Malawians as they contribute to incomes and the household protein requirement.

Since political independence in 1964, the agriculture sector in Malawi has remained dualistic in structure, comprising large-scale (estate) and small-scale (smallholder) subsectors. The two subsectors are largely differentiated by the landholding sizes and the legal and institutional rules that regulate land tenure, and until recently, crop production and marketing, input supply and pricing as well as provision of extension services. Following the liberalisation of the sector, most restrictions separating the two subsectors were relaxed. Nonetheless, distinctions between the two subsectors still remain apparent.

The smallholder subsector comprises about 3 million farm families locked into subsistence-oriented agriculture on 1.8 million hectares of land under the customary land tenure system. Use of simple, low-cost technologies characterizes smallholder production systems, with women playing a vital role in production. The subsector dominates the production of food crops such as maize, rice, sorghum, cassava, sweet potatoes, Irish potatoes, millet, pulses, and vegetables. Lately, the sector is also increasing its production share in export commodities such as tobacco, cotton, rice, tea, paprika, chilies, and groundnuts. The smallholder subsector accounts for about 80% of the country’s food production, 10% of export earnings and 80% of the country’s workforce. The subsector contributes more than 70% of agricultural GDP, 20% of GDP and 90% of agricultural employment.

On the other hand, the estate subsector takes up 13% of the total land area in Malawi under leasehold or freehold land tenure system, mainly growing cash crops. Tobacco accounts for about 60% of the total estate land, tea 20%, sugar cane 18% and the balance (2%) is used for growing other cash crops and food crops. Some estates have started diversifying their production by growing high value fresh vegetables, paprika, and flowers for the international market. Estate agriculture accounts for more than 25%
of agricultural GDP, 10% of agricultural employment, 9% of total GDP and 90% of export earnings (mainly through export of the major cash crops of tobacco, tea and sugar). The subsector generates 45% of formal employment. As a result of using higher levels of technology, and having relatively easy access to inputs, credit, agricultural services, and markets, productivity on estates is higher than that of the smallholder subsector.

As regards the marketing arrangement of the two subsectors prior to the liberalization of the agriculture sector in Malawi in 1987, the Government treated the two subsectors disproportionately. Structures and regulations governing supply of inputs and purchase of produce, provision of credit, advisory systems, and pricing policies of agricultural products were different. Government used ADMARC to buy, store, process, distribute, sell, transport, and export all farm inputs from the smallholder subsector. In addition, ADMARC managed the entire credit and input supply system for the smallholder subsector, which were provided at subsidized rates.

With liberalization, however, markets for credits, inputs and outputs were freed of government interventions. Many private entities entered the markets for agricultural products, thereby letting market forces of supply and demand shape the outlook of the markets. Thus, both the estate and the smallholder subsectors started playing on a level field. This has brought its own benefits and challenges, hence the review of the priorities, policies and strategies for the agriculture sector in the mid-1990s.

By 1995, the Government had completed and adopted the Agricultural and Livestock Development Strategy and Action Plan (ALDSAP), which was aimed at achieving accelerated, broad-based agricultural and rural development goals to fight against hunger and poverty. Other objectives included: improving food self-sufficiency and the nutritional status of the people; expanding and diversifying agricultural and livestock export products, and rural farm incomes; and promoting economic growth while conserving natural resources. ALDSAP had four main thrusts: increasing and widening the range of food crops grown and marketed to meet the needs of all people; removal of restrictions to participation to any production and marketing activities of agricultural products; broadening the export base and diversifying beyond burley tobacco; and expanding livestock activities by integrating them into the core farming systems.

The policies, plans and actions of ALDSAP were reviewed through the Malawi Agricultural Sector Investment Program (MASIP) process, a ten-year rolling investment plan for the agriculture sector. The review highlighted priority areas requiring urgent attention and investment flows, including: irrigation development; improving access to inputs; addressing infrastructure bottlenecks (road, rail, markets, and provision of water, energy, and telecommunication services); strengthening technology research initiatives and extension; improving livestock productivity; building the agroprocessing subsector; enhancing the credit system; and ensuring market access and better terms of trade for Malawian exports. Government planned to tackle all these issues through a number of programs and initiatives including the implementation of the MPRSP and Growth Strategy. In both of these policy documents, vegetables and the improvement of vegetable marketing are given prominence.

The current marketing arrangements for vegetables in Malawi

Some of the commonly grown vegetables in Malawi include tomatoes, carrots, cabbage, pumpkin, eggplant, Chinese cabbage, green leaves, okra, and green beans. Most of these vegetables are adaptable to almost all the regions of the country, although higher outputs are experienced in the central and southern regions. These vegetables are
mostly grown seasonally, which limits the production and availability of the crops on the market. In the event that such crops are not substituted, their unavailability threatens both the nutritional and food security status of the nation.

Just like other products and commodities, marketing of vegetables in Malawi still remains underdeveloped. Structures and marketing arrangements for vegetables are poor and unimproved. Roadside and door-to-door systems are the primary means of sale. Moreover, the merchandise is normally sold in small quantities. Unfortunately, the same system seems to be operating and dominating in almost all the cities and municipalities. There have been a few attempts to trigger marketing of vegetables by selling at the source in strategic locations, but unfortunately this did not build up momentum. Some crops have been placed into shops, but more needs to be done to promote them further.

While the current system of vegetable marketing leaves a lot to be desired, it must be appreciated that processing, storage and packaging have a bearing on the returns and overall marketing per se. Processing of vegetables for value adding is low, and hence prices result in fewer returns to the farmer. Storage remains a big problem for the whole agriculture sector and vegetables in particular. This limits the horizon of vegetable marketing; outreach is restricted by factors like distance and time. If these could be brought under control, the pre- and post-harvest losses would be reduced significantly.

The geographical spread of the cultivated area under vegetables is limited due to the preference of the growers for dambo areas regardless of access to markets. This problem is compounded by other factors including the inadequacy and form of existing infrastructure. Currently, the existing marketing structures for vegetables are restricted. The readily available outlet for most growers is simply along the main roads of the country, with makeshift shops for a few lucky growers. There are only a few farmer organizations to speed up the process, but they are not strong and lack influence. Insufficient policy guidelines for marketing further hinder sales for farmers. The geographical spread is also affected by the nature and stage of the irrigation styles. Irrigation systems remain underdeveloped; most smallholder growers do not use them. Farms far away from the dambo land hardly grow vegetables during the season, let alone the off-season.

A related development from the irrigation problem indicated in the preceding paragraph is that large-scale investments are not forthcoming, which may be due to a lack of affordable credit facilities compounded by high interest and default rates. If irrigation improves and spreads across the country, vegetable production will pick up and eventually would boost vegetable marketing. Long-term investments in the subsector are barred and land fragmentation is encouraged by existing inheritance patterns. These production factors have a bearing on the supply of vegetables and how they are marketed.

It is believed that the potential for the subsector to pick up and grow is high, based upon several factors. In Malawi, vegetables are “traditional” dishes for most of the middle-income bracket, while in villages, vegetables are inevitably the usual “relish,” especially for the less privileged. This implies that there is a strong market for vegetables; what remains is to explore and develop it further. Most of the vegetable farmers have been casual growers up until recently, when activity in the sector picked up. Today smallholder farmers are expanding the number of vegetable varieties they grown and have increased cropping frequency. Vegetable production is proving to be a source of income for most of the rural masses, and also provides jobs for excess labor.
The flow of agricultural commodities (including vegetables) is restricted by such factors like inadequate market information, weak competition, and a weak private sector, which is unable to penetrate all corners of the economy.

**Prospects for the future**

Despite the apparent problems facing the agriculture sector as a whole and vegetables in particular, Malawi stands a better chance to turn the tables around because there has always been an emphasis on crop production in the country. The agriculture sector still enjoys government priority, and there is potential for the widespread use of irrigation. In addition, the government clearly stipulates that the focus in agriculture is on increasing incomes of poor farmers through commercialization of smallholder agriculture and measures (such as improved extension and promotion of small-scale irrigation) to improve productivity. Vegetable marketing can be strengthened by the three activities highlighted below.

*Promoting adequate vegetable supply*

To achieve this, there is a need to organize smallholder farmers to put their productive resources together through farmer clubs, which would help build buyer confidence. In addition, farmers have to be made aware of the potential of the vegetable subsector’s commercial viability.

*Creation of markets and a reliable marketing information system*

As a follow-up to the preceding point, a well-coordinated production system would easily secure a market for vegetable traders. MoAIFS should be able to provide marketing information regarding standards, prices, and timely and accurate forecasts. Future plans should focus on the deliberate creation of collection centers, marketing platforms, and the provision of handling equipment. It is important that government and the private sector take a lead role in these processes.

*Enhance vegetable processing*

Some vegetables should be processed to add value. This would require other inputs like proper storage and packaging.

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The role of research-extension-farmer linkages in vegetable production and development in Malawi

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Abstract

Over the last five decades, many vegetable varieties and production practices have been developed by researchers, transferred to end-users by field extension staff, and adopted and used by farmers in Malawi. The development of vegetable technologies is the responsibility of the Department of Agricultural Research Services (DARS), whereas the delivery of these to farmers is the primary responsibility of the Department of Agricultural Extension Services (DAES), in collaboration with other technical departments within the Ministry of Agriculture, Irrigation and Food Security (MoAIFS), and increasingly so at the present moment, by nongovernmental organizations (NGOs). This approach, that links researchers, extensionists and farmers, has worked well for many decades in the past, but is increasingly coming under pressure owing to the challenges brought about by decentralization, declining public sector resources, farmer empowerment and the liberalization of the market economy as a result of the democratization process, which has over the last ten years swept across southern Africa in general, and Malawi in particular. The overall objective of this paper is to review the methods, approaches and mechanisms used in vegetable technology development and transfer to farming communities in Malawi. Finally, the paper examines the future potential role of the research-extension-farmer linkage paradigm in technology development, transfer and adoption that is demand-driven, market-oriented, client-oriented, and broadened to include a cross-section of players, including policy makers, administrators, donors, input supplies, traders and NGOs, among many others involved in agricultural research and development initiatives in Malawi.

Background information

Country profile

Malawi covers a total land area of over 11.8 million ha, out of which 9.4 million ha is land and the remaining 2.4 million ha is covered by water bodies, dominated by Lake Malawi, the third largest lake in Africa. Some 5.6 million ha are suitable for arable farming, whereas the remaining 3.8 million ha are covered by forest and game reserves, mountains and infrastructure. Of the total available land area (9.4 million ha), 31% is suitable for rainfed agriculture, 32% is marginal land and 32% is unsuitable for agricultural production (EAD 1998). Currently, the population of Malawi is estimated at
12 million, and is growing at the rate of 1.98% per year (NSO 1998). More than 85% are smallholders who reside in rural areas and derive their livelihoods from cultivating small land holdings of 1-2 ha per farm family of five people (Bunderson and Hayes 1985).

Land-locked, with no significant mineral resources, Malawi’s common pool assets are limited. Agriculture dominates the economy, contributing about 35-40% of the GDP and 85-96% of the foreign exchange earnings, employing more than 85% of the workforce, providing 60-70% of the input into the manufacturing industry, and dominates the commercial and distribution industry (World Bank 1995; EAD 1998, Bunderson and Hayes 1995; Saka et al. 1999).

Agriculture is dualistic in nature, consisting of the smallholder and estate subsectors. The estate subsector consists of commercial estates on private land under freehold and lease status; the smallholder subsector comprises about 2.86 million farm families (DFID 1998) that cultivate 1.8 million ha under the customary land tenure system (MoAI 1998; Phiri et al. 2000). Smallholder farmers account for over 35% of the GDP (EAD 1998), and contribute 80% of the total agricultural production; the estate subsector contributes over 90% of the export trade (World Bank 1995). This state of affairs underscores the importance of agriculture, which centers on crop and livestock production, as the main source of livelihoods for the majority of Malawians.

**Major crops**

The major food crops include: cereal crops (maize, rice, sorghum and millet), grain legumes (groundnut, bean, soybean, cowpea, pigeon pea, guarbean, and bambara nut), and horticultural crops (vegetables, spices, cut flowers, tree nuts, deciduous tropical fruits, coffee, cassava and sweet potato). The major export crops include: tobacco, tea, sugar, coffee, groundnut, cotton and macadamia nuts.

Maize is the major staple food crop for nearly all Malawians. Rice is dominant along the lakeshore areas of Karonga, Rumphi, Nkhata Bay, Nkhota Kota, Salima and Mangochi districts, and sorghum and millet are dominant in the Shire Valley districts of Nsanje and Chikwawa. Although vegetables are not exported outside Malawi, there is high demand at local markets throughout the country, especially in “hot spot” vegetable growing areas. Vegetables are a “staple relish” for most Malawians.

**Vegetables in the diet of Malawians**

Vegetables are an important source of mineral salts and vitamins for all Malawians, and especially so for those who do not have easy access to animal protein. There is a high level of vegetable consumption among Malawians because traditionally, Malawians eat nsima, the national dish, with a side dish of either meat or vegetables, or both of these (together).

However, owing to lack of financial resources, most Malawians in rural areas do not have access to meat; their main side dish is usually only vegetables. Nonetheless, even those who have access to meat on a daily basis, for balanced nutrition, always have vegetables. Some vegetables, such as tomatoes, onions and spices, are used to season other vegetables and meats, so that they are actually eaten on a daily basis. Vegetables are important as a source of food, nutrition, and cash income. In addition, rotten or nonconsumable leafy vegetables are a good source of compost for improving soil fertility. Considerable resources are allocated to the development and dissemination of many vegetable technologies to farmers in Malawi.
Types of vegetable crops

Many types of vegetable crops abound in Malawi. These include exotic and indigenous vegetables. Common exotic vegetables include: cabbage, Chinese cabbage, rape, mustard, tomato, onion, garlic, okra, carrot, green paper, eggplant, cucumber, turnips, lettuce, cauliflower, broccoli, Brussels sprouts, pumpkins, and squash. These vegetables are grown throughout the country provided the soils are well-drained, friable and fertile and environmental conditions are suitable, including adequate soil moisture supplied in the form of either rainfall or irrigation.

Common indigenous vegetables include: Denje (*Corchorus trilocularis*, *Corchorus aestuans*), Bonongwe (*Amaranthus ssp*), Luni (*Cat's whiskers*), Chisoso or Blackjack (*Bidens pilosa*), Chidede (*Roselle*), Mnkhwani (*Cucurbita maxima*), Khwanya (*Phaseolus vulgaris*), Mwamunaaligone (*Galinsoga parviflora*), Kamuganje (*Brassica juncea*), Chitambe (*Vigna unguiculata*), and Jute mallow. Although indigenous vegetables tend to be abundant in specific areas during the rainy season, they are fairly well spread out throughout the country, growing around family homesteads or in dimbas. An opportunity now exists to domesticate some indigenous vegetables so that these too can be grown anywhere in the country provided the soils are supplied with sufficient water and plant nutrients.

Objectives

The overall objective of this paper is to review the role of research-extension-farmer linkages in vegetable technology development, production, and the delivery of vegetable technologies to the farming communities. Specifically, the paper gives a broad overview of: major constraints to vegetable production; available vegetable technologies; major stakeholders; technology development and delivery initiatives; mechanisms for strengthening linkages among stakeholders; and challenges, opportunities and achievements made by DARS over the last fifty years. Finally, the paper examines the future challenges in vegetable technology development and delivery to farmers involving multiple stakeholders (including NGOs), against a background of increasing population pressures, a limited and declining land resource base, accelerating environmental degradation, and increasing poverty among rural and urban-poor households.

Technology development and transfer processes

The technology development and transfer processes involve multiple stakeholders that collaborate and work together in partnership to deliver production-increasing vegetable technologies to farmers. What follows is an overview of technology development and transfer initiatives in Malawi over the last five decades.

Constraints to vegetable production

Although vegetables are widely grown throughout the country, there are many production constraints that limit yields. The major limiting factors include: uncontrolled insect pests and diseases, especially during the rainy season, low soil fertility (low N, P, K, Ca, Mg, S, B, Zn and OM) and nutrient imbalances, inadequate soil moisture, especially during drought periods, the use of unimproved and low yielding vegetable varieties, and the use of poor agronomic and crop husbandry practices (improper land preparation, late and inappropriate weeding, inappropriate plant population densities...
and fertilizer application rates). Among these, low soil fertility and insect pests and diseases pose the greatest danger to sustainable vegetable production in Malawi.

Further, it has been noted that many farmers are not adopting newly developed and released vegetable technologies, which are aimed at enhancing vegetable productivity. There are also many reasons for the low adoption rates, including: inadequate seeds and seedlings, lack of awareness and know-how, use of unimproved or local vegetable varieties, poor postharvest technologies, and weak linkages among stakeholders — researchers, who develop technologies; field extension staff (including NGOs), who transfer technologies; farmers or consumers, who are the end-users of technologies; donors, who fund research; policymakers, who create an enabling environment; agricultural chemical companies, who supply farm inputs; and buyers, vendors, merchants and traders, who purchase and sell vegetable crops. However, the poor performance of the vegetable development and delivery system can mainly be ascribed to weak linkages among different actors and the lack of suitable postharvest processing and storage technologies.

Despite these constraints, vegetable technologies are perhaps the most widely adopted and used throughout the country compared with other crops, including the famous “hybrid maize-fertilizer technology.” For example, the uptake of Khama, a new tomato variety, has been spontaneous among farmers. This is because this new variety has longer shelf life, highly demanded by consumers and processors, and is a major source of cash income for farmers and vendors who sell tomatoes to departmental stores in towns, or at roadside markets in Jenda in Mzimba or Njolomole in Ntcheu. Further, because farmers are now aware that they can earn a lot of money for high quality vegetables, they are willing to apply organic and inorganic fertilizers to improve soil fertility, and chemical pesticides and botanicals to control insect pests and diseases, to improve the quality and quantity of vegetables. Although vegetables are not sold outside the country, there is high demand at local markets that are well-organized, with selling points along all major roads in the country and efficient outlets to the major cities of Blantyre, Lilongwe, and Mzuzu.

Thus, the challenge in the vegetable industry is to further improve the modest gains made in the past so that more high yielding, market-oriented vegetable varieties and production practices are developed and delivered to farmers, with the involvement and participation of all major stakeholders using participatory research and extension methodologies. This will ensure that improved and client-oriented vegetable technologies are developed, transferred and used by farming communities. Such an arrangement requires the involvement and commitment of many stakeholders, including researchers, extension staff, farmers, vendors, and consumers that are linked together for synergy. There is a need to use a combination of strategies, including participatory research and extension methodologies, in the development and delivery of technologies to farmers. Thus, the research-extension-farmer linkage is crucial in vegetable production and development.

**Technology development**

**Developers of vegetable technologies**

The main developers of vegetable technologies include: Department of Agricultural Research Services (DARS), Bunda College of Agriculture (BCA), some special horticultural projects, some individual farmers, and some nongovernmental organizations (NGOs).
However, the main provider of vegetable technologies is DARS, a technical department within the Ministry of Agriculture, Irrigation and Food Security (MoAIFS), whose mandate is to conduct research on all crops (except tobacco, tea and sugarcane) and livestock. Vegetable technologies, especially exotic vegetables, are developed by horticultural scientists of the Vegetable Commodity Research Team within the Horticulture Commodity Group based at Bvumbwe Agricultural Research Station (BARS), one of the three main research DARS stations, located in southern Malawi.

The University of Malawi, in particular Bunda College of Agriculture, has taken a lead in developing new indigenous vegetable varieties and production practices, and domesticating some of these (Kwapata, personal communication). Some horticultural projects, such as those under GTZ, JICA and the Chinese Mission, whose major role is vegetable technology delivery, have also been involved in technology development in response to farmers’ specific demands. For example, the JICA Horticultural Development Project at Lobi in Dedza RDP has recently developed and released one tomato production practice: plastic shelter mulch to control Late Blight disease in tomato, which is now in use by farmers.

There are some progressive individual farmers, such as Mr. Chinkhutha of Freedom Farms in Dowa RDP, who are fine-tuning vegetable technologies to meet site-specific requirements, although by and large, these farmers aim at using already developed technologies. Similarly, with the increasing number of NGOs, some of these have found themselves in a situation where they have to develop, or fine-tune, some technologies to suit site-specific requirements of the farmers they are working with.

So far, the rate of adoption of newly released vegetable technologies is generally low in Malawi, but is rather relatively higher in “hot spot” vegetable growing areas, such as Njolomole in Ntcheu district and Jenda in Mzimba district. This is because vegetables are a high value cash crop in these areas and farmers realize a lot of money from the sale of these. Further, because farmers are aware of the importance of using improved vegetable varieties, they are able to: demand new varieties that are high yielding and tolerant to major insect pests and diseases, and invest time and production resources such as fertilizers and pesticides to optimize yields and satisfy market needs in terms of quantity and quality requirements.

Thus, the provision of research services, which was the mandate of DARS (exotic vegetables) and BCA (indigenous vegetables) in the past, is increasingly being shared by other organizations and stakeholders. Although this is giving farmers a wider choice of research service providers, there is a need for: coordinating the various stakeholders; creating an enabling environment for continuous learning, collaboration and networking; and building binding and sustainable relationships and linkages for an effective and efficient research service delivery system.

**Vegetable technologies**

The overall objective of the vegetable research program is to develop vegetable varieties that are high yielding and tolerant to major insect pests and diseases. From such research programs, many agricultural technologies have been developed and packaged (GAP 1984) and recommended to farmers. Generally, there are two types of vegetable technologies that have been recommended: crop varieties or cultivars, and vegetable production practices (crop management and protection practices). For example, among the newly released vegetable varieties are the four tomato varieties: Mbambande, Khama, Mpindulitsa and Changu, and one paprika variety, Papri Queen. The released vegetable production practices include: time of sowing and/or seedling
transplanting; seed rates; planting patterns and plant population densities; methods of seed bed preparation; types, rates, times and methods of mineral and organic fertilizer application; time and methods of staking and harvesting; methods and procedures for raising seedlings in the nursery; insect pest identification and control measures; plant disease diagnosis, identification and control measures; time and frequency of weeding and watering; and postharvest processing and handling practices.

**Conclusion**

Based on what has been presented above, it can be concluded that apart from DARS and BCA, there are many other organizations that also develop vegetable technologies for use by farmers. Private sector organizations, such as NGOs and input suppliers, and some individual farmers are increasingly becoming important in this regard. This is posing new challenges for DARS, which is a public sector organization whose mandate is to develop vegetable technologies for farmers in Malawi. This is creating new challenges in the way technologies are developed following Agricultural Technology Clearing Committee (ATCC) guidelines, the way stakeholders are coordinated, the way quality research is maintained, the way different stakeholders collaborate and network, and how they are linked together for synergy.

An even greater challenge facing agricultural research service providers is the low adoption rates of newly developed and released vegetable technologies, especially by resource-poor smallholder farmers. However, the rate of adoption of new technologies in “hot spot areas” is quite high because of high market demand for produce. Secondly, there has been a slow pace in new vegetable technologies that have been developed and officially released by the ATCC. For example, over the last three years (2000-03), only four tomato varieties, one paprika variety and six vegetable production practices have been officially released by ATCC.

**Technology transfer**

*Delivery of vegetable technologies*

Vegetable technologies in Malawi are delivered to farmers by both public and private sector organizations. Within the public sector, extension services are provided at national and district (or local) levels. Those at national level include: Department of Agricultural Extension Services (DAES), Department of Land Resources Conservation (DLRC), Department of Crop Production (DoCP), Department of Irrigation (DoI), Department of Animal Health and Livestock Development (DAHLD), and Department of Agricultural Research Services (DARS).

Over the last ten years, private sector organizations (categorized either as non-profit making or profit making) and special horticultural projects have emerged as important partners in the provision and delivery of extension services to farmers. These include: private companies, farmers’ organizations and associations, input suppliers, individual farmers, and nongovernmental organizations (NGOs). The most prominent horticultural projects and associations, whose major objectives are to enhance vegetable technology adoption and use, are: the GTZ Horticultural Development Project, the Chinese Vegetable Development Project, the JICA Horticultural Development Project, the Horticultural Development and Organization of Malawi (HODOM), and the Horticultural and Food Crops Project (HFCP).

At the local or district level, both public and private sector organizations provide vegetable extension services. The major public sector extension service provider is DAES at national level, Agricultural Development Divisions (ADDs) at the subregional
level, Rural Development Projects (RDPs) at district level, and Extension Planning
Areas (EPAs) and Sections at the local level. However, with the implementation of the
decentralization policy, agricultural extension services at district, or RDP level, will be
provided by District Assemblies (DA), but with strong linkages to national level extension
organizations. Private sector organizations, especially NGOs, are also very active in
technology delivery to farmers in the areas where their projects are operating.

Users of vegetable technologies

Besides the general public, the main consumers of vegetable crop technologies are
public government institutions, such as schools, hospitals and prisons; and private
sector organizations, such as large estates and manufacturing companies, for example,
the Limbe Leaf Tobacco Company. Vegetables are a “staple relish” for the majority of
Malawians.

Delivering agricultural technologies to farmers

Historical perspectives on agricultural technology delivery to farmers

Historically, five periods in the technology delivery process can be distinguished, starting
from the 1950’s to the present. These periods characterize the attitudes of professionals
and the various assumptions made for the low adoption rates or nonadoption of new
technologies. The salient features characterizing these periods are briefly described
below.

- **1950s and the early 1960s.** It was assumed that farmers “do not know” and should
therefore be “taught the right technology” by professionals. The result was that the
technology often was not useful and not adopted by farmers. This is what has been
termed the traditional “**Transfer of Technology**” approach.

- **1960s and the early 1970s.** Farmers were assumed as not having the necessary
means, and the response from the professionals was “ease the constraints by
providing inputs, credit and implements” so that farmers adopt technologies. The
result was that resource-rich farmers benefited, but not resource-poor farmers. This
is what has been termed the “**Green Revolution**” package approach.

- **1970s and the early 1980s.** It was assumed that the proposed technology did not
fit into farmers’ production conditions, and the attitude of professionals was to
understand the conditions of farmers and design an appropriate technology.
Generally, the constraints were eased and the situation improved, but resource-poor
farmers in remote areas were not reached, and so did not benefit. This approach
has been referred to as the “**Hard System Research**” approach. Farming Systems
Research (FSR) and on-farm research are examples of this approach.

- **1980s and the early 1990s.** It was assumed that the proposed technology does not
match with farmers’ goals, and the response was to let farmers indicate what they
need, so that researchers, extension workers and farmers, can work together to
figure out viable solutions. The result was that this was still a researcher driven-
process with limited participation by extension staff and farmers, leading to low
technology adoption. This is what has been termed a “**Soft System Perspective,**”
“**Agricultural Knowledge Systems (AKS),**” “**Participatory Technology Development (PTD),**” or “**actor networks**” approach.
• **1990s and the early 2000s.** The assumption here is that researchers alone cannot grasp the complexity and dynamics of local situations, so that the response is the one where farmers' indigenous knowledge and their informal systems should play a role in the innovation process. Researchers, extensionists and farmers experiment jointly to contribute their specific knowledge and skills. This is a "Soft System Perspectives" approach that integrates ecological and social aspects, gender analysis and participatory approaches. It is hoped that this approach, which is quite comprehensive, will enhance the development of appropriate technologies.

**Delivering vegetable technologies to farmers from the 1970s**

The main driving force in the delivery of extension services to end-users is the Ministry of Agriculture, Irrigation and Food Security (MoAIFS), which is done through its six technical departments. However, among these, DAES takes the lead in the extension delivery service, providing policy guidelines, coordinating extension services, training field staff and farmers, providing information, education and training materials and initiating and strengthening farmers’ organizations. Recently, DAES has developed a new extension policy that is pluralistic, demand-driven and client-oriented in response to the challenges brought about by the democratization process.

However, other government ministries and departments also provide vegetable extension services to farmers. For example, the Ministry of Health and Population Services (MoHPS), in its nutrition program, advises and recommends the eating of vegetables to improve and balance daily diets. In addition, training institutions, such as Bunda College of Agriculture, provide vegetable extension services to farmers and field extension staff surrounding the college, and to students as part of their training program.

It is increasingly being recognized that most of the vegetable technologies currently used by farmers were developed a long time ago, whereas the newly released technologies have not yet been fully adopted by farmers. There is a need to make Malawians aware of the availability and importance of these technologies. It is for this reason that since the late 1970s DARS has undertaken several technology dissemination initiatives, the latest of which is the use of Technology Transfer Committees (TTCs) to ensure that newly released technologies are adopted and used by farmers. What follows is a brief discussion of these initiatives, which also illustrate the important role of research-extension-farmer linkages: farming systems approach; on-farm trials; demonstrations and field days; DARS publications; provision of information services; release of new agricultural technologies; production of breeder seed; training of frontline field extension staff and farmers; and use of technology transfer committees.

**Farming Systems Approach (FSR):** FSR was introduced in DARS in the late 1970s when some farmers were attached to research stations as unit farmers (Phiri 2001). Later in the early 1980s, this evolved into the Adaptive Research Teams (ARTs), which generally comprised social scientists, production economists, biological scientists, extensionists and anthropologists, with the aim of developing research programs that were holistic, interdisciplinary and cost effective in generating technologies appropriate to the production and consumption goals of rural households in specific microenvironments.

ARTs focused on technology development, dissemination, use, and output at farm level. Although ARTs mainly focused on cereal crops, especially maize, some efforts were directed at vegetable crops, especially in the major vegetable growing districts of Dedza and Ntcheu in Lilongwe Agricultural Development Division (ADD). However, this approach faced several implementation problems, including: lack of proper integration...
and weak linkages between ARTs and research station scientists; misunderstandings on the perceived impact of the FSR; continued low adoption rates of technologies; and the capital-intensive nature of FSR. As a result of these uncertainties and weak linkages among major players, this approach was abandoned in 1992. However, some elements of the FSR approach started emerging again in late the 1990’s when the FARMESA initiative was introduced.

**On-farm trials, demonstrations and field days:** On-farm trials (OFT) and technology demonstrations, and field days are an essential part of the technology dissemination process. OFT are aimed at testing potential technologies in collaboration with farmers with the aim of taking into account farmers’ preferences and constraints before disseminating the technology to a wider audience. Demonstrations and field days, on the other hand, demonstrate the performance of proven technologies identified from OFT. This is seen as an opportunity for scientists to gain feedback from farmers and extensionists. In addition, these trials and demonstrations are a requirement for the Agricultural Technology Clearing Committee (ATCC). The ATCC is a committee that approves the release of agricultural technologies that have been tested for at least three years under both research station and on-farm conditions.

In line with this, many vegetable technologies, especially on cabbages and tomatoes, have been tested and demonstrated on farmers’ fields. Several field days have been conducted. For example, field days have been conducted in Njolomole EPA in Lilongwe ADD for four new tomato varieties (Mbambande, Khama, Mpindulitsa and Changu); four tomato production practices (application of tobacco, ash and soap concoction to control red spider mite, intercropping tomato with onions to reduce red spider mite infestation in tomato, measures for mitigating red spider mite on tomato, application of plastic shelter mulch to control Late Blight Disease); and three cabbage production practices (use of solarization, lime and flusulfamide to control club root disease) involving farmers, field extension staff, local leaders, researchers and other stakeholders.

Recently, DARS has recognized the need for coordinated technology delivery services using on-station “demonstration blocks” for all newly released technologies, instead of scattering them across the length and breadth of the station fields. Vegetable crops have also been demonstrated in these blocks. This approach is already paying dividends in terms of saving time and scarce financial resources, especially so when all DARS research stations are encouraged to hold at least one field day per year. These on-station field days attract local farmers, school children, policy makers, donors, administrators, input supplies, NGO representatives and members of the general public.

**DARS Publications:** DARS also disseminates its technologies through the publication of various documents: *AgriTech News*, extension circulars, posters, station flyers, station guides, conference proceedings, annual reports, research bulletins, and the Malawi Journal of Agricultural Sciences (MJAS). These publications are produced under the auspices of the Agricultural Research Publications Committee (ARPC), which is charged with developing a system that ensures technologies arising from research are documented and communicated to all stakeholders and the general public. For example, 1500 copies of *AgriTech News* are produced per issue, which are distributed to field extension staff, NGOs, farmers, donors, policymakers, local leaders, district assemblies, government ministries and departments, and members of parliament. In this way, newly released tomato varieties and cabbage and tomato production technologies have been communicated to all major stakeholders in the agriculture sector.
Provision of information services: DARS provides library services at all its research stations, which are accessible to all stakeholders in the agriculture sector, including farmers. The network of libraries maintain more than 70,000 references and subscribes to more than 150 journals, maintains databases of serials, monographs, reprints, reports, proceedings of conferences, workshops and meetings, microfiche, theses, and many other documents. Recently, DARS can be reached on the internet at the following address: www.agricresearch.gov.mw, which is a significant step for DARS in the way it disseminates information and agricultural technologies to various stakeholders.

Release of new agricultural technologies: DARS has a formal and credible process of releasing new agricultural technologies. In the early 1970s, the Variety Release Committee (VRC) was formed and charged with the function of approving crop varieties, or cultivars, for cultivation by farmers in Malawi. In 1998, the Agricultural Technology Clearing Committee (ATCC) replaced the VRC. The ATCC has a broadened mandate to approve the release of all newly developed agricultural technologies, including or cultivars, animal breeds, and crop and livestock production practices. For example, the release of four new tomato and three cabbage technologies by the ATCC this year is one way of facilitating technology transfer to end-users.

Production of breeder seed: DARS promotes most of its technologies through the production and provision of breeder seed to seed companies, seed grower associations, NGOs and individual farmers. For example, basic seed of newly released tomato varieties has been provided to some individual farmers, and special horticultural projects such as the GTZ Horticultural Development Project and the Chinese Vegetable Development Project, as an effective and efficient way of making new seeds available to farmers.

Training of frontline field extension staff and farmers: Training is one of the most effective ways DARS transfers technologies and disseminates information to farmers and other stakeholders. DARS scientists train frontline field extension staff and NGO personnel in various agricultural fields, including seed production, insect pest identification, disease diagnosis and control measures and crop management practices. Recently, DARS scientists have compiled all new agricultural technologies released after 1990 for open-pollinated varieties and after 1998 for hybrid varieties, into a Training Course Manual (Saka et al. 2003). DARS research scientists have used this manual to train 95 crops officers and 25 extension officers in the ADDs.

Use of technology transfer committees (TTCs): Over the last three years, DARS has initiated TTCs at all its research stations to spearhead the technology transfer process, but in collaboration with other stakeholders that include field extension staff, NGOs, farmers, local leaders and input suppliers. TTCs aim to enhance technology transfer and use, and improve linkages among stakeholders residing around research stations. The implementation of TTC activities requires the participation of many stakeholders: technology developers (researchers), extension service providers (extension workers), and technology users (farmers). These need to be coordinated and linked together so that they act as one in the technology development and transfer process.

Conclusion

It can be concluded that a lot of concerted effort has been put in place to deliver vegetable technologies to farmers in Malawi. To this end, it also has been shown that
DAES is no longer the only public sector organization that provides extension services to farmers in Malawi. DARS is also taking up the challenge, especially with the formation of TTCs at each research station. There are currently an increasing number of private sector organizations, especially NGOs and private companies, which are actively involved in delivering vegetable technologies to farmers. This state of affairs is also creating new challenges for the vegetable extension delivery system in terms of coordination, quality control measures, collaboration, and maintaining binding relationships and linkages among the various actors.

The role of research-extension-farmer linkages

Linkages among major stakeholders are widely recognized as essential mechanisms for the flow of technologies and information among farmers, researchers and extension workers. In addition, effective linkages are a crucial aspect of a creative and innovative research and extension service delivery system.

The linkage between researchers, extensionists and farmers is important and crucial for technology development and transfer. This is especially so because DARS does not have its own frontline field extension staff that are directly in touch with farmers. Thus, for effective technology transfer, DARS depends on the services of staff from the other five technical departments: Extension Services (DAES), Crop Production (DoCP), Irrigation (DoI), Land Resources Conservation (DLRC), and Animal Health and Livestock Development (DAHLD). These departments maintain a considerable presence of field extension staff at Rural Development Project (RDP) and Extension Planning Area (EPA) levels. Further, DAES has extension field staff at the section level that are always in direct contact with farmers. DARS has always depended on these institutions for the delivery of its technologies to farmers. Hence, one of the major portfolios of DARS has always been to strengthen weak linkages among all these extension service providers and farmers.

Recently, a lot of research and extension service providers have emerged. These include NGOs, individual farmers and input supplies. For example, the Chemicals and Marketing Company Limited recently released a cotton production package that should normally have been developed by cotton scientists at Makoka Agricultural Research Station. This type of situation calls for quality control checks in the way technologies are developed in line with ATCC guidelines. No doubt, the linkage among all stakeholders is of vital importance, so that the major role of the “research-extension-farmer linkage” is to ensure that there is coordinated planning and implementation of programs, improved communication and strengthened linkages among collaborators, partners and stakeholders to achieve synergy.

Strategies for strengthening research-extension-farmer linkages

DARS, in collaboration with other extension service providers, especially DAES, has put in place several strategies to enhance the technology development and transfer processes. The strategies used in developing vegetable technologies are essentially the same as those for disseminating the technologies. This shows that the linkage mechanism among different stakeholders is not a discrete entity, but a continuous variable that transcends the boundaries of the technology development and transfer continuum. These strategies, or mechanisms, include: on-station and on-farm field days; joint field visits; farmer, extension staff and farmer-to-farmer study visits and tours; participation in research priority setting workshops and pre-season seminars; sharing information and experiences through DARS publications; provision of services through functional committees, such as the ATCC and the ARPC; on-station and on-farm
demonstrations and verification trials; collaborative research and extension programs; use of participatory research and extension methodologies; and use of TTCs.

Through the use of these strategies, either singly or in combination, the linkages among researchers, extension workers and farmers, have been strengthened. However, some of these strategies have not been very effective in cementing linkages among stakeholders. This is not because they are bad strategies, but because they are poorly or wrongly implemented owing to many reasons, including continued weak and poor linkages among stakeholders, inadequate financial resources, lack of commitment and a shared vision among stakeholders, and a lack of proper coordination. The introduction of TTCs is perhaps one of the most creative and novel strategies to enhance the technology transfer and adoption processes and strengthening linkages among stakeholders, realizing stakeholders need to be coordinated to conduct quality research and deliver quality extension services to farmers.

Challenges, opportunities and achievements

Despite the availability of many technologies, research and extension service providers, technology development and transfer mechanisms, and the fact that vegetables are widely eaten in Malawi, the adoption rate of new vegetable technologies is generally low, except in vegetable growing “hot spots” where farmers now demand new technologies to increase yields and maximize profits. There are many factors that constrain vegetable production in Malawi. Here we give a cursory overview of: the challenges that constrain vegetable production, the opportunities available to DARS to take advantage of when developing technologies and addressing some of the challenges, and the achievements made by DARS over the last few decades, despite the problems, to illustrate the important role of research-extension-farmer linkages in Malawi.

Challenges

DARS is currently facing serious challenges in the way it generates and disseminates agricultural technologies to farming communities, especially smallholder farmers who lack financial resources to purchase farm inputs. These challenges are both internal and external to DARS.

Internal challenges

The internal challenges include: continued low adoption rates of new agricultural technologies; lack of the institutionalization of participatory research and extension methodologies; developing demand-driven agricultural technologies in partnership with other stakeholders; emergence of other research and extension service providers, including NGOs and input suppliers; poor coordination and weak linkages among stakeholders; low morale and lack of incentives for innovative, creative and highly motivated scientists; inadequate financial, physical, human resources; and poor and inadequate communication channels between and among stakeholders and clients, and external sources of knowledge.

External challenges

The external challenges that DARS has to take into account when developing and disseminating research technologies and maintaining binding relationships and linkages among stakeholders include: liberalization of the market economy; decentralization;
gender issues; HIV/AIDS crisis; declining public sector resources; low literacy levels of
the farmers; increasing poverty among farmers; and removal of subsides on farm inputs.

Opportunities

Despite the challenges, the advent of multi-party democracy in the 1990s has brought a lot of opportunities for DARS to develop and transfer quality technologies to end-users and strengthen linkages among stakeholders. These include: use of participatory research and extension methodologies; availability of a large critical mass of highly-trained agricultural scientists; availability of large amount of research data that can be packaged into production technologies and disseminated to farmers; availability of strong collaborative research program with stakeholders; and commitment by DARS scientists to develop and document new technologies, and communicate information to farmers, donors, policy makers, extension field staff and fellow scientists inside and outside the country, using different communication channels.

Achievements

Over the last fifty years DARS has developed and facilitated the transfer of many agricultural technologies, the bulk of which are currently in use by farmers. Among the many achievements are the following: development of an effective organizational research structure based on multi-disciplinary commodity research teams and groups that embrace participatory approaches, collaboration and networking among stakeholders; development of a network of research, experiment and sub-stations in different agroecological zones that quickly respond to site-specific farmer demands; development of a research master plan that outlines the DARTS vision, mission, goals, strategic objectives and priority areas for research; development of a large number of agricultural technologies (improved crop varieties or cultivars, agronomic and crop husbandry practices, soil fertility improving technologies, integrated pest management, farm machinery implements, advisory services, soil and plant analysis, fertilizer recommendations based on soil tests, insect pest and disease identification and control measures, issuance of phytosanitary certificates, among many others); production of extension circulars, annual reports, research bulletins; establishment and publication of the Malawi Journal of Agricultural Sciences (MJAS) and AgriTech News; development of the DARS Website; establishment of functional committees: ATCC and ARPC; development and implementation of a new DARS career structure; and development of the DARS Strategic Plan.

The way forward

Malawi will continue to face the problem of food insecurity in the foreseeable future due to low agricultural productivity that is principally caused by: low use, or non-use, of new and improved agricultural technologies (crop varieties and production practices); non-use of participatory research and extension methodologies; weak linkages among stakeholders; poor coordination of activities; and increasing poverty among farmers. The situation is exacerbated by: increasing population pressure; land degradation; overgrazing and deforestation; declining public sector resources; and the prevalent HIV/AIDS crisis. There is an urgent need to fully recognize the role of multiple stakeholders in technology development and transfer, empowerment of farmers under decentralized district level structures, and the development of demand-driven and market-oriented technologies. In this way, vegetable productivity will be increased and significantly contribute to improved food security and nutritional status, and reduced poverty in fulfillment of Vision 2020 and the Malawi Poverty Reduction Strategy Paper (MPRSP).
The way foreword for DARS is to respond to both internal and external challenges. DARS has to be more creative and reach out to many farmers. To do this, DARS will have to develop a shared vision and a strategic plan of action that is farmer-led and responsive to farmers’ needs. DARS will need to do some of the following: develop innovative and creative mechanisms for reaching out to research service users, such as the use of TTCs; institutionalize participatory research and extension methodologies as the way forward to ensure stakeholder interaction and collaboration; establish strong and binding cooperative relationships with stakeholder and partners; develop marketing strategies for new research technologies; strengthen linkages among farmers, NGOs, donors, input suppliers, merchants, research and extension workers; develop effective communication channels for the delivery of new technologies; develop quality control measures to ensure that only quality research technologies are developed and delivered to farmers; create an enabling environment to reach out directly to farmers and other users of technologies; train staff and farmers in participatory research and extension methodologies, facilitation skills, and communication skills, among many other skills; and develop strong linkages among providers, deliverers and users of technologies, including donors, input supplies and traders.

Summary

Agriculture is the mainstay of the Malawi economy. Many exotic and indigenous vegetable technologies have been developed. Most of the technologies adopted by farmers were developed a long time ago, whereas many farmers do not adopt newly released technologies. Many strategies and approaches for technology development and transfer, and strengthening linkages among stakeholders are available. For the research-extension-farmer linkage to function properly, linkages among different institutional actors and agricultural knowledge and information systems, must be improved and strengthened. What is more significant is how to continue strengthening the linkages among different stakeholders against a background of many internal and external challenges, despite the new opportunities that have emerged with the advent of multi-party politics.

DARS will have to embrace participatory research and extension methodologies in setting the research agenda, improving communication channels, strengthening the existing weak linkages among the different actors, and reaching out to many farmers for effective research technology development, transfer and delivery to farmers. With the presence of many research service providers in decentralized Malawi, DARS will also have to make sure that the quality of research output is of an acceptable standard. However, DARS may have to review the rules and regulations of how new technologies are developed and released to accommodate other research service providers, including NGOs and chemical companies. The future increasingly will depend on DARS adopting new and novel strategies for vegetable technology development, delivery and use, and strengthening linkages among stakeholders.

Acknowledgements

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References


Vegetable production improvement at the Horticultural Development Training and Extension Center

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Technical Mission of the Republic of China, Lilongwe

Abstract

The Horticultural Development Training and Extension Center (HDTEC) was established at the request of the Malawi government in July 1995. The center’s major activities are experiments, production improvement, demonstrations, training, and extension of horticultural crop technologies.

The center is located within the Natural Resources College, and is situated 1095 meters above sea level with an average annual rainfall of 854 mm and average dry season rainfall of about 100 mm. The rainy season usually starts in November and tails off in March, then from April to October it is usually dry. The center has a monthly average temperature of 16-23°C and a relative humidity of 52-85%. The soil is red acidic loam, and water for irrigation is pumped up from the Likuni River, which is perennial.

The center has introduced twelve kinds of vegetable and cultivars. The introductions emphasize cabbage, tomato, mustard and cauliflower. The vegetable planting demonstration focuses on vegetable soybean, ginger, asparagus, and greenhouse crops. The center's vegetable improvement work has focused on tomato, cabbage, mustard, cauliflower, vegetable soybean, ginger and asparagus.

During 1998-2002, the center conducted ten training courses. A total of 250 extension officers and farmers have been trained. The center has established and supervised two extension programs in Vegetable Production and Marketing and in general extension. The mission team works in collaboration with local field assistants to provide technical advice. From 1998 to 2002 the center has provided vegetable seeds and seedlings covering about 134.2 ha to farmers.

Introduction of commercial cultivars

The center has introduced different kinds of vegetable cultivars from Taiwan, South Africa, Zimbabwe, Holland and other countries. The cultivars are shown in Table 1.

Evaluation

Tomato

The tomato yield is very low in rainy season. Many leaf diseases affect the plants, such as late blight, leaf mold, gray leaf spot, bacterial spot, and viruses.

The tomato yield is high in the dry season. Late blight, leaf mold, and red spider mites are the major pest and diseases problems.
Rainy season
Fresh market tomato trial: The highest yielding is CLN 2037F36t/ha; the lowest is Tommy 10 with 2.7t/ha (Table 2).

Cherry tomato trial: Juliet with 30t/ha is the highest yielding; the lowest is Magnolia at 12t/ha (Table 3).

Dry season
Fresh market tomato trial: The highest yielder was Danny with 85.9t/ha (Table 4).

Cherry tomato trial: Juliet 63t/ha was the highest yielder (Table 5).

**Cabbage**

Rainy season
The major problem is black rot Glory of Enkhuizen, Summer Summit, Hercules, and Conquistador yields are over 90t/ha. Tropical Delight, Marcanta, Supreme, K.Y. Cross, Gloria Kid, and Grandslam yielded about 80t/ha. The open-pollinated cultivars yields are low, about 32-53t/ha (Table 6).

Dry season
The major pest problems are diamondback moth and cabbage aphids. The highest yielding was Conquistador with 150t/ha and the lowest yielding was Golden Acre with 65t/ha (Table 7).

**Mustard**

Chikonje starts bolting when about six leaves are out. For the rainy season, maturity is late and yield is higher than in the dry season. Yield is higher for heading types than broad leaf types (Table 8).

**Cauliflower**

White Coral is an extra-early cultivar. The yield is low in the rainy season. Autumn King and 80 Days are medium cultivars and the yield is high (Table 9).

**Planting demonstration**

**Vegetable Soybean**
Vegetable soybean is same as common soybean, except the bean is harvested while the pod is still green. Vegetable soybean is easier to plant than green peas and has a protein content of about 40%. The technical mission introduced three cultivars from Taiwan. In the rainy season, the pods are ready for harvest about 75-85 days from planting. The green seed yield is 2,000 kg-2,600 kg/ha.

**Ginger**
Ginger is very easy to plant under Malawi’s climatic conditions. Ginger has potential for export to Europe. The technical mission has introduced several ginger cultivars from Taiwan. Ginger requires 7-8 months from planting to harvest. Ripe ginger yield is about 20-25 t/ha.
Asparagus
The technical mission introduced three cultivars of asparagus from Taiwan. After planting, asparagus must grow for ten months before harvesting can begin. In a year asparagus can be harvested for 6-7 months. The green spear yield is about 3-4 t/ha. Asparagus can be supplied to hotels, restaurants, and supermarkets. It has also potential for export to Europe.

Greenhouse planting
Tomato, English cucumber, muskmelon and sweet pepper may be grown in greenhouses during the rainy season to produce high quality, high yield, clean crops. Hybrid tomato cultivars with a long shelf-life, such as Thomas, FA 593, and Radja, are recommended for greenhouse production.

Training
During 1998-2002, the center conducted ten training courses on topics including crucifers, cucurbits, rainy season tomato production, legume crop production, vegetable seedling management, spices and herbs production, maize production. A total of 250 participants attended the courses. The participants were drawn from the eight ADDs.

Extension
As of now, the center has established and supervised two extension programs: The Vegetable Production and Marketing Unit, and General Extension. The Vegetable Production and Marketing Unit farmers are assisted with inputs such as seed, fertilizer, pesticides and technical advice. We encourage the unit farmers to pay back the initial cost of the production inputs through contributions after each crop sale; they deposit the money in a group account as a revolving fund, for sustainability after the project is phased out.

General Extension farmers are assisted with asparagus seedlings, sweet potato cuttings, vegetable seed, and seedlings.

From 1998 to 2002 the HDTEC has provided vegetable seed and seedlings covering about 134.2 ha to farmers (Table 10).

Future plans
Garlic production improvement
The native cultivar has a small bulb size, so there is a need for short-day varieties with larger bulb sizes to be evaluated under Malawi's climate.

True seed Irish potato propagation system
The potato yield is low in Malawi due to viruses carried in seed potatoes. Production by true seed can avoid the virus risk.

Evaluate muskmelon cultivars
Muskmelon production in Malawi is not easy due to Fusarium wilt, bacterial wilt and powdery mildew. Resistant cultivars are needed.
References


Asian Vegetable Research and Development Center. 1996, Vegetable crops agribusiness.

Chongwe HE. 2001. The state of horticultural production in Malawi.


Tables

**Table 1.** List of Vegetable commercial cultivars introductions

<table>
<thead>
<tr>
<th>Crop</th>
<th>Number of cultivars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>74</td>
</tr>
<tr>
<td>Peppers</td>
<td>35</td>
</tr>
<tr>
<td>Onion</td>
<td>20</td>
</tr>
<tr>
<td>Cabbage</td>
<td>32</td>
</tr>
<tr>
<td>Mustard</td>
<td>18</td>
</tr>
<tr>
<td>Kale</td>
<td>11</td>
</tr>
<tr>
<td>Garlic</td>
<td>20</td>
</tr>
<tr>
<td>Ginger</td>
<td>7</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>15</td>
</tr>
<tr>
<td>Vegetable Soybean</td>
<td>4</td>
</tr>
<tr>
<td>Snap bean</td>
<td>22</td>
</tr>
<tr>
<td>Potato</td>
<td>4</td>
</tr>
<tr>
<td>Asparagus</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table 2.** Tomato observation trial, rainy season (Planted: 4 January 2000. Harvested: 20 March-9 April 2000)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Yield (t/ha)</th>
<th>Fruit size (g)</th>
<th>Growth habit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money maker</td>
<td>17.3</td>
<td>80</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Floradade</td>
<td>8.0</td>
<td>100</td>
<td>Semideterminate</td>
</tr>
<tr>
<td>Taichung # 4</td>
<td>7.5</td>
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<td>Indeterminate</td>
</tr>
<tr>
<td>CLN 2037 B</td>
<td>28.0</td>
<td>103</td>
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</tr>
<tr>
<td>CLN 2037 D</td>
<td>30.7</td>
<td>98</td>
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</tr>
<tr>
<td>CLN 2037 F</td>
<td>36.0</td>
<td>85</td>
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</tr>
<tr>
<td>Tommy 10</td>
<td>2.7</td>
<td>80</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Tommy 30</td>
<td>12.0</td>
<td>70</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Zeal</td>
<td>4.0</td>
<td>90</td>
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</tr>
<tr>
<td>861 (F)</td>
<td>7.3</td>
<td>120</td>
<td>Semideterminate</td>
</tr>
</tbody>
</table>

**Table 3.** Cherry tomato observation trial, rainy season (Planted: 23 October 2001. Harvested: 27 December 2001 - 8 February 2002)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Yield (t/ha)</th>
<th>Fruit size (g)</th>
<th>Brix (%)</th>
<th>Growth habit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 154</td>
<td>27.3</td>
<td>30</td>
<td>5.0</td>
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</tr>
<tr>
<td>CH 264</td>
<td>26.7</td>
<td>40</td>
<td>5.5</td>
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<tr>
<td>AVRDC Selection</td>
<td>26.0</td>
<td>20</td>
<td>6.0</td>
<td>Semideterminate</td>
</tr>
<tr>
<td>Ship Saints</td>
<td>28.0</td>
<td>30</td>
<td>7.0</td>
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</tr>
<tr>
<td>Juliet</td>
<td>30.0</td>
<td>40</td>
<td>5.0</td>
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</tr>
<tr>
<td>Camelia</td>
<td>25.0</td>
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<tr>
<td>Magnolia</td>
<td>12.0</td>
<td>30</td>
<td>7.0</td>
<td>Indeterminate</td>
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</table>

**Table 4.** Fresh market tomato observation trail in dry season (Planted: 7 May 2002. Harvested: 25 July – 20 October 2002)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Yield (t/ha)</th>
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<td>Six Pack</td>
<td>64.4</td>
<td>110</td>
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<tr>
<td>Thomas</td>
<td>73.3</td>
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</tr>
<tr>
<td>FA 593</td>
<td>65.8</td>
<td>110</td>
<td>Very long</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Red Kaki</td>
<td>60.7</td>
<td>130</td>
<td>Short</td>
<td>Determinate</td>
</tr>
<tr>
<td>Discoll</td>
<td>79.8</td>
<td>110</td>
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<td>Determinate</td>
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<td>Danny</td>
<td>85.9</td>
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<tr>
<td>Fortress</td>
<td>66.3</td>
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<td>Determinate</td>
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<td>Floradade</td>
<td>58.3</td>
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<td>Money Maker</td>
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<table>
<thead>
<tr>
<th>Entry</th>
<th>Yield (t/ha)</th>
<th>Fruit size (g)</th>
<th>Brix (%)</th>
<th>Growth habit</th>
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<td>Semideterminate</td>
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<tr>
<td>Ching chen</td>
<td>60.0</td>
<td>30</td>
<td>5.0</td>
<td>Semideterminate</td>
</tr>
<tr>
<td>Juliet</td>
<td>63.0</td>
<td>40</td>
<td>5.5</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Santa</td>
<td>40.0</td>
<td>30</td>
<td>7.5</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Ship Saints</td>
<td>36.6</td>
<td>30</td>
<td>7.0</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Magnolia</td>
<td>33.3</td>
<td>30</td>
<td>7.0</td>
<td>Indeterminate</td>
</tr>
</tbody>
</table>

Table 6. Cabbage observation trial in rainy season (Planted: 10 January 2002)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Maturity (*DAP)</th>
<th>Head size (kg)</th>
<th>Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum Head</td>
<td>70</td>
<td>2.0</td>
<td>52.8</td>
</tr>
<tr>
<td>Golden Acre</td>
<td>50</td>
<td>1.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Glory of Enkhuizen</td>
<td>65</td>
<td>2.2</td>
<td>96.0</td>
</tr>
<tr>
<td>Tropical Delight</td>
<td>60</td>
<td>2.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Copenhagen Market</td>
<td>55</td>
<td>1.3</td>
<td>43.3</td>
</tr>
<tr>
<td>Summer Summit</td>
<td>60</td>
<td>2.4</td>
<td>96.0</td>
</tr>
<tr>
<td>Marcanta</td>
<td>65</td>
<td>3.0</td>
<td>85.4</td>
</tr>
<tr>
<td>Gloria Kid</td>
<td>65</td>
<td>2.2</td>
<td>80.0</td>
</tr>
<tr>
<td>Grandslam</td>
<td>70</td>
<td>2.7</td>
<td>85.4</td>
</tr>
<tr>
<td>Hercules</td>
<td>65</td>
<td>2.8</td>
<td>96.0</td>
</tr>
<tr>
<td>Conquistador</td>
<td>80</td>
<td>3.2</td>
<td>96.0</td>
</tr>
<tr>
<td>Supreme</td>
<td>80</td>
<td>2.6</td>
<td>86.7</td>
</tr>
<tr>
<td>K.Y. Cross</td>
<td>65</td>
<td>2.5</td>
<td>83.3</td>
</tr>
<tr>
<td>Spring &amp; Autumn</td>
<td>65</td>
<td>2.6</td>
<td>90.0</td>
</tr>
</tbody>
</table>

Table 7. Cabbage observation trial in rainy season (Planted: 6 May 2002)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Maturity (*DAP)</th>
<th>Head size (kg)</th>
<th>Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum Head</td>
<td>95</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Golden Acre</td>
<td>65</td>
<td>2.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Glory of Enkhuizen</td>
<td>90</td>
<td>3.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Tropical Delight</td>
<td>90</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Copenhagen Market</td>
<td>70</td>
<td>2.7</td>
<td>90.0</td>
</tr>
<tr>
<td>Summer Summit</td>
<td>78</td>
<td>3.8</td>
<td>126.7</td>
</tr>
<tr>
<td>Marcanta</td>
<td>85</td>
<td>3.4</td>
<td>113.3</td>
</tr>
<tr>
<td>Gloria Kid</td>
<td>85</td>
<td>3.2</td>
<td>106.7</td>
</tr>
<tr>
<td>Grandslam</td>
<td>75</td>
<td>3.5</td>
<td>120.0</td>
</tr>
<tr>
<td>Hercules</td>
<td>90</td>
<td>3.6</td>
<td>112.0</td>
</tr>
<tr>
<td>Conquistador</td>
<td>90</td>
<td>4.5</td>
<td>150.0</td>
</tr>
<tr>
<td>Supreme</td>
<td>85</td>
<td>4.0</td>
<td>133.3</td>
</tr>
<tr>
<td>K.Y. Cross</td>
<td>85</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Spring &amp; Autumn</td>
<td>85</td>
<td>3.7</td>
<td>123.3</td>
</tr>
</tbody>
</table>

Table 8. Mustard observation trial (Planted: dry season (DS) 5 May 2002; rainy season (RS) 9 January 2002)

<table>
<thead>
<tr>
<th>Entry</th>
<th>Maturity (*DAP)</th>
<th>Flowering (number of leaf)</th>
<th>Plant weight (kg)</th>
<th>Yield (t/ha)</th>
<th>Growth habit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chikonje</td>
<td>31</td>
<td>40</td>
<td>6</td>
<td>6</td>
<td>0.5</td>
</tr>
<tr>
<td>Ta shim</td>
<td>36</td>
<td>47</td>
<td>-</td>
<td>-</td>
<td>0.7</td>
</tr>
<tr>
<td>Ye – yao</td>
<td>45</td>
<td>56</td>
<td>-</td>
<td>-</td>
<td>1.2</td>
</tr>
<tr>
<td>Bau sin</td>
<td>47</td>
<td>56</td>
<td>-</td>
<td>-</td>
<td>1.6</td>
</tr>
<tr>
<td>Florida</td>
<td>41</td>
<td>46</td>
<td>-</td>
<td>-</td>
<td>1.3</td>
</tr>
<tr>
<td>Broadleaf</td>
<td>Yellow</td>
<td>36</td>
<td>47</td>
<td>-</td>
<td>0.7</td>
</tr>
<tr>
<td>King</td>
<td>34</td>
<td>45</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Mustard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 9. Cauliflower observation trial, planted rainy season (RS): 9 January 2002; cold dry season (CDS) 5 May 2002; hot dry season (HDS) 30 September 2002

<table>
<thead>
<tr>
<th>Entry</th>
<th>Maturity (DAP)</th>
<th>Head weight (kg)</th>
<th>Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RS</td>
<td>CDS</td>
<td>HDS</td>
</tr>
<tr>
<td>Snow Lady</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autumn King #6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wallady No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Coral</td>
<td>43</td>
<td>35</td>
<td>32</td>
</tr>
<tr>
<td>Autumn King #4</td>
<td>67</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>Annan</td>
<td>50</td>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>Green</td>
<td>50</td>
<td>46</td>
<td>43</td>
</tr>
<tr>
<td>Harmony</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow Cap</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow Ball</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• DAP= Days after planting

Table 10. Vegetable seed & seedlings delivered to farmers (1998-2002)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Quantity</th>
<th>Acreage (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabbage</td>
<td>1000 &amp; 600 seedlings</td>
<td>5.0</td>
</tr>
<tr>
<td>Tomato</td>
<td>545 g &amp; 13 501 seedlings</td>
<td>3.1</td>
</tr>
<tr>
<td>Mustard</td>
<td>775 g</td>
<td>3.8</td>
</tr>
<tr>
<td>Kale</td>
<td>300 g</td>
<td>0.5</td>
</tr>
<tr>
<td>Onion</td>
<td>90 g</td>
<td>0.3</td>
</tr>
<tr>
<td>Peas</td>
<td>85 g</td>
<td>0.2</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>925 g</td>
<td>3.1</td>
</tr>
<tr>
<td>Pai-tsai</td>
<td>85 g</td>
<td>0.3</td>
</tr>
<tr>
<td>Cucumber</td>
<td>340 g</td>
<td>1.1</td>
</tr>
<tr>
<td>Okra</td>
<td>300 g</td>
<td>0.4</td>
</tr>
<tr>
<td>Radish</td>
<td>310 g</td>
<td>0.6</td>
</tr>
<tr>
<td>Carrot</td>
<td>150 g</td>
<td>0.2</td>
</tr>
<tr>
<td>Broccoli</td>
<td>35 g</td>
<td>0.1</td>
</tr>
<tr>
<td>Lettuce</td>
<td>30 g</td>
<td>0.1</td>
</tr>
<tr>
<td>Snap bean</td>
<td>224 kg</td>
<td>3.5</td>
</tr>
<tr>
<td>Maize</td>
<td>2554 kg</td>
<td>102.2</td>
</tr>
<tr>
<td>Ginger</td>
<td>4820 kg</td>
<td>1.6</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>68 135 cuttings</td>
<td>2.3</td>
</tr>
<tr>
<td>Asparagus</td>
<td>10 999 Seedlings</td>
<td>0.8</td>
</tr>
<tr>
<td>Vegetable soybean</td>
<td>285 kg</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7893.4 kg &amp; 93 665 seedlings</strong></td>
<td><strong>134.2</strong></td>
</tr>
</tbody>
</table>
The status of vegetable production systems: home gardening, urban and peri-urban vegetable production in Malawi

W.T. Gondwe
Bvumbwe Agricultural Research Station, Limbe

Abstract
In Malawi there are three vegetable production systems: Home gardening, where families grow vegetable for their own consumption; urban vegetable production, where growers grow vegetables in urban areas as a business; and peri-urban vegetable production, where vegetables are produced in locations surrounding cities to sell to urban areas. Home gardening has nutritional and economic advantages for the family. Common vegetables are rape, cabbage, tomato, onion, mustard, green beans, cucurbits, okra, eggplants, lettuce, carrot, garlic, green pepper, pigeon peas, broccoli, cauliflower, spinach, chili pepper, peas, amaranthus, black jack (bidens pilosa), cleome, jute mallow, and a number of local species. High demand vegetables are tomato, onions, mustard, cucurbits leaves, amaranthus, peas and pigeon peas. Consumer awareness influences growing and consumption of some vegetables like broccoli and cauliflower. Vegetables are produced by both men and women, but the majority of sellers are women. There are more small growers than large-scale producers. Sellers are not necessarily growers. Vegetable marketing is not organized. There are many middlemen involved in vegetable marketing. Major vegetable production problems are access to markets, inadequacy of seed, lack of irrigation water and cost of irrigation, high cost of inputs, problems of transportation, storage or keeping quality of many vegetables, and the absence of marketing institutions. A lot of effort must be made to promote vegetable production at all levels.

Introduction
Malawi is a small landlocked country in central East Africa. It lies between 9°45’ and 17°6’ south of the equator and between 33° and 36° east of Greenwich meridian. The country has a total area of 118,484 Km² out of which 94,276 Km² is land and 24,208 km² is covered by water. The country is bordered in the north and northeast by Tanzania, in the west by Zambia and in the south and southeast by Mozambique. The country is heavily dissected and has gently undulating landforms, which vary in altitude from 200 to 1500 meters above sea level. Mountains and hilly zones whose steep slopes represent ecologically fragile areas characterize the country. The varying topography has an important influence on the climate of the country, drainage, soils, vegetation, and hence agriculture. The mean annual rainfall varies between 500 mm in the rift valley areas and 1600 mm in the highlands or plateaus. All the rain falls within a five-month period from November to April. Mean daily temperatures range from 25 °C in the rift valleys to 13 °C in the highlands.

Malawi’s agricultural policy
The country’s agriculture policy aims to enhance the overall social welfare of Malawian farmers by improving agricultural productivity for domestic needs and import substitution; expanding the agricultural export base; raising incomes; ensuring food self-sufficiency while promoting crop diversification; and maintaining the environment and the natural resource base of the country.
Characteristics of Malawi agriculture and vegetable production

The agricultural sector in Malawi is divided into two subsectors according to the level of production. These are smallholder and estate sectors. The smallholder sector is on customary land and is characterized by small land holdings that are basically for subsistence farming. People grow food crops for direct consumption. Estate farming is large-scale farming and mostly practiced on private land under freehold or leasehold title. Farms are medium to large and farming is commercial on large landholdings, consisting of hundreds of hectares. Smallholder growers own small landholdings of about a hectare but collectively produce large quantities of vegetables. A sizeable quantity of vegetables is imported from neighboring countries, especially Tanzania. Traders bring the vegetables into the country both officially and unofficially. They make a significant contribution to the supply of vegetables in the border districts and some towns. Some of these vegetable crops are tomatoes, onions, Irish potatoes and cabbage. These vegetables are easy to transport and can stand long-distance movement on vehicles or trucks. This trade is not documented but makes a big contribution to the supply of vegetables on the Malawi market especially in the northern and central regions of the country. Urban and semi-urban residents or dwellers that can afford the prices consume these vegetables.

Position of vegetable crops in the Malawi food system

Vegetables are the most common food crops in Malawi and are consumed by all Malawians irrespective of origin, race, age, sex, and economic status. Many types of vegetables are grown in the country because of the diverse climatic conditions that result from different topographies and geographical locations. The quantity of vegetables consumed by different classes of society, to a large extent, is based on economic status and lifestyles of families. More than 70% of Malawians are in rural areas (MANRRMP) and are subsistence farmers. They farm as a way of earning a living or acquiring food. These farmers generate income of less than US$250 per year.

According the World Bank rating, the quality of life of more than 60% of Malawians is below poverty line. This means the majority of Malawians cannot afford high protein foods (beef, chicken, fish, etc.) because they are too expensive. The majority of Malawians, therefore, rely on vegetables as their source of protein, fiber and vitamins.

Vegetable production systems

The issue of production systems addresses questions like who produces vegetables to feed more than 10 million people, and how and where are vegetables produced. The country had 9.9 million people in 1999 and all these people, who included children, are now old enough to eat some vegetables. Those who have died have been replaced by new births, and the population is growing towards 11 million or more now. These people eat vegetables every day, on average. Somebody must be producing them and making them available apart from importations from some neighboring countries. Vegetable production systems can be roughly be divided into two systems. There is commercial production and home gardening.

Who produces vegetables and for what?

The smallholder subsection owns about 82% of the total agricultural land area under customary ownership owned by about 1.6 million farm families (Cahill and Cammaer
Small farmers produce the largest portion of vegetables using simple hand tools (hoes, watering cans, knives, trowels, axes, etc.). There are few large-scale vegetable growers in the country. Production is largely controlled by the availability of irrigation water; dams, rivers or swamps, and wells. In the rainy season, rain water supplies the water used for growing vegetables, but irrigation is still needed to supplement rainwater. Large-scale growers use dams, rivers or wells for irrigation with advanced irrigation equipment and technology.

A wider variety of vegetables are available in the rain season than in the dry season. This is because during the rainy season there are many plants that grow without human effort. These are indigenous vegetables, which germinate and grow with the coming of rains. These make a substantial contribution to the quantity of vegetables on the market or consumed during the rain season. Among these are many Amaranthus species, Cleome (*Gynandropsis gynandra*), nightshades (*Solanum scabrum, S. nigrum*), jute mallow (*Corchorus olitorius*), African Eggplant (*Solanum aethiopicum*), Chisoso, (*Bidens pilosa*), okra (*Abelmoschus esculentus*) and pumpkins (*Cucurbita pepo and C. moschata*) to mention a few. During the rainy season, the supply and variety of vegetables is higher than during the dry season when vegetables only can be produced near sources of water -- in river valleys, near dams or wells. Recently the Government has introduced treadle pumps to farmers, which they use to irrigate vegetables. The farmers produce vegetables because of the existence of markets in the urban areas. They are also able to access inputs from towns.

In the dry season vegetable growers make deliberate efforts to grow vegetables of their choice. They do this where they have a reliable source of water or moisture. Water is the most limiting factor to vegetable production in the dry season. This situation has a big influence on the type of vegetables grown. Growers, assuming everything is equal, will grow vegetables that are of high value or are in high demand to justify the effort. Again many people grow vegetables in home gardens but the majority does so to generate income from sales. Home gardening is usually on small plots of land because family vegetable needs are quite small. Metered water in semi-urban areas discourages home gardening because people have to pay for every gallon of water used. Paying for water also makes people grow small home gardens to reduce the cost of water. So only high-value vegetables the farmers are able to sell are grown in large quantities.

Sometimes farmers grow only those vegetables for which seed is available or that is easy to obtain. It is common to see vegetables that easily seed under Malawi conditions being more abundant than those for which seed must be bought. Some variables that influence farmers’ decisions about which vegetables to grow and how much are:

- availability of seed
- access to markets
- availability of irrigation water or moisture
- demand for the vegetable, which also reflects size of the population, income levels, and education
- maturity period: how long it takes for the vegetable to mature. This is a more important factor for irrigated crops than it is for rainfed crops.
- input availability
- keeping quality of the vegetable (cabbage is available on the market all year round because it keeps well)
- transportability; compare transporting spinach and rape to cabbage and carrot
- racial composition of the society (Indian, Native Malawians, European, Chinese), age and religion For example, consumption of garlic and hot pepper in general is more by our Indian communities than it is with native Malawians.
Vegetable gardening

Household based vegetable production, which is also called home gardening, is as old as human beings themselves. It is frequently carried out by women (Ninez 1984). Home gardening has a big impact on the family’s food supply and nutritional status. But agricultural research rarely addresses or talks about it vegetable crop research projects or activities. An average family in an African country feeds on food produced by the family itself. In many urban areas production of vegetables in backyards is a common feature. The problems of home gardens should also be addressed in research programs.

Support for home gardening should be an issue for agricultural development. This is because home gardening has a lot of nutritional benefits. Home gardening assures equal access, to a large extent, to vegetables for members of the family or among families in a community because families are able to grow vegetables by themselves. They do not need large sums of money to grow vegetables, especially for vegetables that easily seed, like many indigenous vegetables. The beauty of home gardening is that families have direct access to vegetables of their liking apart from raising incomes for households. Improvement of income may not result in improvement in nutritional status of family members. Sometimes a family may have a lot of income, but what food is bought may depend on who controls the money or income. The one who controls the income may not be interested in the health of the family as such.

Benefits of home gardening

Production of vegetables at home affects household vegetable consumption and the nutritional status of the family through direct consumption of vegetables from the garden. There are also indirect benefits like raising income from excess produce or saving income by avoiding buying vegetables from the market. For example tomatoes can be quite costly in the rainy season. If one grows one’s own tomatoes there is a lot of savings. There is also the trouble of walking to the market everyday or every other day to buy vegetables, which is avoided if one has a home garden. The other benefit is the improvement of the nutritional status of family members from a variety of vegetables grown. For example, a typical home garden in Malawi will have tomatoes, rape, onions, mustard, eggplants, beans, and cabbage. The many benefits of home gardens are:

- A good amount of vegetables are produced on a small land area.
- Available family labor is better used in preparation of a home garden.
- Home gardens provide additional nutritional benefits to the family.
- Home gardens act as experimental fields for any vegetable production system an individual wants to try.
- Home gardens ensure a readily available supply of nutrients to the family.
- Home gardens provide vegetables even when there are some disruptions in farming due to drought or other disturbances because things are under the control of the family.
- Home gardens usually need low inputs, which are affordable.
- In one’s own garden a grower can tailor production to the family’s own needs and available resources.
Problems encountered by home gardeners

Problems faced in home gardening are the same problems faced by all vegetable growers in the country. In general some of these problems are:

- limited availability of certified seed for different vegetables
- inadequate suitable varieties for a number of vegetables
- diseases and insect pests that attack different vegetables
- poor and inadequate postharvest technologies for many vegetables
- inadequate irrigation facilities and technology
- limited water resources
- high cost of inputs, fertilizers and pesticides
- absence of institutional support for home gardeners

Uranda: peri-urban vegetable production

Production of vegetables varies from large-scale enterprises to market gardening where the growers aim at producing vegetables to raise money, to private gardens where the producer, usually a family, grows vegetables for home consumption. The growth of urban areas has fueled an increase in commercial vegetable production because of the rise in demand and the size of the market.

Urban areas are cities or towns. Peri-urban areas are areas surrounding urban areas or towns. The urban areas influence lifestyles of peri-urban populations. Peri-urban agriculture is to a large extent influenced by the urban areas. The agricultural decisions are based on the influence of the towns or urban populations. There are many variables that influence urban vegetable production. The most important variable is that people in urban and peri-urban areas have money to buy vegetables. So there is a strong market for vegetables. During a visit to one of the peri-urban markets in August this year the number of vegetables seen were as listed below.

Types of vegetables found at one peri-urban market

1. Amaranthus (different types); green one preferred
2. Beans (field beans, green beans, bean leaves)
3. *Bidens pilosa* or black jack (Chisoso)
4. Broccoli
5. Cabbage
6. Carrot
7. Cauliflower
8. Eggplant
9. Garlic
10. Lettuce
11. Mustard or Ethiopian mustard (*Brassica juncea* L.)
12. Nkhunguza (a legume with pods like soybean; the pods are cooked green)
13. Okra
14. Onion
15. Peas
16. Green pepper (*Capsicum annuum* L.)
17. Hot pepper (*Capsicum frutescens* L.)
18. Pigeon peas
19. Pumpkin leaves, flowers, and immature fruits
20. Rape (*Brassica napus* L.)
21. Roselle (*Hibiscus sabdariffa* L.)
22. Snap bean
23. Spinach
24. Tomato

These vegetables are found in different quantities, which in most cases reflect the demand. The most abundant were tomato, cabbage, onion, mustard (mpiru), rape, okra, green pepper, hot pepper, and beans. Sellers and growers account for the differences in abundance of different vegetables give many reasons. Tomato is consumed by almost all households in the country and is a popular condiment or side dishes. It is also used in many forms such as in salads, tomato paste, tomato sauce, etc. Many vegetable farmers will make efforts to produce tomatoes. Both during the rainy or dry season, tomatoes are relatively more abundant than any other vegetable. Some vegetables are more abundant than others because seed is easy to get or can easily be produced locally. Cabbage is more abundant than rape because farmers say it is easy to handle and transport and keeps longer than rape and many other leafy vegetables. Cabbage is also being used as a salad vegetable by many makeshift food stalls that sell potato chips. This has also increased consumption of both cabbage and potatoes. For vegetables like rape and mpiru Ethiopian mustard (*Brassica juncea*) farmers prefer to produce Ethiopian mustard to rape because housewives prefer it; it does not need a lot of cooking oil to prepare. Mustard needs less oil than rape. Some vegetables are not produced in abundance because the demand is low.

**Land area under vegetable production in the urban and peri-urban areas**

Most vegetable growers in the dry season have limited resources for vegetable production. Land is limited because vegetable production is done in river valleys or swampy areas where there is water after rains or residual moisture; this is especially true for peri-urban growers. In these areas land is usually limited and many producers have less than a hectare. There are some commercial farmers who have begun large-scale production of vegetables to supply to urban areas and have plans to export some of their produce. Large-scale farmers have irrigation systems and large land areas, but they are few in number. These farmers are close to urban areas, so they have easy access to markets and inputs.

The land area under vegetables is very difficult to establish. There are many small land areas under production across many urban areas of the country. Improvement in communication has also spread out the vegetable production areas. Many traders are able to bring vegetables to cities or urban areas from distant places. So some vegetables found in urban areas are produced in neighboring districts or distant places. The general increase in quantity of some vegetables on the market gives an indication that production is increasing, but to increase land area is difficult. An interesting observation is the increase in the consumption of salads by an average Malawian.

**Seed sources and seed availability**

Successful vegetable production depends on a good supply of quality seed. Seed industries, therefore, play an important role in the promotion of vegetable production in any country. Large-scale production of vegetables must begin with the development of a reliable vegetable seed production system.

Most vegetable seeds on the market are imported, including seeds of popular vegetables such as tomato, cabbage, eggplant, onions, carrot, lettuce, Chinese
cabbage, spinach, pepper, green beans, broccoli, cauliflower, and many others. Imported seed is very expensive and contributes to the high cost of vegetable production. Seed inadequacy is among the most limiting factors to vegetable production in Malawi. The country does not have enough seed for a number of vegetables. The country has a limited capacity to produce certified vegetable seed. The local seed production program only produces open pollinated seed of a selected few vegetables. It also produces, again to a limited extent, indigenous vegetables like cucurbits, rape, amaranthus, Jute Mallow, and pigeon peas. Production of cabbage, onions and others that need vernalization has not been possible. So vegetables that easily seed under Malawi conditions are more available than those for which new seed has to be imported all the time. This seed situation is reflected in the type and abundance of vegetables found on the market. Crops like rape, mustard, okra, peas, cucurbits, pigeon peas, beans, amaranthus, and cleome are more common than lettuce, cauliflower, and broccoli.

Reference


AVRDC-The World Vegetable Center collaborative activities in vegetable crops research and development in Southern Africa

M.L. Chadha and M.O. Oluoch
AVRDC – The World Vegetable Center, Regional Center for Africa

Introduction

AVRDC – The World Vegetable Center, Regional Center for Africa (RCA) has been involved in vegetable production, research, training and development in Southern Africa since 1992. AVRDC-RCA works in close collaboration with national agricultural research and extension systems in Africa to:

- Conserve and enhance the genetic resources of selected vegetables.
- Develop improved vegetable varieties, their seed production systems, and sustainable production technologies.
- Disseminate relevant vegetable research information and technologies
- Train promising African vegetable researchers and extensionists.
- Strengthen the national research institutions.

The current AVRDC-RCA strategic themes for Africa are: Germplasm management and promotion of African indigenous and priority exotic vegetables; sustainable seed supply for AIVs and priority exotic vegetables, and strengthening the capacity of researchers and extensionists of national systems through training, participatory technology development and transfer.

AVRDC in Africa serves as a bridgehead to extend AVRDC’s improved varieties and technologies to Africa, while the NARES, NGOs and the private sector benefit from AVRDC’s R&D activities. In addition, AVRDC in Africa is an effective catalyst for regional cooperation in research, training, and exchange of improved germplasm, technological know-how and information. In Southern Africa, AVRDC-RCA research, training and development activities are being carried out in the following countries; Tanzania, Malawi, Zimbabwe, Zambia, South Africa, Namibia, Lesotho, Botswana, Swaziland, Mozambique, Mauritius, Angola, and the Seychelles. The main activities have involved capacity building programs and implementation of applied vegetable research, development and technology transfer as well as improving seed systems and access to help increase consumption of priority exotic and African indigenous vegetables.

Capacity building and Information dissemination

AVRDC-RCA is hosting a Collaborative Vegetable Research and Development Network in Southern Africa (CONVERDS) that has the following mandates: provide the forum and mechanisms for improving communication and rapid exchange of technology derived from research; through consultation, identify research needs, set their priorities and encourage the NARES of the region to focus on these problems; foster collaborative and complementing research and technical exchanges, always taking into account the institutional strengths, weaknesses and needs of member NARES; minimize duplication of efforts and enable the formation of complementing vegetable
research units that are able to address the production and use problems at the national and regional levels; hold periodic network meetings, as one of the means for developing collaborative plans, evaluating results, and fostering exchange of information; identify NARES partners for collaboration; and to source funding and provide technical support to enable the NARES with lead roles on specific commodities and/or cross-commodity network activities to effectively discharge their responsibilities. Through CONVERDS, new varieties, low cost production technologies, and extensive capacity building programs have been carried out in Southern African countries.

As agricultural productivity and profitability declines, more and more women are working off the farm to generate money for purchasing food, fertilizer, household goods, or medicines. A strong rural economy, which vegetable production promotes, will enhance the livelihoods of women. Women farmers in Africa are the substance that binds African society. AVRDC is committed toward empowering women with education and training, and promoting strong rural economies. Today in Africa, 50% of AVRDC trainees are women. AVRDC-RCA is carrying out (since 1994) long- and short-term regional and special skills training courses in vegetable crops production, research and technology transfer in Southern Africa; and over 1000 research and extension personnel from NARES, NGO's and the private sector have been trained. The trained personnel are helpful in implementation of applied research and technology transfer activities related to vegetable crops. The trained personnel and the diversity of vegetables hosted by AVRDC from its R&D programs are an excellent source of readily available improved germplasm for technology transfer and implementation of applied research and technology transfer activities related to vegetable crops. In addition, the vegetables can be produced under multiple home garden and commercial farming systems that can help diversify the crop production systems as well as help improve consumption to reduce current rates of micronutrient and protein calorie deficiencies, improve food security and diversify diets and income through increased production of indigenous, legume and selected exotic vegetables.

AVRDC is actively involved in vegetable research and development in collaboration with the National Agricultural Research Systems (NARES) in Southern Africa. AVRDC has conducted variety trials with these NARES and carried out participatory National Review and Planning Workshops on vegetable R&D with the Southern Africa Development Community (SADC) countries (1990), Zambia (1996), Tanzania (1998), Mozambique (1999), Mauritius (2001) and currently in Malawi (2003); whereby recommendations and priorities for vegetable research and development were identified.

Information on the production, processing and use of vegetable crops has been disseminated widely. The ongoing programs create awareness at the household level by distributing brochures and leaflets on vegetable production, use and processing technologies.

AVRDC has been cooperating with vegetable farmers based on participatory learning and action research experiences to help identify constraints and feasible solutions to vegetable production in Southern Africa. To introduce new vegetables and related production and marketing technologies in Southern Africa, the socioeconomic units of AVRDC has been conducting ex-ante and ex-post farm surveys, to identify constraints on the expansion of the horticultural sector in general, and evaluating the production and market potential of different indigenous and exotic vegetable crops in quantitative as well as qualitative terms. Several such evaluations have been conducted in Southern Africa. In these evaluations, a comprehensive review and analysis of available vegetable crops and related technologies are conducted for their social acceptability, economic viability, and environmental sustainability as well as the nutritional and economic implications for the poor.
**Promotion of improved exotic and indigenous vegetable varieties**

Vegetable research and development activities of AVRDC in Southern Africa focus on the main constraints: identification and selection of vegetable diversity suitable for low input requirements, short duration and rich in nutrients; adaptation for farmers use, and organizing access to seeds. To improve the seed systems and on-farm seed production of target vegetable crops; AVRDC has helped increase the supply of seed of low input vegetables and selected high value crops to help reach the most vulnerable households. Additionally, AVRDC is actively engaged in germplasm evaluation of exotic and indigenous vegetables to identify superior lines suitable for adoption in specific localities. This germplasm evaluation has resulted in identification of superior varieties and release of some new varieties that are being promoted and marketed.

In Malawi, R&D activities are being carried out in central and southern regions. The activities include baseline survey studies on indigenous vegetables, evaluation of indigenous and priority exotic vegetables, germplasm improvement, improving access to vegetable seeds, and developing production packages for vegetable crops. Additionally, AVRDC-RCA is actively implementing a program on “Promotion of Neglected Indigenous Vegetable Crops for Improved Nutritional Health.” The goal of the project is to improve household food security of resource-poor groups by: safeguarding biodiversity of indigenous vegetables; reducing malnutrition and poverty among small scale farmers and consumers; and diversifying and stabilizing farmers’ incomes and nutritional health through better use of indigenous vegetable crops under home garden production and commercial farming systems. This program is being implemented in Central and Southern Malawi in collaboration with the Agricultural Research Department of the Ministry of Agriculture. In Zimbabwe, R&D activities have been carried out on evaluation trials on priority exotic vegetables while in Mozambique, R&D activities carried out have included evaluation trials on priority exotic vegetables, baseline survey studies on the status of the vegetable sector, distribution of vegetable seeds to flood damaged areas in Southern Mozambique and poverty stricken areas in central Mozambique to improve vegetable gardening and reduce malnutrition and poverty. From 2002 and in collaboration with UNICEF, AVRDC has distributed over 2 tonnes of indigenous and exotic vegetable seed to drought-prone areas in Southern Zambia. Evaluation trials on priority exotic and indigenous vegetable crops have also been carried out in Swaziland, Lesotho, the Seychelles, Mauritius, Botswana, Mozambique, Angola, Namibia and South Africa. The programs conducted so far in these countries have been aimed at improving vegetable home gardening and access to seeds to help meet the emergency food requirements and attain food security at the household level.

Vegetable production is an important agricultural activity in Southern Africa. Further expansion of vegetable production offers good opportunities for improving smallholder livelihoods through marketing of high value crops. Yet, vegetable production in this region is limited by short- and long-term constraints that include, but are not limited to declining soil fertility, non-availability of organic inputs, labor shortage, pest infestations, and limited marketing and processing opportunities. AVRDC is trying to address some of these constraints through the intensification of production systems with vegetable legumes to address the causes of land degradation, declining soil fertility, and low and erratic rainfall; use of organic gardening in mixed home garden and commercial farming systems to develop sustainable production systems; promotion of need-based, low-cost technologies; employing IPM approaches to address the high prevalence of weeds, pests and diseases of vegetable crops; improve market access by gauging information on farmer-market linkages and adding value to produce through improved processing.
and storage; and increased awareness to improve the productivity and implementation of enabling agricultural policy.

The use of drumstick tree (Moringa oleifera) seed powder is very effective in clarifying dirty water and has been used in some countries in East Africa. Moringa is a drought-tolerant tree that can grow throughout SSA and the leaves and immature pods are being consumed widely as a vegetable. Therefore, seed production should be increased by encouraging small-scale farmers to plant or grow this tree on their homesteads or around farm boundaries. AVRDC has been disseminating Moringa seeds in Southern Africa for adoption and adaptation.

Promotion of available technologies and Introduction of improved varieties

Small-scale farmers in Southern Africa usually keep and maintain small herds of livestock including cattle, goats, sheep, and chickens. Farm manures produced from livestock can be used as organic fertilizers either applied directly or mixed in compost preparations. However, the low availability of livestock manure in peri-urban areas makes it essential to look for alternative low-cost solutions to improve productivity in Vegetable production. AVRDC has been looking at sustainable organic gardening in mixed cropping systems as well as the use of legumes as green manure for crop intensification.

Indigenous vegetables

Vegetable varieties used by Southern Africa producers often originate from Europe and other parts of the world and are, therefore, not adapted to local agro-ecological conditions. This is especially true for exotic crops like tomato, hot and sweet pepper, eggplant, cabbage, Chinese cabbage, kale, collards, and lettuce. To minimize or reduce the effect of erratic rainfall pattern and extended dry periods, small-scale vegetable farmers in SSA practice multiple cropping systems. The common cropping system is mixed or intercropping of several crops with variable water requirement. Some of the species in the crop mixture are short and quick maturing with low water needs. These crops consist mainly of leafy and indigenous vegetable species (e.g., amaranth, jute mallow, sweet potato, African eggplant, nightshade) that have better chances of reaching maturity before drought occurs. This array of indigenous vegetable varieties are well adapted to local agroecological conditions and are less susceptible to local pests and diseases, but are usually lower-yielding varieties. There is thus a need to identify improved vegetable varieties that are both adapted to local conditions and high-yielding. AVRDC has developed a wide variety of leafy and indigenous vegetables that are short-maturing, high yielding and nutritious, and are being tested for their adaptability to local agroecological conditions and/or tolerance to major pests and diseases in Southern Africa. Once a variety is identified, it is used as such after genetic enhancement or incorporated into breeding programs to include desirable traits into other varieties. Research for improved varieties is directed toward collection, identification of open-pollinated varieties for resource-poor vegetable producers, genetic enhancement and evaluation for superior traits, seed multiplication, development of production technologies, seed distribution to farmers and NARES, and seed multiplication at farm level.

The implementation of Applied Research and technology transfer as well as improving seed systems will play a catalytic role in increasing consumption of high value vegetable crops as well as low input African Indigenous Vegetables (AIVs), increase accessibility to quality seed and support community-based production and marketing networks for AIV seed and vegetables. AVRDC is focused on improving the production of indigenous
vegetables with the aim of improving nutrition and giving farmers new opportunities to increase their incomes. AVRDC has joined with NARES in Africa and IPGRI to collect and conserve germplasm of more than 1000 indigenous vegetables from Africa, including selections of nightshade (Solanum scabrum S. americanum, S. villosum), African eggplant (Solanum aethiopicum, S. macrocarpon, S. anguivi), Ethiopian mustard (Brassica carinata), spider-flower plant (Gynandropsis gynandra), amaranth (Amaranthus dubius, A. hybridus, A. lividus, A. thumbergii, etc), jute mallow (Corchorus olitorius), okra (Abelmoschus esculentum, A. caillei), pumpkin (Cucurbita spp.), moringa (Moringa olifera), sun hemp (Crotalaria ochroleuca, C. brevidens), vegetable cowpea (Vigna unguiculata), and lablab (Lablab purpureus). Promising lines of these crops are being identified—some lines are already purified, characterized, evaluated (AVRDC 2000, 2001, 2002, 2003, 2004) and their cultivation and use have been developed, documented in English, French, and local languages, and are being disseminated. Nutritional tests are also being conducted to understand the special properties of these lines. Twenty promising lines/varieties of okra, pumpkin, moringa, African eggplant, nightshade, jute mallow, spider plant, Ethiopian mustard, amaranth, vegetable cowpea, and sun hemp are currently available for promotion.

Tomato evaluation and production

Despite its relative importance and level of usage, tomato yields in Southern Africa average as low as 6 t/ha, and are among the world’s lowest (FAO 2004). The old tomato varieties -- Marglobe, Money Maker and Roma -- are still, despite their susceptibility to diseases and other undesirable features, the cultivars of choice of many Southern Africa farmers. It is very important to improve or replace these cultivars with disease resistant and higher yielding varieties to improve productivity and consumption and to reduce the hazardous effects of pesticides on the environment and on human and animal health. In 1994 AVRDC initiated a research and development program to address tomato production constraints in Southern Africa. Through these research activities, high yielding and multiple-disease resistant tomatoes (with differential resistance to tobacco mosaic virus (TMV), fusarium wilt, root knot nematodes and tolerance to tomato yellow leaf curl virus (TYLCV) have been developed. These multiple disease resistant lines have shown a fruit yield potential ranging from 60 to 100 t/ha in comparison to 6-16 t/ha average in Southern Africa Region versus a world average of 27 t/ha (FAO, 2004). In 1997 two AVRDC tomato lines were officially released for general cultivation in Tanzania; and in 2002, two more lines were released for general cultivation in Malawi. Through public-private sector partnerships, the two lines of tomato released as varieties in Tanzania have virtually replaced the old tomato varieties among farmers. The two varieties have not only changed the yields and income obtained by farmers but has also changed the seed market balance from that of over dependence of imported seeds to that of an inward-looking attitude among tomato growers (Ministry of Agriculture 2004). These lines and additional others are currently being evaluated in Zambia, Zimbabwe, Botswana, Namibia, South Africa, Swaziland, Lesotho, Rwanda, Kenya and Uganda. Two AVRDC lines have performed well in research trials in Zambia. The two promising lines are expected to be pre-released in Zambia after on-farm trials. AVRDC has also developed lines resistant to late blight caused by Phytophthora infestans, one of the most devastating diseases of tomato in the African highlands. These lines are being evaluated in Tanzania and will be pre-released soon. In addition, AVRDC researchers have recently bred tomato lines that are up to 10 times richer in beta-carotene, the precursor of vitamin A in human digestion. Promotion of this “golden tomato” has the potential to create an impact on reduction of malnutrition in Southern Africa. Additionally, research at AVRDC has revealed that cooking significantly increases iron bio-availability in vegetables. Tomatoes, including cherry tomatoes, are not only rich in beta-carotene and iron, its micronutrient bioavailability is also high (with or without cooking). Tomato is one of the few vegetables that can enhance the bioavailability of
iron in rice and beans when rice or beans and tomato are mixed together. The introduction and promotion of these lines are ongoing and their production systems will help diversify diets and improve the nutrition, health and income of poor vulnerable communities in Southern Africa.

In addition, AVRDC has developed and is actively promoting in Africa new varieties of vegetable soybean, mungbean, sweet and hot pepper, onions, and eggplant; some of the lines have been officially released. The diversity of vegetables hosted by AVRDC from its research and development programs would be an asset to Africa in terms of being a good source of readily available improved germplasm for technology transfer. In addition, the vegetables could be produced under cereal and agroforestry-based home garden and commercial farming systems that can help diversify the crop and livestock production systems as well as help improve consumption to reduce current rates of micronutrient and protein calorie deficiencies, improve food security and diversify diets and income through increased production of indigenous, legume and selected exotic vegetables. A major strategy in Southern Africa is to improve year-round production of different vegetable varieties under low input supply and use of low-cost irrigation systems.

**Pepper evaluation and production**

In sub-Saharan Africa, the biggest constraint to pepper production are diseases that in many cases can create yield losses of up to 50%. The use of genetic resistance remains the best control strategy. Pepper (*Capsicum spp.*) including sweet pepper (*Capsicum annuum*, L. *Var. annuum*) is said to be the world’s second most important solanaceous vegetable after tomatoes. Growers in Southern Africa face serious production constraints due to susceptibility of the crop to many diseases and pests. As a result, the yield is still quite low. The use of genetic resistance remains the best control strategy. Since 1986, AVRDC has given priority to breeding multiple disease resistant sweet pepper lines and selection of the best lines with good horticultural traits for adaptation. Since 1997, an ongoing collaborative project between AVRDC and Institut National de la Recherche Agronomique (INRA) in France has tested multi-disease resistant (Cucumber mosaic virus, Potato Virus Y and Tobacco Etch Virus) sweet pepper lines in Tanzania, where screening for fungal (*Phytophthora blight*) and viral diseases has been ongoing. In addition, hot pepper is increasingly gaining importance in East and Southern Africa as an export crop in addition to its importance in diversification of crops in home garden systems and income generation in many households. However, the existing varieties have been showing very low yields and are increasingly susceptible to diseases and pests. AVRDC has been developing high yielding and stable chili inbred lines with multiple disease and insect pest resistance for the hot and humid tropics. As part of the AVRDC International Sweet and Chili Pepper Nursery (ISPN and ICPN) trials, sweet and hot pepper lines have been evaluated at AVRDC-RCA, Arusha, Tanzania since 1997 to determine their adaptation to the African highlands.

**Onion evaluation and production**

Onion is considered as a very important vegetable, widely grown and is second only to tomatoes in the tropics. Day length and temperature highly affect plant crop growth during the early growth stages and bulbing requires cool conditions with adequate water supply. Yields achieved by most farmers in Africa are below potential. One of the hampering factors to high productivity is poor cultivar performance. Farmers continue to use old varieties which have lost their genetic potential over time. AVRDC has developed onion lines with multiple disease resistance and high yielding potential. These lines are being evaluated in Tanzania to identify germplasm with superior traits for release and further promotion.
Legume evaluation and production
AVRDC has a wide collection of improved vegetable and grain soybeans to introduce to the region. Vegetable soybeans are harvested when green and can yield as much as 12 t/ha. The green beans are rich in protein, cholesterol-free fat, vitamin E, and calcium. The residue after harvesting the pod can be as high as 30 t/ha. The green residue can be fed to cattle or can be incorporated in to the soil. The residue contains as much as 170 kg N, 12 kg P and 100 kg K. Growing vegetable soybeans can improve soil fertility and generate new jobs through value-added processing. AVRDC’s grain soybeans are either tolerant or resistant to soybean rust and adapted to tropical conditions with a yield potential of about 2.5 t/ha in about 90 days. AVRDC also has some promising vegetable soybeans which have been tested in Tanzania for green manure to improve soil fertility. In Zimbabwe and Mauritius, some of the promising vegetable soybeans have been evaluated and are already being taken up by the local population.

AVRDC has also developed mungbean varieties (Vigna radiata var. radiata) with synchronised maturity that resist major diseases and can yield about 1.5 t/ha after 60–70 days. Mungbeans are a popular legume rich in iron and easily digestible protein; they can alleviate anemia. The leaves can also be fed to the cattle.

Promotion of IPM technologies
Cabbage and tomato are widely grown vegetables in Southern Africa. One of the most common insect pests on cabbage is the diamondback moth (DBM), Plutella xylostella. DBM has developed resistance to several conventional synthetic pesticides and often destroys dry-season cabbage crops (Herren and Löhr 2001; AVRDC 2002). Tomato fruit borer (TFB), Helicoverpa armigera, and whitefly, Bemisia tabaci, are important pests of tomato; for instance TFB causes fruit losses of up to 24%. Whiteflies transmit tomato yellow leaf curl virus (TYLCV), which has emerged as the major threat to tomato production in the tropics and subtropics. In Southern and East Africa, spider mites have emerged as a major threat to vegetable and some cereal crops with heavy infestation observed across many crop commodities. Heavy spraying with miticides has led to the mites developing resistance to common miticides available in the region. Alternative crop protection strategies are needed for DBM, TFB, TYLCV, spider mites and diseases and pests of other vegetable crops. AVRDC, in collaboration with ICIPE, has already introduced parasitoids for the management of DBM, namely Diadegma semiclausum, Microplitis plutellae, Oomyzus sokolowskii and Diadromus collaris in selected countries in East and Southern Africa. In those specific localities, they have become well established and have drastically reduced the need for pesticide use. Experiments conducted at AVRDC-Regional Center for Africa in Arusha, Tanzania, showed that plants treated with neem seed extract gave significantly lower larvae/pupae counts and leaf damage and recorded significantly larger head yields in cabbage (AVRDC 2002). For TFB, sex pheromone traps, nuclear polyhedrosis viruses (NPV), and trap crops are available for control. And for TYLCV, AVRDC has developed varieties resistant to strains of the disease. These technologies are becoming widely adapted and are ready for dissemination in the region. In collaboration with ICIPE, biological control of these pests as well as screening for pest resistance is being explored in Tanzania to help reduce pesticide use and environmental degradation.

Postharvest shelf life
Vegetables are highly perishable commodities and need special treatment and storage to prevent losses, which are typically between 20 to 60% in sub-Saharan Africa, where there are no special storage facilities. Exposure of vegetables to the sun in most African markets leads to the destruction of vitamin content and other nutrients. Infestation by microorganisms results in deterioration of vegetables during the postharvest period. There is also the loss of produce caused by poor packaging during transport as well as
in the markets. Some of the constraints to vegetable production are the lack of varieties suitable for processing and shipping; inadequate marketing information and skills; poor handling and storage technologies; and undeveloped processing industries. Improved harvesting techniques (optimal time-of-day and stage of plant development), as well as pre-cooling, packaging, and cooling can help to reduce losses during shipping and marketing at the field, wholesale, retail and consumer level. On the other hand, varieties specifically bred for long shelf life can best help reduce the losses attributed to poor storability. AVRDC has bred two tomato varieties, Tanya and Tengeru 97, which have been released in the region. The two varieties have a longer shelf life compared to other existing varieties and now are being grown widely in the region, especially in Tanzania. AVRDC has started research on onion, which focuses on breeding for postharvest shelf life. The Center has been evaluating appropriate varieties/lines for storability under ambient conditions and several promising lines with good storability have been identified.

References


# Timetable of Activities

**Timetable for the First Review and Planning Workshop on Vegetable Research and Development in Malawi, Malawi Institute of Management (MIM), September 23-24, 2003**

**Monday, September 22, 2003**

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<td>08.00 - 08.25 am</td>
<td>Registration</td>
<td>Secretariat</td>
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<tr>
<td>08.25</td>
<td>Arrival of the Guest of Honour</td>
<td>Chairman</td>
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<tr>
<td>08.30 – 08.45</td>
<td>Viewing of Horticultural Displays by the Guest of Honour, Invited Guests and Participants</td>
<td>Chairman</td>
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<tr>
<td>08.45 – 08.55</td>
<td>Welcoming Remarks by the Master of Ceremonies</td>
<td>Mas. of Ceremonies</td>
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<tr>
<td>08.55 – 09.05</td>
<td>Welcoming Remarks and Objectives of the Workshop by DARS</td>
<td>A.P. Mtukuso</td>
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<tr>
<td>09.05 – 09.05</td>
<td>Welcoming Remarks by AVRDC Representative</td>
<td>M.L. Chadha</td>
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<tr>
<td>09.15 – 09.25</td>
<td>Welcoming Remarks by PS, MOAIFS on the importance of Vegetables in Malawi</td>
<td>C.J. Matabwa</td>
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<tr>
<td>09.25 – 09.45</td>
<td>Official Opening by the Guest of Honour</td>
<td>Guest of Honour</td>
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<tr>
<td>09.45 – 10.00</td>
<td>Group Photograph</td>
<td>Chairman</td>
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<tr>
<td>10.00 – 10.30</td>
<td>Tea Break</td>
<td>Secretariat</td>
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<tr>
<td>10.30 – 11.00</td>
<td>Current Policies in Vegetable Research and Development in Malawi</td>
<td>A.P. Mtukuso</td>
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<tr>
<td>11.00 – 11.30</td>
<td>The Role of the University and Training Institutes in Vegetable Research and Development in Malawi</td>
<td>M.B. Kwapata</td>
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<tr>
<td>11.30 – 12.00</td>
<td>The Role of the Department of Agricultural Research Services in Vegetable Research and Development in Malawi</td>
<td>A.T. Daudi</td>
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<tr>
<td>12.00 – 12.30 pm</td>
<td>The Status of the Vegetable Industry in Malawi: Present Status and Future Prospects</td>
<td>C. Mwandira</td>
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<td>12.30 – 01.00</td>
<td>The National Vegetable Seed Program: Present Status and Future Prospects</td>
<td>J.H. Luhanga</td>
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<td>01.00 – 02.00</td>
<td>Lunch Break</td>
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<tr>
<td>02.00 – 02.30</td>
<td>An Overview of Major Diseases and Nematodes Affecting Vegetable Crops in Malawi</td>
<td>M.P.J. Theu</td>
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<tr>
<td>02.30 – 03.00</td>
<td>An Overview of Major Pests Affecting Vegetable Crops in Malawi</td>
<td>E.H. Kapeya</td>
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<td>03.00 – 03.30</td>
<td>The Role of Research-Extension-Farmer Linkages in Vegetable Production and Development in Malawi</td>
<td>A.R. Saka</td>
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<td>03.30 – 04.00</td>
<td>Tea Break</td>
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<td>04.00 – 04.30</td>
<td>The Status of Vegetable Production Systems</td>
<td>W.T. Gondwe</td>
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<td>04.30 – 05.00</td>
<td>Present Status and Future Scope of Vegetable Processing, Preservation and Use in Malawi</td>
<td>L.M. Maseko</td>
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<td>05.00 – 05.15</td>
<td>Overview for the day and Housekeeping Issues</td>
<td>A.T. Daudi</td>
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**Tuesday, September 23, 2003**

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<th>Time</th>
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<tbody>
<tr>
<td>08.00 - 09.00 am</td>
<td>Status and Limitations in the Marketing of Vegetable Crops in Malawi</td>
<td>M.C. Longwe</td>
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<tr>
<td>09.00 – 09.30</td>
<td>The Role of NGOs in Vegetable Research and Development in Malawi</td>
<td>WVI CISARNET</td>
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<td>09.30 – 10.00</td>
<td>The Role of Women in Vegetable Production and Use</td>
<td>Mrs. Matenje</td>
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<td>10.00 – 10.30</td>
<td>Tea Break</td>
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<tr>
<td>10.30 – 11.00</td>
<td>The Role of AVRDC-RCA in the Improvement of Vegetable Research, Training and Development</td>
<td>M.L. Chadha</td>
</tr>
<tr>
<td>11.00 – 11.30</td>
<td>Traditional and Biotechnological Approaches in Vegetable Breeding</td>
<td>J. Mkumbira</td>
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<tr>
<td>11.30 – 12.00</td>
<td>The Status and Future of Vegetable Organic Gardening in Malawi</td>
<td>Chinkhuntha</td>
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<td>12.00 – 12.30 pm</td>
<td>The Role of Indigenous Vegetables in Attaining Food Security in Malawi</td>
<td>C. Messinger</td>
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<td>12.30 – 01.00</td>
<td>The Importance of Vegetables in Nutrition and Health</td>
<td>Y.M.Z. Nyasulu</td>
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<td>01.00 – 02.00</td>
<td>Lunch Break</td>
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<td>02.00 – 02.30</td>
<td>The Role of Horticulture and Food Crops Project in Vegetable Production &amp; Marketing</td>
<td>G.J.C. Kauta</td>
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<td>02.30 – 03.00</td>
<td>The Chinese Technical Cooperation and the Vegetable Program in Malawi</td>
<td>L. Sen-Hsiung</td>
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<td>03.00 – 03.30</td>
<td>Japanese International Cooperation Agency and Vegetable Production in Malawi</td>
<td>JICA</td>
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<td>03.30 – 04.00</td>
<td>Tea Break</td>
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<td>04.00 – 04.30</td>
<td>Farmer Participatory Vegetable Research and Development in Malawi</td>
<td>Mwendo-Phiri</td>
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<td>04.30 – 05.00</td>
<td>Workshop Synthesis and closing</td>
<td>Daudi/Saka Chadha/Oluoch</td>
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</tbody>
</table>
List of participants

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Other Participants
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<table>
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<tr>
<th>Acronym</th>
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<td>ACB</td>
<td>Agricultural Communication Branch</td>
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<tr>
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<td>ADD</td>
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<td>AKS</td>
<td>Agricultural Knowledge Systems</td>
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<td>ALDSAP</td>
<td>Agricultural and Livestock Strategy and Action Plan</td>
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<tr>
<td>DDAES-FNO</td>
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<td>FARMESA</td>
<td>Farm Level Applied Research Methods for Eastern and Southern Africa</td>
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<td>FSR</td>
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<td>GTZ</td>
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<td>MP</td>
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<td>MPRSP</td>
<td>Malawi Poverty Reduction Strategy Paper</td>
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