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THE IMPORTANCE OF INDIGENOUS KNOWLEDGE IN REDUCING POVERTY OF RURAL AGRARIAN HOUSEHOLDS

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EXECUTIVE SUMMARY

Between January 2005 and March 2006 a study was carried out in two adjacent villages in the Mopane district, Limpopo Province, South Africa. The main residents in the area are Shangaan speaking descendants. The study had three primary purposes (a) to tentatively look at possible areas where indigenous knowledge and scientific knowledge relating to agricultural production could integrate in order to optimise the two knowledge systems so that the local situation with regard to poverty could be improved; (b) to record the indigenous knowledge relating to agricultural production of African vegetable crops; and (c) to consider how these crops contribute to poverty reduction of agrarian households in the form of food security and food nutrition. Because the purpose was to tentatively look at areas for cooperation this report does not give account of actual integration, that is for a further study. What it does is to list indigenous knowledge and practices and suggest areas for collaboration. The primary means of gathering data was through the use of Participatory Rural Appraisal tools during workshops, informal and semi-structured interviews and participant observation in order to generate qualitative information. A formal questionnaire survey of 108 randomly selected households was carried out during the winter month of June 2005, in order to get inferential socio-economic data on the population of the two villages and to get an idea of the extent of consumption patterns and the significance of African Leafy Vegetables as a foodstuff. The fact that multiple methods and tools were used allowed for the triangulation of data.

The report starts by describing the three different types of agriculture that are currently practised worldwide and looks at an international understanding of indigenous knowledge, while taking note of the current ways in which indigenous knowledge is considered for the purposes of integrating it with scientific knowledge. This provides the international perspective on indigenous knowledge in agriculture. In order to answer the three questions the study covered a number of areas. To understand the context in which indigenous knowledge is developed attention was paid to the history of the villages, agricultural activities in the villages and an understanding of the socioeconomic circumstances of the villagers was generated. Some of this information was gathered by means of the survey of 108 households. Indigenous knowledge in the two villages is important as a means of producing foodcrops. 96% of the respondents during the survey had consumed African vegetables during the past twelve months and 95% said they dried and stored some African vegetable leaves during the past year to ensure food for winter. The various foodcrops are identified and in some cases where nutritional information is available they are compared with exotic crops such as cabbage. African leafy vegetables such as Amaranth and Cleome and pumpkin/squash leaves compared more than favourably. While African vegetables are still a predominant source of vegetable in the villages they are being gradually replaced by the availability of exotic vegetables in the area. Despite the fact that the latter need to be purchased they are popular amongst the younger generation and the children. African vegetables and traditional food crops tend to be high in nutrients and thus sufficient availability or increased consumption of these foodstuffs could reduce levels of undernourishment.

Cropping and harvesting practices were studied and while these were relatively simple in terms of the minimal use of external inputs there was a strong knowledge base which could make use of some of the scientific knowledge becoming available in this field. Due to limited resources, especially land, and the spreading of risk associated with crop failure intercropping was a favoured practise. Residents were aware of the benefits and constraints of this practise and had developed specific farming systems to suit there needs and to ensure crop development. Despite this there were a number of places where practices could be improved.

Residents were also aware of the importance of soil nutrition and here too they had developed their own local systems to improve soil fertility. Again further support in this area could also enhance crop production. Similarly different forms of fertilisation should be examined by the villagers due to water scarcity and the use of manure for household purposes.

In some instances seed was collected and stored but residents indicated that they could notice a decline in the plant population over the past forty years. Despite this few attempts were made to conserve seed. Respondents requested help in this area. Some reasons for reduced seed were lack of water management skills and subsequent erosion as a result of forceful but erratic thunderstorms.

Rituals and taboos were examined to determine their relevance in the agricultural production process. While a number were identified it was clear that only the elder generation still practised the rituals and obeyed the taboos. The younger generation had started to question these and did not seem to obey or practise them.
While African vegetables and crops do have some direct economic significance this is for a relatively small group of people. We noticed that some crops were sold in the surrounding areas and that this was in fairly small volumes. However, there is a market and some of the vendors wished they could get more varieties as there was a demand for diverse produce.

This study demonstrates that most local households rely on their indigenous knowledge about agricultural practices to ensure that they can produce a supplementary source of food for the household within the constraints imposed upon them by poverty and their physical environment. However, given developments in agricultural research there seems a good likelihood that agricultural research can collaborate with some of the members of these households to collaboratively develop technologies that will enhance current endeavours and enable them to optimise their production. Given the knowledge of agricultural principles and some of the local innovations practised by some farmers it is clear that integration is a possibility

While a number of areas for the integration of indigenous knowledge and scientific knowledge presented themselves and indicate good potential for collaboration there are two areas which we consider to require immediate attention. Water management and soil management are problematic in the area and the two needs to be addressed simultaneously. Because of the simple and low external input requirements of current technologies these can be tested and adapted by local farmers in conjunctions with researchers. They need to be addressed before the other areas of potential collaboration because if not done so agriculture will decline and there won't be much point in considering the other areas such as seed systems, food preparation and processing.

A second phase is proposed that will enable the understanding of how the knowledge systems integrate. This process should be recorded so that the inherent principles, along with the technology are available for other villages in the area. The process of the integration of science and indigenous knowledge needs to be recorded in order to be understood and lessons learnt. Process recording and monitoring will enable the identification of what works, what doesn't work and why this occurs. This phase should invoke the participatory approaches of Farmer Field Schools and Participatory Technology/Innovation Development. It should also include the presence of a social scientist to carry out the process monitoring or implementation research in order to investigate and understand the process of integration of the two knowledge systems.

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The Department of Science and Technology, Indigenous Knowledge Systems Unit, which encouraged us to undertake the study and which also financed part of the study by covering some of our travelling, accommodation expenses and workshop costs in the two villages is greatly appreciated as is the Human Sciences Research Council whose Parliamentary Grant paid for our salaries while we undertook this study.

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Introduction

Agricultural development projects in Africa have predominantly followed the input-output development model, which assumes that a country's economic and social development can be externally induced (Donnelly-Roark, 1998). This assumption ultimately ignores the roles of the project actors and the effects that they have on the process (in essence their knowledge and behaviour) and suggests that they are no more than passive recipients of development technologies and strategies. Such a model also ignores the effects that internal and external influences within the development process bring to bear on the project. Projects based on this model identify beneficiaries who receive various externally derived and often locally unavailable and typically expensive inputs, the use of which are expected to bring about development. However, such projects have not brought about sustainable development because once the flow of these inputs is stopped – due to any number of reasons (including a withdrawal of funding, subsidisation, etc.) – the associated "development" falters. Following from our research and that of others involved in agricultural development in South Africa and the rest of the world, we argue that indigenous or local knowledge and related social and cultural practices are important but much neglected resources for agricultural development, especially when the notion of sustainable development is considered. Rather than replacing what people know with new, often expensive, unfamiliar, culturally and socially inappropriate and consequently locally unsustainable technologies, it makes sense to consider and understand what people know and, where appropriate, to build upon this knowledge. As Robins (2003) points out, rural communities often employ hybrid, highly selective and situational responses to exogenous development interventions, which he describes as indigenous modernities: "Development packages are resisted, embraced, reshaped or accommodated depending on the specific content and context" (2003: 265).

With this in mind an interdisciplinary study was developed in which a collaborative team of natural and social researchers from the Science Councils employed participatory action research methods with local community members and focused on the dynamics of indigenous knowledge in poverty reduction strategies. The overall aim was to analyse the possibilities for collaboration and integration of indigenous knowledge and scientific knowledge in order to improve the use of both systems of knowledge to reduce the effects of poverty amongst those most severely affected – rural agrarian households. The focus was on local natural resources and in particular on African vegetables, which are an important food resource for many rural communities in South Africa. The use of indigenous knowledge in producing and consuming these vegetables is realised but seldom documented. This project set about identifying and documenting the various types and dimensions of indigenous knowledge used with regard to African vegetables and other "traditional crops". The emphasis was on cultivation and propagation, harvesting, consumption, storage, marketing and the associated social and cultural practices linked to these activities. In light of this information the opportunities and possibilities for further research that considers the integration of science and indigenous knowledge is identified where necessary, if such research can reduce the poverty of rural agrarian households. This knowledge will be tentatively and provisionally assessed and analysed to determine if, where and how it can integrate with mainstream scientific knowledge to improve the cultivation, harvesting and consumption practices, thereby further reducing poverty. Such a study is important in order to implement a more effective and appropriate research and development process in South Africa, especially one that involves the collaboration and integration of indigenous and external or scientific knowledge. This study differed from previous studies by a) considering the potential for integration of indigenous and scientific knowledge for technology development and transfer, and b) by giving special attention to the role of African vegetables and associated indigenous knowledge in local poverty reduction and food security strategies.
In terms of the findings, the study makes recommendations on what needs to be considered in order for the two knowledge systems to collaborate to bring about greater impact and promote sustainable agricultural development in terms of household food security and poverty reduction within South Africa. It was foreseen that the process would provide suggestions on how indigenous knowledge can collaborate equitably with mainstream science to bring about synergy.

It is not our intention to suggest that indigenous knowledge holds the answer to all development constraints, be they agricultural or other sectors of development. This is especially so in the current circumstances where numerous factors contribute to underdevelopment or to a lack of positive impact by development interventions. Such factors include increasing poverty; population pressure on resources and the deterioration of the natural resource base; the unprecedented effects of rapid climate change, and the short-term and long-term effects of HIV/AIDS in Southern Africa. However, we

do support the idea that development needs to start with what people know and build on their knowledge and experiences where these are relevant and desirable. To this extent peoples' indigenous knowledge should be treated with equal respect to that usually accorded to scientific knowledge; neither is infallible and often, as worldwide research has illustrated, local knowledge and related practices are more effective. In this report, based on a case study of two rural villages in the Mopane District of the Limpopo Province we provide some examples of how important indigenous or local knowledge is to its users, different ways in which they use this knowledge, and the potential that indigenous knowledge has in some areas of agricultural development. We also consider possible ways in which local knowledge and "scientific" knowledge could work together for mutual improvement. Given the limited resources available for this project these areas of collaboration were not practically investigated, this will form part of a second phase should resources become available.

Primarily, the study looks at some examples of local peoples' agricultural practices in which they have used their indigenous knowledge as well as innovations to overcome many of the socio-cultural, socio-economic, political and environmental constraints they experience. Because our focus is on agriculture, we begin with a discussion on the different types of agriculture that are practised worldwide. Our ensuing discussion will focus on one of these general types, namely resource-poor agriculture and the resource-poor agrarian households in South Africa. We then discuss indigenous knowledge and its role in agricultural development from a global developmental perspective. This is followed by a brief examination of the practice of indigenous knowledge research in South Africa. From there we present our research findings, which indicate the significance of indigenous knowledge to agricultural development in the two villages in which we conducted our study. We conclude with some suggestions for areas of collaboration for the two knowledge systems in terms of local agricultural development in the two villages.

Three General Types of Agriculture Practised Worldwide

Generally, the discourse that favours modernisation has influenced the development process in developing countries around the world. Although it can arguably be considered successful in many contexts, it has not been very successful in sub-Saharan African agriculture. In the modernisation paradigm, which is closely linked to the input-output model, new scientifically researched technologies are always considered favourably by those with influence. South Africa, despite its links to an indigenous heritage has also been subjected to its share of modernist agricultural development interventions. Despite our post-modern era, the South African government extension and research services (like those of many developed and developing countries) still attempt to resolve complex problems with simple and easy quick-fix solutions. Consequently, indigenous knowledge and related agricultural practices are often overlooked or attempts are made to replace them with more "acceptable and efficient modern methods". This presupposes universal truths and consequently universal solutions. In essence the smallholder farm is seen as a scaled-down version of its larger counterpart and no consideration is given to socio-economic and agroecological diversity between the two types of farms or even within the types, which influence the nature of the farm and farming practices. Pschorn-Strauss and Weinberg (2002) note that the South African government and the African Union's (AU) New Economic Plan for Africa's Development (NEPAD) favour new technologies such as genetic engineering and genetically modified organisms (GMOs) in agriculture because they fit into the macroeconomic strategy of these two political structures, which favour industrialised agriculture, globalisation and externally led development in opposition to locally led development strategies. In order to understand that farms (particularly in terms of size, scale of operation and resources) and associated agricultural practices are amongst others socio-economic and agroecological creations rather than stages in evolution, we need to pay attention to the different types of agriculture practised in the world today. This will give us a better understanding of resource-poor farmers' and agrarian households'[1] circumstances, allowing us to illustrate the contribution that indigenous knowledge can make to alleviate the effects of these constraints.

[1] For the purposes of a working definition we define agrarian households as those households in rural areas that supplement their household food supply by producing crops and livestock on a small scale, usually on the plot on which their primary dwellings are situated. The produce from these activities is primarily consumed by the household although in some instances it might be sold or exchanged

The 1987 Brundtland Commission identified three general and distinguishable types of agriculture that are practised around the world and that are a result of the interaction between diverse socio-economic[2] and agroecological factors. The three types of agriculture are industrial agriculture, green revolution agriculture and resource-poor agriculture (WCED 1987).

1. Industrial agriculture is predominantly found in Europe and North America, with enclaves in some developing countries. Large-scale agriculture practised in South Africa and that practised in some South American countries such as Argentina, are examples of this type of agriculture from developing countries. Industrial agriculture is not only characterised by highly capitalised infrastructure and machinery, large-scale farming units, reliance on high volumes of external inputs such as synthetic fertilisers and pesticides, but in certain parts of the world (North America and Europe) it is also heavily dependent on government subsidies.

2. Green revolution agriculture is found in optimal environmental regions of developing countries. These areas are either well irrigated or receive reliable and sufficient rainfall. Farms are both large and small in scale and rely on high-yielding crop varieties with corresponding high volumes of external inputs. Examples include parts of Latin America and North Africa, and the vast irrigated plains and deltas of South, Southeast and East Asia (Chambers, Pacey & Thrupp 1989). Both industrial and green revolution agriculture employ fairly simple farming systems, often involving the planting of a single type of crop (monocropping) on large fields. Uniform environments are sought out and these agricultural types are relatively low-risk in comparison to resource-poor agriculture. Although it is not unusual for farmers in green revolution areas to diversify their agricultural activities and farm with a variety of crops and livestock, they tend to place a major emphasis on monocrop production.

3. Resource-poor agriculture is associated with marginal or unfavourable areas that are almost exclusively rain-fed and that are often characterised by an undulating terrain with fragile or poor soils. The farming lands are very diverse and include drylands, wetlands, highlands, hinterlands or remote areas; forests, mountains and hill slopes; grasslands, swamps and semi-desert areas. Examples include most of sub-Saharan Africa, upland areas in Southeast Asia, East Asia, Latin America and the Deccan Plateau in India (Chambers *et al.* 1989). This form of agriculture is characterised by complex farming systems and diverse environments, and by being exceptionally risk-prone. Resource-poor farming is very risky because of the diverse agroecological environment and socio-economic circumstances of the farmers. To overcome these constraints farmers usually employ complex and diverse livelihood strategies.

Agriculture in Africa and South Africa

Simply put farmers[3] in South Africa, irrespective of race or gender, generally fall somewhere along three axes[4]: size; access to resources; and primary purpose of production. Firstly, they fall somewhere on a continuum between large-scale and small-scale. Secondly, they fall along a continuum of resource-rich and resource-poor. And thirdly, they fall along a continuum of commercial production and subsistence production. This means that a small-scale farmer might be resource-rich, resource-poor or somewhere in between (resource-medium). Such a farmer could also be either involved in commercial production, subsistence production or somewhere in between the two (producing primarily for household consumption but selling any surplus). We should furthermore bear in mind that these characteristics are all relative. Movement within or across these categories is not a fact of evolution, progress or a result of modernisation. Location within any category and mobility to another category is rather a result of an individual farmer's physical environment, socio-economic and physical

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locally for other household needs. Such a working definition can apply equally to urban households following agricultural practices for similar means.

[2] Here we include historical and political factors that might have influenced or still are influencing the current situation, including wars, political upheaval, colonisation and globalisation.

[3] "Farmers" include peasant/family smallholders, pastoralists, forest dwellers and artisanal fisherfolk among others. The term "farming" is used in a wide sense to refer to the activities of all people who produce and/or harvest from plants, animals and aquatic resources.

[4] Other important criteria would include age, gender, education level, equity aspects, infrastructure, input and output markets, etc. For the sake of simplicity we confine ourselves to three criteria.

circumstances, occasionally personal choices and a host of external factors, including political policies. Most farmers in developing countries are identified as being resource-poor, but in South Africa farmers will fall somewhere within a grid composed of all three of axes we described.

The majority of large-scale farms in South Africa are owned by white males, or companies run by white males, who farm for commercial purposes. Generally, these farmers have access to and can afford to make use of virtually all the prerequisite conventional agricultural technologies, inputs and capital. They tend to be relatively resource-rich in comparison to their black counterparts. For our purposes we consider as small-scale or smallholder any farmer who is a black (including African, coloured and Indian) male or female farming individually, rather than communally, on less than 3 hectares of land[5]. Small-scale black farmers are mainly resource-poor since they make little use of high-external-input agricultural technology and capital. There are some whom we would term as resource-medium – they are able to make some use of conventional agricultural technology[6], inputs and capital, but they also make use of locally available agricultural inputs. Consequently, we stratify this group into two types: resource-poor and resource-medium. The resource-poor group tends to farm mainly for subsistence purposes, while the group with access to some resources tend to farm more for commercial purposes and consume some of their produce. Agrarian households fall within the former group. Our research experience informs us that the farming practices of the farmers in both these groups are often a mixture of "traditional" and conventional practices. Close scrutiny of these practices also reveals that they contain improvements upon and local adaptations of both these types of farming practices.

There are a number of characteristics that distinguish African smallholder farmers from North American and European large-scale farmers, and also from some large-scale farmers found in parts of Asia, South America and Africa:

- Generally restricted access to farmland: The size of land available to African farmers can be anything between 0.1 acres and 10 acres. There is also often an uncertainty of tenure which prevents further expansion.
- Multiple cropping systems: African smallholder farmers actively engage in intercropping and multi-storey cropping, rather than monocropping. This means that they plant a number of crops in a single field. This is a consequence of the small size of their farms, the challenging environmental (climatic and soil) conditions and the subsequent need to spread their risk. If one crop is lost they will still receive the benefit of the other crops. This is their crop insurance strategy. Monocropping would increase their risk dramatically and would remove their insurance. This practice also enables farmers to produce for more than one market and purpose. Furthermore intercropping practices can provide a means of improving soil structure and nutrient content (Hart 2005). If crops are monocropped rather than intercropped, this is done by allocating small areas of the land to a specific crop, so that on one parcel of land you might find several diverse crops being grown. This seems to be more a practice with farmers whom we term resource-medium and again it provides a measure of risk spreading and market diversity.
- Lack of subsidies: Whereas European, North American and Chinese farmers receive government subsidies, African farmers do not. Even large-scale African farmers no longer receive subsidies from their governments. In the event of crop failure they cannot recoup the production costs.
- Mechanisation: Farming in Europe and North America is highly mechanised while in Africa most farmers tend to rely exclusively on human labour and animal traction. In South Africa some resource-poor to resource-medium farmers use a mixture of both forms of traction (Hart 2002).
- Low-external-input agriculture: External inputs, such as hybrid seeds, agrochemicals and fertilizers are costly and often difficult to access. Consequently, African resource-poor farmers tend to make very limited use of these external inputs. Instead, many have developed their own systems of crop rotation, fertilisation, composting, manuring, seeds and crop development,

[5] Makanya (2004) has suggested that 80% of the African population are smallholder or small-scale farmers with access to between 0.5 and 3 acres of land. Our experience in South Africa is that some smallholder farmers have access to about 3 hectares. However, the lack of any clear consolidation on research relating to definitions, numbers and landholding or tenure makes any typology rather difficult. Rural agrarian households generally tend to have access to less than 500m^2 for home gardens.

[6] Conventional agricultural technology is understood as technology and practices that have been developed or improved upon at research farms. It is the technology that is most closely associated with industrial and green revolution types of agriculture. Its effectiveness is largely based on suitable agro-ecological conditions and the reliance on high externally derived inputs.

storage and exchange, pest control, etc., that rely almost exclusively on locally available resources. Numerous examples of these practices are available in Reij & Waters-Bayer (2001) and van Veldhuizen *et al.* (1997) and coincide with what is known as the science of agroecology (Altieri 2002). These practices are intrinsically interwoven within the farmers' and local community members' social and cultural systems (Hart and Mouton 2005). The high cost of external inputs and the fact that they were generally developed for more suitable uniform environments (where irrigation and other resources were readily available) than those inhabited by most African farmers are primary reasons for the general failure of the Green Revolution in sub-Saharan Africa. High-input agricultural practices involve purchasing expensive inputs and the farmers seeking credit in order to farm in this fashion. This method does not encourage the risk management system of intercropping and storey cropping[7]. When crops fail, farmers go into debt, as they cannot repay the advanced credit.

- Most resource-poor farmers are unable to purchase agro-chemicals due to the costs associated with these products. Because agrochemical fertilizers are expensive, these farmers rely on local crop residues, organic material and soil micro-organisms such as invertebrate, fungal and bacterial species for soil fertility. These components are stressed in agroecology and sustainable agricultural practices such as permaculture.
- Unlike their large-scale counterparts, 90% of farmers in Africa rely on saved seeds as their primary source of plant material (Orton 2003). Other sources for obtaining seeds can include exchanging with neighbours and relatives (often associated with local cultural practices) or exchanging with and purchasing from extension services, local markets and rural supply stores (Orton 2003: 23).
- Many resource-poor farmers breed and develop their own seeds, which have multiple site-specific requirements. Rosset (2004) points out that research in sub-Saharan Africa has shown that in the case of improved varieties of seeds, yield response to fertiliser, variety, soil management, irrigation practices, etc., is highly specific to the site where planted, the soil, the season and the farmer. His point is that while conventional breeding programmes do not consider these factors, many farmers' breeding strategies actually include them over time – making their locally developed seeds more appropriate to local conditions than the more costly hybrids and transgenic varieties.

Despite this list of distinctions, Packham (2002: 3) reminds us that when it comes to reducing risk and selecting technology there are a number of issues that all farmers generally have in common:

> "...it is ...often forgotten that most farmers (and particularly small farmers) place higher value on reducing risk than they do on maximising production, and that they are more interested in optimising the productivity of scarce farm resources than in increasing land or labour productivity. Farmers will also choose a particular production technology based on decisions made for the entire farming system, not only on a particular crop".

Surveys of smallholder farmers in Peru revealed that farmers preferred alternative agricultural practices such as agroecology because it optimised labour usage, capital and the use of scarce resources and was accessible even to the poorest farmers (Altieri, Rosset & Thrupp 1998). Unfortunately, most policy makers normally overlook these factors regarding the nature of farmers' circumstances and related decision-making. They are also ignored by agricultural researchers (be they economists, agronomists, geneticists or sociologists) and extension officers when developing or introducing technology in support of policy. A brief anecdote will help to illustrate the disparity between conventional advice and farmers' circumstances. Despite being offered in good faith, advice is often given in ignorance.

One can only imagine the thoughts that cross the mind of an African farmer when he or she is told by agricultural extension officers and researchers that all the "weeds" in the household garden must immediately be removed to allow the maize to improve in quality and yield. The "weeds" that many African farmers intercrop with staples (e.g. maize, bananas, sorghum and millet) or domesticated[8]

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[7] These two systems also have other purposes such as crop protection and soil fertilisation.

[8] Domesticated crops are those crops that have been selected and bred for certain characteristics. This process is sometimes deliberate (public and private research organisations and farmers who retain some seeds for planting during the next season) and sometimes unconscious (those plants that are most responsive to cultivation under the local circumstances will become the progenitors of the crop for the next season). The process of selection results in vast differences between the cropped plants and the original progenitors from the wild, many of which are no longer available. Despite

exotic vegetable crops (e.g. cabbage, pumpkin, green beans, tomatoes) actually form the major part of the diet of many African households. These crops are generally known as African Leafy Vegetables (ALVs). In some countries, including Uganda (TUAN 1999), Kenya (Chweya & Eyzaguirre 1999) and parts of South Africa (Twine, Moshe, Netshiluvhi & Siphugu 2003; Hunter & Twine 2005; our own observations during 2004, 2005), a number of varieties are sold in urban markets and are even grown in urban areas; such is their significance for urban and rural residents alike. These plants are relatively cheap to purchase in contrast to exotic vegetables such as cabbage, spinach, etc., and many are more nutritious than exotic vegetables. In some parts of Africa many of these plants are not actively cultivated as they appear as volunteer crops on a seasonal timetable. In others they need to be actively cultivated because they are becoming a diminishing resource (Hunter & Twine 2005). Weeds are typically defined as not necessarily bad or harmful plants, but rather those that are in a place where humans do not want their presence (Reijntjes, Haverkort & Waters-Bayer 1993: 218). Consequently, local rural dwellers – unlike extension and research personnel – do not consider these plants as weeds because their presence is desirable and even vital to their food security, and often beneficial to sustaining their agricultural resources. We shall see that villagers in our study practice limited weeding and remove plants they consider as weeds while leaving others which they consume.

Most African farmers, especially those residing in the drier and drought prone areas of South Africa, produce crops for household consumption and, where feasible, attempt to sell any surplus that they make to local markets. This practice is remarkably different to that of European and North American farmers, and also large-scale commercial farmers in Africa, who predominantly concentrate on producing crops for the various national and international markets to which they have access. While these farmers tend to monocrop large tracts of land, the smallholder African farmers tend to intercrop on the relatively small pieces of land on which they practise agriculture. Intercropping is carried out for a number of reasons, including the spreading of the risk associated with crop failure and for achieving food variety. Other reasons include perceptions that the presence of some plants add to the development of others, either by providing natural protection such as shade and windbreaks or by replacing depleted nutrients in the soil that are removed by other plants (this includes the nitrogen-fixating properties of legumes). We noticed similar practices amongst agrarian households but before looking at the study methods and results we need to consider indigenous knowledge and how it might collaborate with agricultural research and technologies.

Review of Indigenous knowledge and Scientific Knowledge interaction

Working definition of Indigenous Knowledge

Indigenous knowledge is generally described as the knowledge that local people in a given area or community have developed over time and which they continue to develop (Warren 1991; Scoones & Thompson 1994a). Therefore, such knowledge is not static and not confined to the "original" inhabitants of an area; it is locally developed knowledge that continues to be developed (Warren 1992; IIRR 1996; Grenier 1998; Langill 1999). It is usually:

- based on experience and can include the influences of externally derived knowledge;
- tried and tested over generations and even centuries of use (although this is not necessarily always so as in the case of recent farmer innovations which might have been practised over a shorter period but could include some older practices)[9];
- adapted to local environmental conditions and constitutes part of local culture;

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differences, gene flow took place between cropped plants and the progenitors in the wild that accounted for much of the biodiversity.

[9] It is also important to note that various external factors can erode, but not necessarily destroy, a person's or people's indigenous knowledge base. These can be factors such as natural and political disasters for example floods, drought, wars, etc. In South Africa policies and practices such as those experienced under Apartheid can have the effect of eroding the indigenous knowledge base, especially when people are uprooted and removed from familiar unfamiliar physical environments. Twine *et al.* (2003) have pointed out that overpopulation of an area and the erosion of traditional leadership structures which previously ensured that indigenous nature conservation practices were adhered to, can also result in the erosion of the indigenous knowledge base, with seemingly negative consequences to the local environment and therefore food security.

- transferred orally rather than documented;
- dynamic and changes continuously.

The content of indigenous knowledge is not confined to one subject only, but covers a wide range of diverse topics in a particular area. These include agriculture; animal husbandry; food preparation; local beliefs and rituals; education; institutional development and management; natural resource management; religion and spirituality; healthcare, etc. (Warren 1991). It can also include sub-topics of these topics. By virtue of the numerous topics that are included under the concept of indigenous knowledge and its use in local level decision-making, it is deemed a vital resource for development initiatives and in many instances can be equal or superior to what is generally described as "Western Scientific Knowledge (IIRR 1996; Langill 1999). Of course, as we shall see, this does not mean that indigenous knowledge is flawless and always equal to or better than scientific knowledge.

Indigenous knowledge is not a new development concept. It was reportedly used in the late seventies. Since the 1990s scientists from diverse disciplines started to pay increasing attention to indigenous knowledge or what they then termed 'indigenous technical knowledge' - ITK (Grenier 1998). In agriculture the focus on this local resource is seen as being the cornerstone of many agricultural development interventions in the developing world, in particular low-external-input sustainable agriculture or LEISA (IIRR 1996; Langill 1999; Langill & Ndathi 1998; Mettrick 1993; Reijntjes *et al.* 1993; Scoones & Thompson 1994a; Torkelsson & Anandajayasekeram 2000). Many agricultural researchers and extensionists talk of indigenous technical knowledge (Chambers, Pacey & Thrupp 1989; Mettrick 1993; Torkelsson & Anandajayasekeram 2000). Some have tended to describe this resource in broad terms (Torkelsson & Anadajayasekeram 2000) while others have interpreted this rather narrowly to refer exclusively to the role of people's technical knowledge and abilities in agricultural production. Mettrick (1993: XXIII) describes indigenous technical knowledge as:

> "the knowledge of local people about their environment and the technical aspects of their farming situation, including a capacity to expand that knowledge through observation and experimentation".

During the latter half of the 1990s the trend has been to accept indigenous technical knowledge as being more a part of indigenous knowledge rather than the same thing (IIRR 1996; Langill, 1999; Langill & Ndathi 1998). As Scoones and Thompson (1994b: 18) explain:

> "In recent years, this perspective [indigenous technical knowledge] has been expanded to consider indigenous knowledge as *cultural* knowledge, producing and reproducing mutual understanding and identity among the members of a farming community, where local technical knowledge, skills and capacities are inextricably linked to non-technical ones (i.e. cultural, ecological and sociological factors....). ....it appears that this broader conception of indigenous knowledge is gaining wider currency" (italics in original).

Given the breadth of local information that is incorporated into indigenous knowledge, an increasing number of agricultural and development professionals have realised the importance of this local resource, especially in agricultural initiatives in marginalised areas. There are a number of reasons for the interest in and value attributed to agricultural indigenous knowledge:

- Farmers and rural households in marginalised areas strive to adapt both to their circumstances and to their natural environment. Both are continually changing and farmers and agrarian households continuously adapt to ensure survival. Resource-rich farmers in better and more central areas have used conventional science to manipulate the environment to suit their needs. Given the constraints of resource-poor farming households and their ability to eke out a livelihood in what are often the direst of circumstances – if service providers are to assist them to sustain or improve production - then an understanding of their indigenous knowledge is required.
- Most resource-poor farmers in marginalised areas have been practising low-external-input agriculture (LEIA) for generations due to their typical location in these remote areas, and did this in spite of non-existent or minimal support from research and extension services. The implication is that they have developed a vast knowledge of such localised practices. In many cases this knowledge has proved to be an effective and efficient coping strategy for their survival. A further implication is that a strong foundation exists within these areas upon which sustainable agricultural practices such as LEISA can be built. Of course some of the existing practices are no longer sustainable due to increasing pressure on natural resources (Twine *et al.* 2003) and the rapid climatic changes that are currently being experienced.

- Indigenous knowledge can provide the currently constrained research and extension services with low-cost solutions. It forms a base upon which further research (conventional and complementary) can be developed to optimise local practices (Torkelsson & Anandajayasekeram 2000). Grenier (1998) cites Richard Wilk's (1995) example of how, over a period of several years, the numerous studies and projects that attempted to commercialise the production of edible palm oil from a native tree in the Belizean rainforest failed, despite access to high-yield trees and a range of tried and tested modern technologies. Throughout this period local household production, based on a variety of simple local technologies, never stopped.
- Local farmers have developed ways to improve soil structure, water-holding capacity, nutrient availability, water availability, and pest control without using artificial inputs such as chemical fertilizers, pesticides and herbicides (see Reijntjes *et al.* 1993). These strategies often use carefully planned crop rotation, intercropping or companion planting methods that farmers have developed or adapted over time (Hart 2005).
- Many local farming systems mimic nature ensuring that optimal use is made of sunlight, nutrients and rainfall. As nature changes, so farmers have continued to mimic nature – thereby ensuring to some degree the sustainability of local agriculture (Reijntjes *et al.* 1993).
- The realisation that agricultural systems are intertwined with and often an important part of the local social systems has warranted closer attention being paid to agricultural indigenous knowledge and its embeddedness in the broader social context. This enables researchers and other service providers to more completely understand this knowledge and thereby avoid making incorrect assumptions about local practices.
- Often the farming systems employed are complex designs of ecological agriculture that farmers have fine-tuned to their local environment (Kotschi *et al.* 1990; Reijntjes *et al.* 1993). It is argued that the sharing of such knowledge can ensure the improvement of local systems and practices along the lines of sustainable agriculture (Chambers *et al.* 1989; Mettrick 1993; Reijntjes *et al.* 1993; Scoones & Thompson 1994a; Pretty 1996; Van Veldhuizen *et al.* 1997; Torkelsson & Anandajayasekeram 2000).
- By virtue of the fact that indigenous knowledge is often disseminated across generations, giving it a long-term perspective, and is shared in varying degrees within communities, securing the notion of equity inherent in sustainable agriculture, it is believed to be a source of sustainability for the resource-poor farmer (Torkelsson & Anandajayasekeram 2000).

Arising from this significance and awareness of the dynamics of indigenous knowledge, a number of agricultural and pastoral researchers now talk about farmers' and rural people's local innovations. According to Waters-Bayer and van Veldhuizen (2005: 1):

> "Local innovation refers to the dynamics of indigenous knowledge – the knowledge that grows within a social group, incorporating learning from own experience over generations but also knowledge gained from other sources and fully internalised within local ways of thinking and doing. Local innovation is the process through which individuals or groups discover or develop new and better ways of managing resources – building on and expanding the boundaries of their IK."

Local innovation is therefore intrinsically a part of indigenous knowledge and precisely what makes it work despite changing circumstances. With access to wider sources of knowledge and the assessment and incorporation of these into local practices, indigenous knowledge often loses its "traditional" appearance. However, it is still locally developed and therefore still indigenous or local knowledge.

Integration of Knowledge Systems

With over a quarter of the world's population dependent on resource-poor agriculture, and given the problems faced by industrial and green revolution agriculture such as declining yields, reliance on costly external inputs and increased tolerance of pests to pesticides (Wolf 1986; Chambers 1994; Grenier 1998), coupled with the seeming significance of indigenous knowledge and local innovations in resolving some of these issues in particular areas, it is vital that more appropriate research is conducted in South Africa, sub-Saharan Africa and in other developing areas of the world. However, conducting such research is not always a simple process, as the value (or lack thereof) that "Western" trained researchers and scientists place on indigenous knowledge can be understood in three different and conflicting ways:

- Some see indigenous knowledge as a primitive form of knowledge, which is incorrect and unscientific, requiring conventional research to educate its users and thereby modernise them. Modernisation is the key and considered to be the best approach by proponents of this view.
- A small group of applied researchers see it as a highly valued and under-utilised resource that needs to be carefully studied and then the "best elements or practices" (those considered relevant by scientists) should be extracted and combined with science. This process is highly extractive and ignores the social, cultural, spiritual and other dimensions associated with indigenous knowledge which in fact make it effective; allowing principles to be transferred from generation to generation. Unfortunately this is a fairly common approach, although it is nothing more than a weak attempt at legitimising indigenous knowledge in the eyes of the academy.
- An even smaller group, emerging from the second, argue that neither form of knowledge, indigenous or scientific, can be regarded as a complete and static stock of knowledge for they reflect contrasting epistemologies, created within specific environments, under various circumstances. Both forms of knowledge are in fact evidence of dynamic processes of observation, investigation and experimentation. Both can include and adapt external innovations. Indigenous knowledge is equal to scientific knowledge and differs only in the resources at its disposal.

This last viewpoint has been given enormous support from agricultural development studies carried out by non-government and other organisations with smallholder farmers in developing countries around the world. This research has shown that if only the "best tenets" of indigenous knowledge are extracted, then the resulting technology or innovation is usually less effective. For example, trying to get farmers to plant an improved variety of a local plant without observing the necessary preparatory rituals or social taboos would be tantamount to trying to get an engineer to believe in a new concrete mixture when she knows that the foundations have not been correctly laid. Similarly, a lack of knowledge about the local environment or weather patterns could also make the introduction of new technology ineffective. Research has identified that in the applied development situation neither indigenous knowledge nor scientific knowledge can claim superiority over the other; rather they complement one another. Therefore the premise that one is universally better than the other is incorrect; it is their contribution within the context of a particular problem or requirement that is important, making one more advantageous than the other. This realisation has resulted in a greater awareness of the dynamic nature of indigenous knowledge and its role as an important resource for sustainable local agricultural development. Some scholars have argued that by comparing and integrating scientific and indigenous knowledge, the most suitable solutions to development issues can be found (Gorjestani 2000; Grenier 1998; Millat-e-Mustafa 2000).

During 1995 and 1996 a number of debates appeared in the Indigenous Knowledge Development Monitor that are relevant to the integration of these knowledge systems. Agrawal (1995) argued that indigenous knowledge should not be archived and disseminated in its current form. This form is largely web based or in printed form. The argument is primarily that the specific nature of indigenous knowledge prevents it from being a universal application and that such methods of archiving are in any event difficult for local farmers to obtain. He was generally against the connotation of best practices that this form of archiving and disseminating could encourage. In a counter to this Warren (1996) argued that the knowledge system needs to be globally accessible as the information is pertinent to farmers and scholars, as well as development agents. This would allow the knowledge system to become valued globally and promote the global realisation that the current dichotomy between the two knowledge systems is ridiculous. He stressed that it should be up to local people to determine which aspects of their knowledge and practices they retain *in situ* and which they permit to be stored *ex situ*.

In the same series of debates Kohler-Rollefson (1996) emphasised that while there was significant merit in indigenous knowledge we must remember that it is unable to solve all those problems which have come about in recent times, such as major animal diseases. In this regard scientific methods and solutions were superior. In order to ensure integration he argued that there was a need for constructing an interface between these two systems. This is to be done by introducing indigenous knowledge into academic curricula and by getting 'converted' social scientists to collaborate with 'unconverted' natural scientists. Of course this latter area has improved in recent years with many natural scientists realising the significance of indigenous knowledge in their work.

Van 't Hooft (1996) argues that real integration can only occur in development settings if the development agents and farmers truly collaborate on developing solutions to locally pertinent issues,

instead of the former collecting knowledge and then developing packages which local people can adopt or reject. As Hess (1996) points out, following the work of Paulo Freire, there is a need to accept peoples' views as a precondition for true dialogue and collaboration. In agriculture these approaches are being manifested in participatory research and more recently in Participatory Technology or Innovation Development (Waters-Bayer and van Veldhuizen 2005), where support is given to farmer developed technology and initiatives in order to increase their effectiveness. It was this approach in mind that we set out to do this study.

A Brief Overview of Indigenous Knowledge Research in South Africa

Since 1994 much has been said about indigenous knowledge and its role in a democratic South Africa. In November 2004 the Arts and Culture Portfolio Committee of the Parliament of South Africa approved the Indigenous Knowledge Systems (IKS) Policy for South Africa, which consists of four key areas that drive the policy:

1. Affirmation of African cultural values in the face of globalisation;
2. Development of services provided by indigenous knowledge holders and practitioners;
3. Contribution of indigenous knowledge to the economy; and
4. Interfacing with other knowledge systems.

All four areas are undoubtedly relevant, but areas 2 and 3 stand out in terms of the contribution indigenous knowledge can make towards resolving two key problems facing Africa:

- Poor health, including HIV/AIDS; and
- Poverty, including food insecurity.

With approximately 80% of the African population using traditional medicines to meet their healthcare needs and the vast majority of sub-Saharan African residents dependent on resource-poor agriculture (characterised by a lack of modern inputs and almost exclusive reliance on locally available resources) for their livelihoods, including household food, indigenous knowledge can make a significant contribution to alleviating these problems.

In the general context of development, areas 1 and four 4 are also important. Globally, and throughout Africa, indigenous knowledge has had to interface with other knowledge systems, in particular the dominant paradigm of Western scientific knowledge. This interaction has largely been on the health and agricultural development frontiers, and has been far from friendly or even mutually beneficial. In the health frontier and given the commodity orientation of the capitalist economic system, "indigenous" populations in South Africa – particularly elders and traditional healers – were sought out for their knowledge of the medicinal properties of various local plants. These are the bio-prospecting tendencies of many local and international researchers and research organisations – be they public or private. The Council for Scientific and Industrial Research (CSIR) is a pioneer in this bio-prospecting field within South Africa. Researchers often used this knowledge for their own enrichment, giving little credit and acknowledgement to the local informants, and no reward, even when this became an issue. The process has been predominantly one-sided and extractive.

One of the concerns with these extractive activities is that they have raised the need for and thereby created the problem of trying to protect indigenous or local knowledge by attaching intellectual property rights (IPR) to such knowledge. This is problematic because indigenous knowledge is generally held communally or shared by a number of people who are often not clearly identifiable, and no clear legal evidence exists as to where the ideas originated. Similarly, we noted previously that indigenous knowledge is dynamic and continually changing. The problem is further compounded by the difficulties in attaching IPR to intangible products and the fact that indigenous people often tend to be marginalised – therefore not being able to afford the costs involved in attaching and enforcing their IPR on tangible goods as prescribed by legal process. In a discussion on IPRs in other parts of Africa, Kuyek (2002) argues that because of their resource-poor circumstances and the level of bio-prospecting that has taken place, IPRs might in the future prevent many African farmers from getting access to valuable local natural plant resources unless they have the money to purchase access rights to these resources from the holders of the intellectual property rights.

On the agricultural frontier, much of the research that has taken place has been linked to the commercial production and sustainable harvesting of medicinal plants by rural dwellers to ensure that rural communities can participate in the local and global economy in a sustainable fashion, without depleting South Africa's stock of medicinal plants. In South Africa the Agricultural Research Council

(ARC) has largely carried out work of this nature for crops such as Devil's Claw (*Harpagophytum procumbens*), Marula (*Sclerocarya birrea spp.*), Buchu (*Barosma betulina*) and Honeybush (*Cyclopia spp.*). The Council for Scientific and Industrial Research (CSIR) has carried out work on the health benefits, nutritional composition and improved processing of numerous local plants, which are purported to have medicinal properties and are in demand by a predominantly European and North American import market. The ARC, the University of Pretoria, the University of the North West and the CSIR have also done some research on indigenous food crops and infusions, mainly around the area of improving yields, postharvest quality and processing. However, there is a concern that much of this research is carried out on station and is often not appropriate to the diverse socio-economic and agroecological circumstances of resource-poor farmers and households. Similarly, it is often not directly relevant to the purported beneficiaries. The implication is that those most needing support in the form of research are not receiving it at the end of the day, especially as much of the research is done in collaboration with private companies for commercial purposes.

To argue that the significance of indigenous knowledge in agriculture is not receiving attention in South Africa would be incorrect. Rather, we would argue that it is not receiving enough attention, nor is it receiving the right attention. For example, in a recent edited publication of indigenous knowledge uses in Southern Africa, Normann, Snyman and Cohen (1996) only allocated two of the thirteen chapters to indigenous knowledge within the agricultural sector. The other eleven chapters concerned research done about medicinal plants and their uses. We would also charge that when attention is paid to indigenous knowledge use in agriculture, this focus is inappropriate as it emphasises commercialisation of indigenous plants under 'suitable' conditions. When the focus is on food plants and crops, the trend seems to be to adapt them to conventional agricultural practices in order to improve their yield or make them resistant or tolerant to various conventionally determined pests and diseases. Local context and requirements are generally ignored. Unfortunately, these activities do not consider the direct benefits that current indigenous knowledge has for resource-poor farmers and rural households, especially with regard to food security and meeting their immediate resource needs. The production of these plants and crops now become heavily reliant on external expensive inputs and suitable environmental conditions. Such technology is inappropriate for resource-poor farmers, including agrarian households.

Farmers and agrarian households typically have immediate needs with regards to food security and cannot wait years for the results of conventional agricultural technology to bear fruit. Similarly, they cannot afford to wait for agricultural research and extension services to provide them with solutions; therefore the most dynamic among them will innovate using the resources they have at hand. By providing a number of examples from our study of the different uses of indigenous knowledge and local innovations by agrarian households, we show that it is an area that needs further attention, including a different focus, from the research community, specifically those engaged in sustainable development and poverty alleviation.

Study Methodology

The study involved a social scientist from the Human Sciences Research Council's Urban, Economic and Rural Development Research Programme, an agricultural scientist from the Agricultural Research Council Vegetable and Ornamental Plant Institute and two Shangaan speaking fieldworkers, one of whom was permanently resident in the village of Berlyn. Both scientists have a background in indigenous knowledge gathering and in African Leafy Vegetables. While the one fieldworker was a graduate in social anthropology and sociology the other fieldworker has done regular work in the village of Berlyn for various social scientists.
The primary means of gathering data was through the use of Participatory Rural Appraisal tools during workshops, informal and semi-structured interviews and participant observation in order to generate qualitative information. A formal questionnaire survey of 108 randomly selected households was carried out during the winter month of June 2005, in order to get inferential socio-economic data on the population of the two villages and to get an idea of the extent of consumption patterns and the significance of African Leafy Vegetables as a foodstuff. Members of the research team lived in the village of Berlyn for a number of days at certain periods in order to get more involved in village life, to conduct participant observation and to carry out the survey. Visits to the village were carried out more or less on a monthly basis from late January 2005 until late March 2006 with most of the participant

observation being conducted during the planting and growing season between November and March. The delay in the summer rains as a result of the prevailing El Nino and La Nina weather patterns during 2005 meant that planting did not occur until November 2005.
The PRA tools were used at various times during the study, but their predominant use occurred at the beginning of the study in order to get background information and to generate an awareness of what types of crops were produced and consumed. The tools also helped in the gathering of data relating to indigenous knowledge practices. Approximately 45 people from the two villages attended the workshops. In Molati all of the people who attended the various PRA workshops were female and were a mixed group ranging in age from early thirties to late seventies. In Berlyn two males attended the workshops and all but one of the participants were in their sixties and seventies. While most of the workshop participants were senior household members, two Inyangas – traditional healers - attended the Berlyn workshops and were willing to contribute some of their knowledge about plants and animals, specifically limited medicinal properties of the various plants. Attendance of the workshops was done entirely on a voluntary basis.
The data from the workshops was further explored by means of participant observation, semi-structured and informal interviews. The methods complemented one another and allowed for triangulation of data.
Informal and semi-structured interviews included some of the men and women who attended the workshops as well as a number of others who were unable to attend the workshops. A few of these interviews along with participant observation sessions were organised in advance with the respondents, but typically during the course of our interaction with the villages we would ask them if they had time to talk to us and if we could watch them at work. Their willingness to share information was completely voluntary.
The survey focused on 108 randomly selected households across the two villages. An aerial photograph of the two villages indicated that there were approximately 800 households. Each was assigned a number and the 108 households were selected using a random number table. 90.7% of the respondents were directly involved with household food preparation, while 93% were female and 7% were male. Of those interviewed 48% were heads of the household while 36% were either the spouse or partner of the household head.

The decision was taken not to separate the participatory, qualitative and quantitative data from the two villages for the purposes of data analysis. There are a number of reasons for this decision:

- The close proximity of the two villages meant that they are exposed to many of the same circumstances;
- Research indicated that many of the people interviewed in the different villages in fact shared similar problems such as soil erosion, water scarcity, etc;
- Residents share the same local resources to a large degree, including social resources such as traditional healers, churches, enterprises and exchange networks including family ties;
- Molati and Berlyn have separate Indunas but they fall under the paramount traditional leadership of Chief Mohlaba;
- When residents are away from the villages they all talk about coming from Molati even if they are residents of Berlyn. Most outsiders are more familiar with Molati as it is the older settlement. The name Berlyn was initially used by those forcibly moved to the area in 1963 to indicate that they originally came from the farm Berlyn, situated between Letsitele and Nkowankowa.

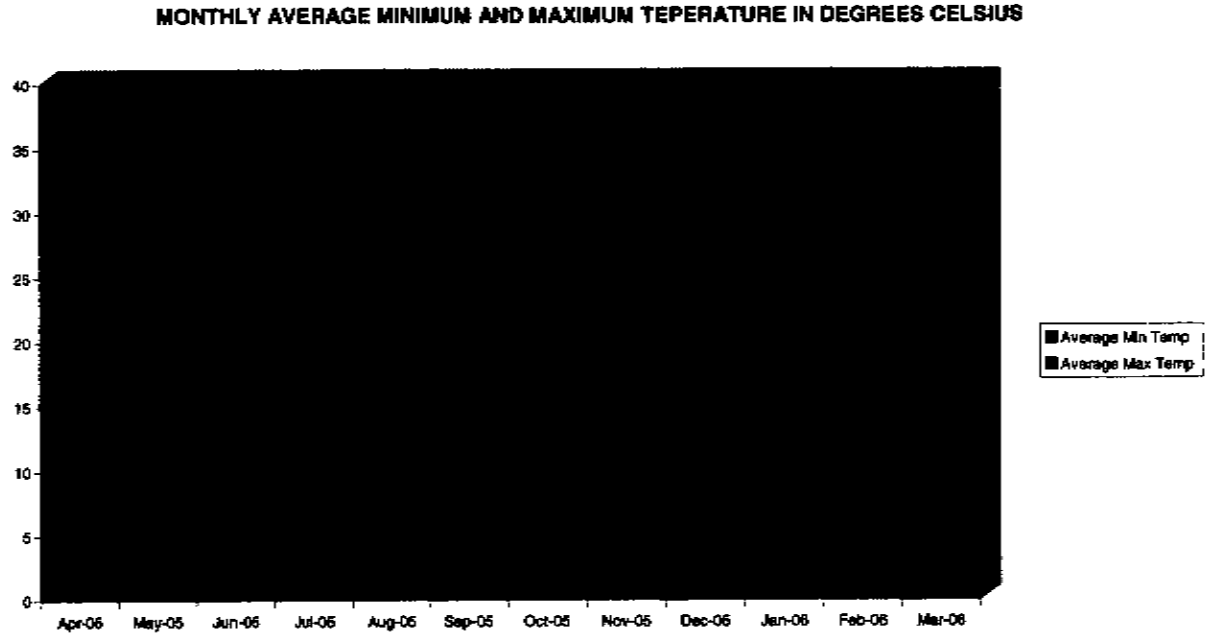
However, the fact that we have combined the data for analytical purposes should not suggest that that we found a homogeneous community in this part of the Nkuna Traditional Authority Area. In fact this was not the case. Although indigenous knowledge is often considered as very site specific we are certain that by combing the data together for purposes of analyses we do not detract from its value. This is because we rely heavily on a number of case-studies and on information presented during workshops with focus groups.

Background to the Study Area

The field site is located in the Nkuna Traditional Authority Area, which formed part of the former Bantustan Homeland of Gazankula. It currently lies in Mopane District of the Limpopo Province with the main local towns being Nkowankowa and Letsitele. The Greater Tzaneen Municipality provides some services to the towns and villages in this area as they fall within its jurisdiction. Tzaneen is the

largest town and houses the local government. The population of this area primarily consist of Basotho and Tsonga. The latter seem to be in the majority in the Nkuna Traditional Authority Area and are Shangaan speakers. The Basotho inhabitants speak sePedi and seem to be the earlier inhabitants of this eastern part of South Africa, which includes parts of the Limpopo and Mpumalanga provinces. The Tsonga seem to have migrated to the area from KwaZulu-Natal and Mozambique during the later part of the 1800s. The maximum and minimum monthly average temperatures are indicated below in Chart 1, indicating that the area has a very warm summer with a mild winter.

Chart 1: Minimum and Maximum Temperatures during the Study Period



The Tsonga of Southern Africa

Discussions with local Indunas and elders in the Nkuna Area indicated that the exact history of the Tsonga arrival in this area is far from clear. Some elders are trying to get more accurate details. It is believed that the Tsonga originated in central Africa and settled in various parts of Southern Africa including the current countries of Zimbabawe, Mozambique, Swaziland and South Africa. Writings of various missionaries suggest that they were agriculturalists growing many of the crops that are still grown in the study area today and to some degree pastoralists (Junod 1927, Junod 1938). With the expansion of the Zulu Kingdom, under Shaka, in the present day KwaZulu-Natal the history of the Shangaan speaking Tsonga becomes slightly blurred. Some say that Shaka sent Soshangane to conquer the Tsonga in southern Mozambique, but instead he settled there with his followers, rather than returning to Shaka's kingdom. Others say that Soshangane and his followers fled from Shaka and settled in southern Mozambique. In any event it is known that Soshangane and his followers integrated themselves amongst the Tsonga. As a result of this the language of the Tsonga comprises of three subgroups or dialects: Ronga, Tswa and Shangaan. In 1752 Portugal had claimed Mozambique as a colony but allowed the indigenous rulers to rule their people under the over-arching authority of the Portuguese administrators. Soshangane is said to have fought against the Portuguese in the 1830s. When he died in the 1850s a power struggle for succession ensued and many of the Shangaan speaking Tsonga fled as far as the Congo, but also into the neighbouring parts of present day South Africa. Here they met with the Basotho and obtained land from the Basotho rulers (Niehaus 2002). Today some local residents still have ties with families in Mozambique. Although some details are vague regarding the oral history of the Shangaan speaking Tsonga currently inhabiting the Nkuna Area, it is clear by their own admission that their culture has been influenced by a number of other ethnic groups whom they encountered during their history of migration and settlement.

Overview of the Villages of Berlyn and Molati

The two villages are situated next to one another on a gravel cul-de-sac about 10kms east of the agricultural town of Letsitele in the Mopane District of the Limpopo Province. Molati lies at the end of the cul-de sac and is the older of the two villages. There are a number of Christian churches in the villages with denominations having a church in only one village, providing people from the two villages to interact with one another socially and spiritually. Ancestor worship is still practised by members of the older generation with many of the houses having a shrine for this purpose. Some Christians also practise ancestor worship and follow established ritual in respecting the ancestors. Both villages are served by a clinic in Mafarana which services at least three other villages in the area. A mobile clinic comes to see the children approximately once a month but the presence of a doctor is irregular.

According to Molati residents, local families lived and farmed in the area for generations but it was only in 1969 that any formalisation took place. The Induna and officials from the Department of Agriculture marked out stands and roads in the area. The people who had been living in the surrounding hills now moved to the stands, as did other people who were looking for places to stay. According to residents this formalisation was the wish of the chief and the South African government. In the mid Seventies a primary school and a number of churches were established. These were followed by the introduction of communal taps for household purposes in 1979. Water was pumped to reservoirs, which supplied the taps in the village. Later, in the 1980s, three boreholes were established in the village and fed the communal taps by means of 2 diesel and 1 electric pump (only in 2003). Some people had freestanding taps on their stands but the majority had to make use of the communal taps. Electricity was introduced into the area in 2003. Only one of the local residents could afford the installation cost of about R3000.00. He saved his money in order to do this. However, by the end of 2005 the United Dutch Reformed Church in Molati had received money and electricity was installed in the church and the Umfundisi's house. Other residents make use of gas and wood to cook their food and use candles for light. There are no streetlights in the area and besides the gravel access road, which is occasionally maintained, the roads between the stands are generally in a poor condition as a result of erosion. Privately owned land and the hillside generally restrict any further expansion of Molati. Census figures obtained from the Greater Tzaneen Municipality indicated that in 2003 Molati had 1998 people from which the municipality determined that there were approximately 377 households.

Berlyn has had two distinct periods of development, firstly in 1963 and then again in 1986. In 1963 the residents of the farm Berlyn[10] were forcefully removed in terms of the Group Areas Act to the area next to where present day Molati is situated. They were more or less dumped there and expected to fend for themselves. No provision was made for water and they had to rely on a few seasonal streams. Some of these people were able to get work on the farm Berlyn when it became a sisal-producing farm in 1965. In 1966 they were given access to land surrounding the Molati/Berlyn settlements on which they could plant and harvest their own crops. Irrigation was exclusively rainfed. During 1969 formalisation of Berlyn took place. The Induna and the Department of Agriculture marked out stands and roads in the area. This was done at the same time it was done in Molati. By the late seventies Berlyn, like Molati, also had a number of reservoirs which were supplied by water from the Letaba River. The reservoirs fed communal taps that were situated around the village of Berlyn. In 1986 more people moved into the area and were allocated stands between the now existing village of Berlyn and the tarred road passing Mafarana in the east. Overtime this portion of land was gradually settled and became known as the newer part of Berlyn by the older residents. A single borehole was introduced in 1986 and connected to many of the existing taps with only a few people having freestanding taps on their property. Because this borehole and pump have to supply a village equal in size to Molati certain parts of the village receive access to water on certain days. In practice the schedule is not adhered to and the supply of household water is erratic. In August 2005 this diesel pump was stolen and this system for household water collapsed. There are plans to install an electric pump and while a pumphouse has been erected no pump had been installed by the end of March 2006. People relied on Molati's pumps and the seasonal streams. The household survey we conducted in June 2005 does not reflect this situation; however, even with the household water system operating the data suggests that it was insufficient and often inefficient with many households accessing water from other alternative sources including purchasing it in the nearby village of Mafarana. Nobody in Berlyn has

[10] The government of the day wanted to start producing sisal on the farm and decided to move the workers to the recently established Gazankulu homeland.

had electricity installed because of the cost involved. Census figures obtained from the Greater Tzaneen Municipality indicated that in 2003 Berlyn had 1823 people from which the municipality determined that there were approximately 344 households. During the course of our study we estimated the current number of combined households in both Berlyn and Molati to be approximately eight hundred. Residents pointed out a number of new households that were only a year or two old. The data that follows is based on our survey of 108 households in June 2005.

Socio-economic Data for Berlyn and Molati

Household Structure:
The average household size was 4.77 people per household. The median was 4, with 81% of the households having six or fewer members. 19% had between seven and eleven members. On average the households had 2.64 members who were 18 years or older. 81% of the households had three or less members over 18 years of age. 55% of the households surveyed were female headed. 78% of the main dwellings were constructed from brick with the remainder being constructed from mud and wood. 92% had corrugated iron roofs. Only 14% of the houses were built with any form of government housing subsidy scheme. This excludes employment related housing allowances.

Transportation and Communication:
Only 4% of the households had access to their own motor vehicle. Two taxis from Letsitele serviced the two villages, taking passengers to Letsitele, for R5.00/person, where they could catch a taxi to Nkowankowa, for another R5.00/person. From this larger taxi-rank passengers could board taxis to Tzaneen (for R6.00/person) or other major centres. Within the villages the taxis only used the main gravel road that linked the villages to the village of Mafarana as the other roads were generally in a poor condition due to erosion. This is despite the attempts of some residents to reclaim the eroded roads. Within the two villages most residents walked from one place to another. Donkeys were used for ploughing home gardens, transporting water and other household necessities such as firewood and manure. Donkeys were usually spanned in two or four to a cart depending on the load. The carts were often made from automobile parts with a number being the back part of a pickup truck or utility vehicle (bakkie). While none of the households had access to a Telkom landline telephone 46% had members who owned a mobile cellular phone. Only 3% of the households had Eskom grid electricity installed. Some of the houses we went to had battery operated radios with some households using car batteries to power television sets, hi-fis and mobile phone chargers.

Household Water Supply:
As noted previously water is a problem in the villages. While none of the households had hot running water plumbed into the main dwelling one household had plumbed in cold water. Only 11% of the households had a tap on their stand, access to which they shared with their neighbours. 75% of the respondents had to travel more than one hundred metres in order to obtain water for household purposes. A number of the Berlyn residents reported having to access water from a stream for household purposes prior to the theft of the pump in August 2005. During workshops respondents noted that the water they collected from the taps and the stream was used exclusively for household activities, such as washing, cleaning, drinking and cooking. Home-garden crops were not irrigated because the collection of sufficient irrigation water would require too much time and the use of communal taps would mean that some households would not be able to collect sufficient water for more important household uses. The latter is also a result of the water supply being irregular and only being available in certain areas on certain days of the week. Consequently, home gardens were rainfed and generally crops were only grown during the summer rainfall season. Some residents mentioned using very small amounts of household water to irrigate pumpkin/squash plants when first planted or if they considered the rainfall to be very insufficient.

Income and Employment:
Respondents were asked a number of questions with regards to income and employment. Of the households included in the survey 83% of them had total monthly incomes of less than R2001 per month. 46% had an income of between R751 and R1500 per month, while 27% had an income of less than R751 per month. At the extremes one household reported having no income and one household reported having a total income of more than R5000 per month. 66.3% of households had at least one member who had some kind of employment: a member with full-time employment (22.4%); a member with part-time employment (24.3%); and a member with occasional or seasonal employment (19.6%). During the winter months we noticed that some of the younger women were employed on the citrus

farms in the area. The survey suggests that the demand for employment is greater than the local supply. Respondents were also asked about constraints relating to household income during the previous year. Table 1, below illustrates the number and percentage of households that reported at least one of the following financial constraints.

Table 1: Financial constraints experienced during the previous 12 months.

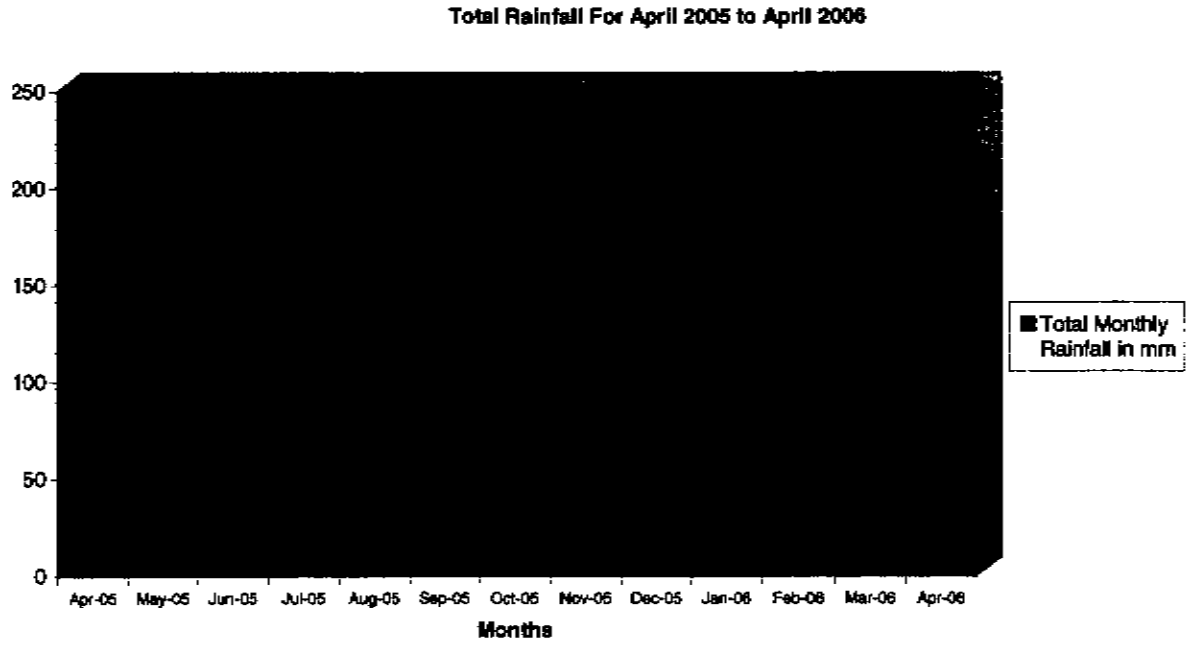
Constraint	No. households	% Households
On occasion asked family members outside of the household for financial assistance	51	47
On occasion asked friends for financial assistance	12	11
Could not repay clothing / furniture accounts on time	22	20
On occasion unable to purchase food for the household	52	48
On occasion could not afford the fees to send children to crèche / school	45	42
Borrowed money from a moneylender	21	19

The figures in Table 1 illustrate that between 42% and 48% of the households experienced financial constraints with the purchasing of food, paying for education fees and that as a result of constraints had to rely on other family members for financial support. Most significant here is the fact that 48% of the households experienced problems relating to food security despite, as we shall see below, the presence of Provincial Department of Agriculture projects in each village.

Livelihood Sources:
Residents indicated that they relied on a number of livelihoods for their survival and general well-being. 83.2% noted that their households received old age pensions (24.3%) and other social grants (58.9%), including disability and child grants. Remittances from permanent and temporary migrants contributed to the livelihoods of 28% of the households. While 89% of households produced agricultural crops as a livelihood source 59% acknowledged producing livestock as a source of livelihood. 6.5% of households acknowledged gathering wild edible plants. A very small percentage of households, 2.8%, acknowledged hunting and trapping wild animals as a source of livelihood. An even smaller percentage, 2%, indicated that they collected and sold firewood as a source of livelihood. A donkey trailer load of firewood, about the size of a small bakkie load, sold for R100 during 2005. Observations in the villages suggest that a number of households purchase firewood from these woodcutters. Several respondents, 5.4%, reported that they had other sources of livelihoods that included selling traditional beer, fixing electrical appliances, private provident fund, receiving food from relatives, selling exotic vegetables in winter and renting out plants to decorate halls for local functions. we also observed that some individuals made and fired clay bricks which they sold locally.

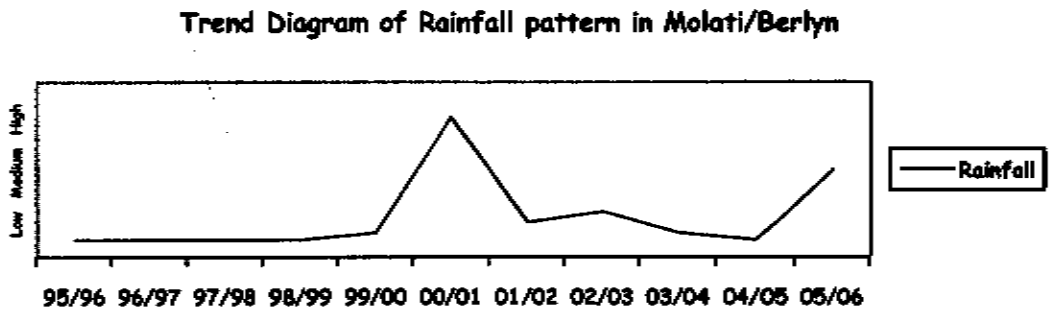
Rainfall Patterns:
The fieldworker who resided permanently in the village of Berlyn was supplied with a rain gauge and a minimum and maximum temperature thermometer. He took daily readings at 8am and then reset the instruments. Chart 2, below indicates the rainfall pattern from mid-April 2005 until the end of April 2006 that was recorded by the fieldworker. A total of 906mm fell during this 13-month period. For four months (July to October 2005) there was no rain at all and for a further two months (May and June 2005) the rainfall was insignificant at around 1mm. The bulk of the rain fell between November 2005 and March 2006. This totalled 867 mm and was considered very high by local residents. They remarked that the amount of rain they had experienced during this period was much higher than normal. It was also mentioned that the first summer rain was delayed as it usually came in September. During discussions in May 2006 residents reported that they had obtained a better than usual harvest during the summer cropping season as a result of the higher than usual rainfall. The rainfall in this area usually takes the form of thunderstorms in which the downpour is relatively brief but has tremendous force, washing away topsoil and seeds.

Chart 2: Rainfall Pattern during the Study Period



The rainfall pattern indicated in Chart 2 is largely due to the El Nino and La Nina weather patterns experienced during this period. If we accept that rainfall only really fell during six months of the year – April 2005, November 2005 through to March 2006 – then the average rainfall for these six months is 148 mm. During the various workshops residents indicated the rainfall pattern trends for the previous ten years. These are exhibited in Trend Diagram 1 below.

Trend Diagram 1: Recalled Rainfall Pattern During the Previous Ten Years



The Trend Line indicates that during the previous 10 years the villages last received very significant rainfall during the summer of 2000/2001. This was the same time that severe floods were experienced in neighbouring Mozambique. Residents reported that the rainfall during that season was excessive and abnormal with some mentioning minor flooding and the destruction of crops. Since that time the rainfall has been much lower with rainfall reverting back to 'normal' patterns during the 2003/2004/2005 summer seasons. In 2005/2006 residents again reported an unusual amount of rainfall, but nowhere near the volume experienced during 2000/2001. The pattern illustrated by the trend line suggests that high volumes of rainfall are abnormal with the local perception being that the area usually receives low volumes of rainfall.

Soil Erosion and Water Management:
Heavy rains wash away top soil which contains nutrients required by plants. During the dry winter season the vegetation is reduced and the ground is left bare after harvesting and grazing. Comments about the intensity of the rain highlighted the amount of water running through the village after thunderstorms. This is intensified by the water running off the hills at the back of the villages. This kind

of problem can have a significant impact on soil availability/ suitability (soil erosion removes topsoil) and the seeds of self seeding plants in the area. Mulati and Berlyn experience most of their precipitation in the form of thunderstorms. The water rushes down the hills, through the villages and takes away the topsoil. In some areas patches that are bare of topsoil have already developed, and even during the rainy season these patches have not been covered with vegetation due to the loss of nutrients and the bare soil being too hard for any root penetration. The seeds that would have been caught between the plants and in the soil (called the seedbank) have been lost when the topsoil was washed away. Plants now have to grow close to these areas and either re-seed the area (these seeds will probably be washed away by the next rains due to the loss of topsoil and plants) or covered by creepers. Wind also causes loss of topsoil in the bare patches where there are no roots to keep the soil in place.

There are several ways in which to prevent soil erosion and they include (Burgess, Maina, Harris & Harris 1998:75):

- Add organic matter to the soil to improve the soil quality and aid in soaking up the water
- Use mulches to cover the soil. This prevents splashing and puddles forming in the soil and improves water absorption
- Build rain water catchments and use terraces on sloping soils
- Keep the soils covered with a mixture of plants that will help keep the soils in place through their root systems and protecting it with their leaves.

The following observations were made concerning water management in the two communities:

- Some stone bunds were visible along the road between the homes.
- Waterharvesting is done in an informal manner. When it rains people place their containers outside to catch water. Many attempt to use the roof of the houses, but there are no gutters, so the effectiveness of this is very low.
- No special way of planting is followed to help insure the capture of water within the garden or field. Simple and effective methods could include contour furrows, stone bunds, grass strips, planting pits, semi-circular pits, earth basins and raised beds.
- Everyone clears the area between the road and their fences by removing the plants and their roots. This practice makes the roadsides very vulnerable to erosion, and gullies are starting to form in many areas. When asked why they were doing this, they replied that it discourage snakes from coming near the home, while others say they have always done it and do not know why. Showing people where the gullies are starting to form due to this practice has led to some leaving the plants they have not removed. There was a visible difference between areas where the plants were removed and not removed. Awareness creation about these simple ideas can already help to slow the flow of water down and encourage water retention within the village. Currently water is just rushing through, and very little water gets time to penetrate into the soil.
- One homestead in Molati had to be abandoned due to the constant flooding during thunderstorms which was being channelled by eroded gullies towards the homestead.

Many areas have become barren and there might be an increase in this, as the soil erosion increases and the topsoil is lost. The area where the football field had been in Berlyn has been abandoned because the soil had become when wet. The topsoil had been removed and the clay subsoil exposed, causing the problem. The new field is just a few meters on, and the same problem will shortly exist around the goal post areas due to the removal of the topsoil there. No attempt has been made to rehabilitate the previous area by breaking the rock hard surface to enable plants to grow to help reclaim the area. As the next area becomes unusable, so they will further expand until that whole area is one piece of barren land becoming a quagmire during the rainy season.

The water damage in the area is very obvious and has visibly worsened during the year that this study was undertaken. The dongas have grown appreciably in depth. One specific donga in the area where the pension payouts take place has receded by at least one meter. This has become an attraction to the children, who enjoy the excitement of the 'abyss' and are constantly standing about on the edge that looks unstable. The locals seem unconcerned. Eventually this donga will cut off one area of Berlyn from the other, as it is too deep to cross by jumping, thus effectively separating a community into two areas. The same is happening at the top of Molati, where the donga is constantly deepening. No vehicle can pass except a 4x4, truck or donkey cart (this is water route). In a few years no vehicle will make it, and foot traffic might be the only solution for a few years before it becomes completely impassable. Everywhere the dongas have become deeper and the roads are deteriorating rapidly.

One lady in Molati has constructed a number of stone bunds and other constructions to help slow the flow of water from the hills into her homestead. She is the first homestead at the top of a very steep slope, and the water rushes down the mountain and past the homestead at quite a speed. She has spread some stone structures in the road in front of her to help slow down the water that flows towards the other homes further down the road. The effect of these stone bunds is visible as they have stopped soil and plants are now growing between the structures. Where her fields are directly adjacent to the hill, she has large stones that prevent the water from entering her field and eroding her fields. Where the knowledge comes from she cannot say she just knows she has to do it. She decided to do it on her own and feels that it works as there was a gully in front of her house, but it has now been rehabilitated and there is no gully there anymore. You can still see some stones from these older constructions. However, in many instances advice on placing bunds along the contour would improve water management and also allow water to penetrate into the soil as its descent would be reduced considerably. Minor water catchments or dams might be a means of further managing and utilising water from the hills.

Some villagers feel that the climate has changed since 2000 and consequently everything in the villages has changed. Their erosion problems have mainly started from 2000. They stated that before 2000 the crops were better and they had lots of rain. In 2000 they had floods, and since then their crops and the rain have been less. The sun has become more intense, and it is much drier. It is the first time since 2000 that they have planted in December, as they usually have to plant in January due to the late rain. They see a big decrease in the amount of African vegetables growing, as the drought has had a negative effect on them. This change in weather conditions needs to be taken into consideration, as the local knowledge seems to be inadequate during this time, as it does not seem to have had time to incorporate the changing weather patterns.

Some people complained about not being able to grow even the few plants they desired. Certain plants are highly prized, and these include pumpkins, ocra, chillies and tomatoes. By using suitable grey water some of these crops could be grown close to the homestead, making it easy to irrigate them. Adding more organic matter to the soil or mulching can further enhance the ability to grow preferred crops. This will improve water retention and help stretch the use of the little water there is. There are certain principles related to grey water that need to be discussed with the villagers, including the following:

- understanding which water can be recycled and which plants can be irrigated using this water;
- water must not contain any oils (from washing oily dishes) and food particles;
- water with hard detergents (laundry water) are generally also unsuitable.

Common Agricultural Activities:
Despite the shortage of water and limited period of rainfall most households grew a number of crops in their home gardens. The cropping season was mainly during the summer months and the start, end and duration of the season was heavily dependent on the rainfall pattern. Crops intercropped in various ways on the home gardens included various African Vegetables (89%) as listed in Table 2 and also crops such as Pumpkins / Squash (79%), Cowpeas (74%), Maize (89%), legumes such as Beans, Groundnuts and Bambara nuts (83%). 61% of households reported growing fruit such as paw-paw (papaya), Marula, avocado, litchi and mango. In some households we noticed a handful of tobacco plants growing for personal consumption. Some households planted small quantities of Matimba (soetriet) which they described to us as 'local sugarcane'.

A handful of men and even fewer women have access to larger fields which they cropped during the summer period. This cropping practice was also heavily reliant on rainfall. One male farmer (a pensioner) mentioned to us that he was in the process of getting water from his borehole at his home to the nearest of his three fields[11]. He is considered a relatively wealthy person by local standards and has the necessary mechanised implements to farm large tracts of land. Large fields are predominantly intercropped with Maize and Groundnuts or Cowpeas. On occasion Tinhwembe is also intercropped with maize. One person mentioned that this was ideal if the Tinhwembe was planted in areas where there were termite hills, as these plants grew better in such areas. This illustrates an awareness of the contribution termites make to soil composition by aerating the soil and decomposing organic matter.

[11] This farmer used his own resources to establish a borehole on his household plot and was planning on piping the water to the nearest field he was cropping.

Table 2: African Vegetables, Grains and Exotic Vegetables used in the Villages

	TSONGA	ENGLISH	*LATIN*
	African Vegetables		
1.	Tinhwembe	Pumpkin / Squash Leaves	*Cuccurbits sp.* (often local landrace of *C. pepo*)
2.	Kwembe	Pumpkin / Squash Fruit	*Cuccurbits sp.* (often local landrace of *C. pepo*)
3.	Swiluva	Pumpkin / Squash Flowers	*Cuccurbits sp.* (often local landrace of *C. pepo*)
4.	Tinyawa Leaves (Miroho ya Tinyawa)	Cowpea leaves	*Vigna unguiculata*
5.	Tinyawa Fruit	Cowpeas	*Vigna unguiculata*
6.	Muxiji	Blackjack	*Bidens pilosa L. and B. bipinnata L.*
7.	Mihlata	Sweet Potato Tubers	*Ipomoea batatas*
8.	Tshimbu	Sweet Potato Leaves	*Ipomoea batatas*
9.	Guxe	Jews/Jutes Mallow	*Corchorus tridens*
10.	Ntsumbula	Cassava / Manioc	*Manihot esculentum*
11.	Xiyakayana	Wild gherkin	*Cucumus anguria*
12.	Ximbangana	Rhirudzu / spiderflower	*Cleome gynandra L.*
13.	Gumbu-gumbu	Milk Thistle	*Sonchus oleraceus*
14.	Mariwa	Tsamma	*Citrullus lanatus*
15.	Nkaka	Balsam apple	*Momordica balsamina*
16.	Vilolo	Purple flower	*Talinum sp*
17.	Rirhudzu	Spiderflower plant / cat's whiskers	*Cleome gynandra L.*
18.	Thyeke	Amaranth	*Amaranthus grassians / spinosum/ cruentus*
19.	Phuphuruka	Kale	*Brassica oleracea L. / Sabellica L.*
20.	Sindza mbita	?	*Waltheria indica*
21.	Nkeketi	Wild Bindweed	*Convolvulus farinosus*
22.	Marhanga	Calabash / Bottle gourd	*Lagenaria siceraria*
23.	Mandhanda	Okra	*Abelmoschus esculentus*
24.	Vilolo	Has a purple flower	*Talinum sp*
25.	Mapampunu	Boerpampoen	*Cucurbita maxima*
26.	Vurhakarhaka	Wild gherkin	*Cucumus sp*
27.	Biriviri	Local Chilli	*Capsicum frutescens L.*
28.	Makalavatla Leaves	Watermelon	*Citrullus lanatus var lanatus*
29.	Makalavatla Fruit	Watermelon	*Citrullus lanatus var lanatus*
30.	Timanga	Peanut / Groundnut	Arachis hypogaea
31.	Tindluwa	Bambara Groundnut	*Vigna subterranean L.*
32.	Dinda	skaapdubbeltjie	*Dicerocaryum eriocarpum (uncommon)*
33.	Ngwelani	Creeper in tree	***Found but not flowering, not identified***
34.	Xichumbe	Looks like peas	***Not found***
35.	Nyamangana	?	***Not found***
36.	Risanya	Type of nettle	***Not found***
37.	Dedeledele	?	***Not found*** *(uncommon and usually found in swampy areas or stagnant pools of water)*
38.	Mukwariba	?	***Not found***
39.	Matambala	Like sweet potato	***Not found***
40.	Xihadya	Found in mountain	***Not found***
41.	Swikhaba	Found in mountain	***Not found***
	Grains		
1.	Mavele	Maize	*Zea mays*
2.	Matimba	Soetriet / Chewing sorghum	
	Exotic Vegetables		
1.	Swikwembyana	Butternut	*Cucurbita Moschata*
2.	Swikwaribani	Gem squash	*Cucurbita pepo*
3.	Matamatisi	Tomatoes	*Lycopersicum lycopersicon or Lycopersicum esculentum*
4.	Tinyala	Onions	*Allium cepa*
5.	Tikherotsi	Carrots	*Daucus carota*
6.	Khavichi	Cabbage	*Brassica oleracea var. capitata*
7.	Tiherekisi	Peas	*Pisum sativum*

The planting and harvesting times for a few popular traditional foodstuffs during the period of 2005 to 2006 are illustrated in Calendar 1. Planting times for some of these crops will differ from year to year as it is highly dependent on the rainfall pattern. Typically planting only occurs after the first summer rains. Some years the rains arrive in late September or early October. In 2005 the rains arrived in November and then the amount decreased by half during December affecting the growth cycle somewhat.

Calendar 1: The general planting and harvesting times for traditional crops in the two villages during 2005/2006.

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mavele (maize)	H for green mielies	H for green mielies	H for green mielies	H for green mielies	H for maize meal	H for maize meal					P	P
Marhanga (Bottle gourd)			H	H							P	P
Tindluwa (Bambara)	P				H							
Timanga (Peanuts)			H	H							P	P
Tinyawa (Cowpeas)	H	H	H								P	P
Makalavatla (Watermelon)			H	H	H						P	P
Mariwa (Tsamma)			H	H	H						P	P
Phuphuruka (Kale)		P	PH	PH	PH							

Livestock Activities:

During the course of the household survey in June 2005 69% of the households said that they owned livestock. While none of the households owned land for grazing large livestock they could all access common grazing land. Livestock ownership patterns were as follows:

- 6.5% of the households owned between 4 and 15 head of dairy cattle.
- 13% of the households owned between 1 and 32 head of beef cattle with 7% owning either one or two head of cattle.
- None of the households owned horses.
- 6.5% of the households owned donkeys.
- 15% of the households owned goats with 9% owning between two and seven goats. Three households owned between 17 and 23 goats.
- None of the households owned sheep.
- 4% of the households owned pigs. While 3% owned between two and four pigs one household owned 36 pigs.
- 53% of the households owned poultry such as chickens, ducks, geese or pigeons. 36% owned less than 15 fowls. 17 % owned between 20 and 40 fowls.

These figures vary from season to season and as a result of household needs for food, income and ceremonies.

Those households that keep livestock gave the following reasons for keeping livestock:

- Main source of household food (27%)
- Main source of income (4%)
- Extra source of food for the household (30%)
- Donkeys were kept for transportation and traction (6.5%)

The livestock in both villages seem to be suffering from a loss of knowledge about the entire livestock system. At the beginning of summer a disease killed almost all the chickens in both villages. Only individual chickens could be found at a few places during that time. While probing this phenomenon, it was found that many households do not exchange or change their cocks, and that the flock stays the same over the generations. This causes huge inbreeding problems and makes the chickens vulnerable to diseases. Basic breeding and selection information could cause a huge improvement in all livestock residing in the area.

During winter several cows and calves were lost due to poor grazing. Explaining to farmers the economics about selling cattle to lessen the pressure on the grazing and enabling farmers to buy or sow additional feed to save the rest, might help farmers make these decisions efficiently. One farmer felt it is not worth selling livestock for a low price, even though that money might have saved the livestock he had lost due to the lack of or the poor quality of feed.

Animal traction is very important in both villages and donkeys are used for ploughing and transporting water. The high value of the work they do ensures relatively good looking after. The harnesses could, however, be improved as many donkeys develop wounds due to chafing that could have been avoided. There is a donkey expert in Makhado who could be contracted in to provide advice and support to local donkey owners and users. This would be especially with regard to nutrition, care, and repairing and fitting of harnesses to ensure maximum comfort and optimum efficiency.

Department Of Agriculture Endeavours and Reliance on Indigenous Knowledge for Food Production

Agricultural Extension Services and Projects

The Limpopo Province Department of Agriculture and Environment (LPDAE) are coordinating two agricultural projects in the area. Both are vegetable garden projects, one is situated in Molati and the other is situated in Berlyn. Women from the respective villages are involved in the project close to their village. In Berlyn two men are involved in the project while in Molati the project members are exclusively female. The chairpersons of each project are both female. One extension officer services both projects. She has an office in Mafarana and spends a least one day per week at each project giving advice and organising inputs. More recently she has been involved in fundraising and organising agricultural skills training. The main extension offices are situated on the farm Berlyn.

Molati Vegetable Garden Project:
In 1983 a number of women in Molati came together to form a care group. They described this as a group of women, who share the same sentiments, share information, collaborate and support one another. In 1984 the Molati vegetable garden project was started when this group acquired land from the Nduna and each woman brought her seeds to plant on her demarcated plot. People generally grew cowpeas, maize, groundnuts, pumpkins and beans. In 1985 the local government Department of Agriculture provided them with a borehole and pump, an irrigation system, a reservoir and a fence. Unfortunately, in 1991 the borehole pump was stolen and was only replaced in early 2006. From 1991 the ladies continued to plant crops in the field but were highly dependent on rainfall for yields. Consequently, they concentrated on traditional crops as they considered these to be drought tolerant. Between 2000 and 2002 the area received heavier than usual rainfall and they dug wells, which they used to irrigate the crops. However, the harvest was still considered insufficient, as they did not produce enough crops in order to sell the surplus. Since the theft of the borehole pump they were unable to produce exotic/domestic vegetables and thus only grew summer crops. In 2003 and 2004 a NGO, at the request of the LPDAE, provided the project with a new fence and irrigation pipes. In 2005 they received an irrigation tank and in 2006 they received the borehole pump and some other inputs from a Finnish donor, again at the request of the LPDAE. The LPDAE initiated a chicken project with the members and the chicken houses were built by late 2005. In March 2006 they were planting butternut that was provided by LPDAE. Currently the active project membership is about 20 female members.
The Molati vegetable garden project members received ten days of training from 30 August to 9 September 2005. The training was for the older members of Molati and was about vegetable seedlings and how to effectively produce them. Isaac Ledwaba, from Nchebeko Skills Consultancy, was contracted by the Department of Labour to do seedbed and seedling training in Molati. He mentioned that the shortage of water was severely affecting his effectiveness, as planting and producing seedlings without water was a problem.
The training included the following:

- Raise seedbeds and mix soil with kraal manure.
- Plant seeds in rows, cover lightly with soil and water.
- Plant a corner 'post' at each corner, with one joint 'post' in the middle of the long side to help support the different posts laid over the length (to support the lengthwise sticks).
- When a network of sticks has been constructed and secured, place thatch over the sticks.

This structure forms a miniature nursery for seedlings and protects them from the sun, birds and heavy rain showers.

Berlyn Vegetable Garden Project:
In 1994 the traditional authority was given money for the development of the villages within its area of influence. The local Nduna decided that the money for Berlyn should be used for a vegetable garden

project so that the people could help themselves. He approached the current group with the idea and then approached the LPDAE for further assistance. The Nduna allocated land to the project and then they obtained irrigation piping and taps, borehole and a pump, reservoir, water tank and fencing. The members initially paid a R12.00 registration fee and each pays R2.00/month to purchase diesel for the pump. In 1995 the local extension officer started supporting them by providing advice and organising training on exotic vegetable crop management, manuring/fertilisation and irrigation practices. In 1998 this project took part in a local agricultural competition in a neighbouring ward and won first prize. This recognition encouraged them to do better. It also created an awareness of the value of their products and people came from neighbouring villages and towns to purchase their produce. By 2004 the extensionist had organised with the SPAR supermarket in Tzaneen to purchase their produce. However, in November 2004 the borehole pump was stolen. As a result of lack of irrigation and unfavourable rains in 2004/2005 the project members lost the major proportion of their crops. In 2005 an anthropologist who had lived in the village for a number of years during the late 1980s and early 1990s organised another borehole pump. However, given the good rains during the summer of 2005/2006 the group decided to use it in the winter of 2006. Currently, the active project membership is 10 females and 2 males, although the latter do not seem to be actively engaged in any cropping activities.

Commentary:
We met with some of the members of the two vegetable garden projects on a number of occasions to talk about local agricultural practices. They recounted that at the project sites, when they were growing exotic / domestic crops they made use of conventional agricultural technologies and inputs. These included monocropping of exotic crops; mechanisation was reported for soil preparation; the use of irrigation and irrigation scheduling; the use of pesticides, herbicides and fungicides and the scheduling of these; and the use of synthetic fertilisers and sometimes manure. Extension personnel had provided advice and training in these topics and also to some degree provided the inputs. However, at home and in the project gardens, during the period when the water pumps were stolen, they reverted back to "traditional" food crops and African vegetables. During this time and typically in the home gardens agricultural practises invoked the use of indigenous knowledge - especially low external input principles. Ploughing was either done by hand, using hoes, or with donkey traction, if the household could afford the latter – usually costing between R60 and R80, depending on the size of the home garden. The crops selected and planted at home or at the project site were all predominantly rainfed, except in the case of pumpkin / squash which was occasionally given extra water by some households at the beginning of the cropping season. No fungicides, pesticides or herbicides were used. Only those households that could afford synthetic fertiliser applied it in conjunction with manure. Some households we observed did not use manure, they merely ploughed the plant residues from the previous season back into the soil. The marked difference in the practices used at home and at the projects, under the guidance of the agricultural extensionists, led us to question these differences.

Many of the women reported that the difference was that at home they practised things the 'traditional' way and did not want to lose this part of their culture as it enabled them to secure food, even in times of poor rainfall. They also noted that they did not have the resources to make use of the modern technologies and inputs at home, as many of these were expensive. For example, water was scarce and therefore it was pointless for them to attempt to produce most of the exotic crops. Similarly, most people could not afford to purchase and therefore to use agrochemicals such as pesticides, fertilisers, etc. While we noticed a few households incorporating synthetic fertilizer with manure and ploughing this into the soil, we only came across two people who could afford and used pesticides. The reason for this was given as having sufficient income to do so. One was a retired government employee (who was not involved in any project but had access to a number of fields in the area) and the other was the spouse of a schoolteacher. Those people we interacted with who were not members of projects made use of the more "traditional" practices, which relied on low external inputs.

At the projects, when these had functioning irrigation systems, the members used conventional practices for three reasons. Firstly this was how the extensionists had explained that they must produce the exotic crops. Secondly, they generated an income, which was used to purchase inputs after the donated inputs had been depleted. Thirdly they had access to irrigation water and were therefore able to control this resource making the use of expensive inputs warranted as water was available. Without good access to water the inputs would be an unnecessary expenditure. The purpose of the projects was for them to become sustainable, however, this was largely constrained by the subsequent irrigation complications. These prevented the members from growing exotic crops in

winter and making an income that they could use to purchase more inputs. The cycle was interrupted by the irrigation constraints and people had to resort to low input 'traditional' cash and food crops.

If the training provided in Molati can be used as an example, we felt that based on our limited time in the village a number of changes could be made to make future training more effective. Most notably these are the following:

- Possibly training should focus on more suitable crops, those that most residents crop, rather than those only grown by vegetable garden project members when they have access to water and external inputs.
- The location of seedling plots could be changed to areas where human traffic is higher (such as home gardens) as this might lessen animal damage to seedlings.
- Kraal manure is sometimes regarded as a problem in the villages, as discussed below; therefore teaching composting could help alleviate this problem.
- The timing of training is completely out of the rainfall cycle from which the communities are currently obtaining water.
- Recycling household water for seedlings would be an option if the seedbeds are closer to households.
- It seems that training is 'forced' on the farmers with them being unable to give much inputs on the decision making process. By finding out their current requirements, more appropriate training could be targeted for the villages at the right times.
- Those trained should be encouraged to share knowledge with other residents.

Identified African Vegetables

Defining African Vegetables

Many rural communities in South Africa rely on foods that are harvested from plants growing in the wild or which occur in their household gardens and fields as seasonal volunteer crops. Volunteer crops are usually a result of previous cultivation of this plant or, alternatively, of not having removed it during weeding activities, allowing it to flower and reseed itself. Although many of these plants are indigenous to Africa, others originate from other parts of the world. Nevertheless, given their suitability to local social and environmental conditions, they are an important part of local culture, food culture in particular, and livelihood resources. The different parts of the plants that are used as foodstuffs include roots, tubers, stems, rhizomes, leaves, flowers, fruits, nuts, gums, berries, cereals and legumes. Generally at least two parts of the plant can be eaten, of which the leaf is almost always one[12]. Consequently, many researchers throughout Africa talk of African Leafy Vegetables (ALVs). In South Africa local people formerly ate a diet of meat, milk, wild cereals and wild plants but lately the Pedi proverb "Meat is a visitor, but *morogo* a daily food" has become a reality for most rural people (Fox & Norwood Young, 1982). *Morogo* is the Sepedi name for African leafy vegetables. Amongst the Tsonga the word is *Miroho*.

Farmers and residents in the two villages classified local African vegetables as being those vegetables that were available in the area before the 1930s (Molati) and for others, those that were available upon their arrival in 1963 (Berlyn). These plants grew freely and abundantly in the area at these times. Similarly, many of the residents pointed out that they had been introduced to these plants by their grandparents and can remember them eating these plants. This classification was irrespective of whether or not the plants were known by locals and researchers alike to be exclusively of South African or exclusively foreign in origin. The reason for this was that the current residents had always experienced the plants as growing in the area, often appearing to occur naturally, and had consumed them as vegetable dishes. For example, pumpkin was well known to the residents who mentioned that their grandparents had consumed it, although the primary origin of the pumpkin is South America, where it was domesticated, with a secondary diversification in India. According to the International Institute for Rural Reconstruction (1996) such a distinction for identifying indigenous knowledge or an indigenous item is perfectly acceptable. Indigenous knowledge, and in this instance by extension the classification of indigenous or local African vegetables, is something that is particular to a specific

[12] As a result of this and the fact that households have to grow the plant in order to get at least one of the desired products (leaves, roots, flowers, or fruit, etc.) we use the terms African Vegetables and African Leafy Vegetables more or less interchangeably in this report.

locality. This does not imply that it must originate from that area since time immemorial and that it must be free of influence from external elements (IIRR, 1996; Grenier, 1998; Langill, 1998). We would also postulate that this does not imply that it cannot be found elsewhere, although there might be some variation around the knowledge attached to it. All knowledge is dynamic and is continually changing, making it impossible for it to be free from external influences. For the purpose of our references to African vegetables in this discussion the definition provided by the residents of Molati and Berlyn is accepted and used, i.e. the plant has been cultivated in the area or seemingly occurs naturally in the area for as long as the current residents could remember. On the other hand the residents identified exotic or domestic vegetables as those vegetables whose origin was definitely not local and were usually foreign to South Africa but had been introduced into the area during the lifetime of the current residents to whom we spoke. Such crops include cabbage, spinach, beetroot, etc. According to the Trend Diagram 5 depicting exotic vegetable consumption this introduction occurred from the 1950s onward. The Berlyn residents who had been resident on Berlyn farm at this stage also reported the 1950s as being about the time that they became exposed to the exotic vegetables. This process of introduction occurred firstly by means of consumption and later, in a few cases resulted in cropping of the plants. This latter activity is being encouraged in the vegetable garden projects.

During the course of the study, residents who attended the workshops were asked to identify and rank the African vegetables that were found in the parish. Initially the participants identified approximately forty types of African vegetables. After obtaining clarity regarding this number it was realised that the different varieties actually referred to foodstuffs that were derived from the plants rather than thirty different plant species. A single plant can provide different foodstuffs which were eaten at different times during the lifecycle of the plant. In some cases more than one part of the same plant was eaten (leaves, stems and fruit) at different times and each part was given a different name and locally identified as a separate African vegetable resulting in the appearance that each vegetable referred to a different plant species. In other cases the same part was eaten at different times during the life-cycle and was given different names. It was also realised that parts of some plants, which we would term exotic vegetable plants and whose origin was known as being exotic (for example, the pumpkin and squash plant), and which had grown in the area for decades and at least prior to the 1930s, were also categorised as African vegetables[13]. Examples of this were the African vegetables known as Tinhwembe, Swiluva and Kwembe. The young green leaves of the pumpkin plant were eaten and given the name Tinhwembe, while the yellow flowers were known as Swiluva and often mixed with Tinhwembe or Guxe (Jutes Mallow). The young and ripe pumpkins were eaten and known as Kwembe. Very young pumpkins were often sliced and put into Tinwhembe, but the dish was still known as Tinhwembe. According to scientists on the research team the plant was originally produced for its fruit (the pumpkins/squashes) and is definitely of exotic origin, although local landraces were identified. Further examples are the pods of the cowpea plant that were eaten when green and known as Tinyawa, while the young leaves were eaten and known as miroho ya tinyawa. When the leaves of the plants are dried they are known as Mukhusa. For instance dried pumpkin/squash leaves would be termed *mukhusa wa tinhwembe*.

In these two villages an African vegetable was not necessarily a particular plant but rather a particular part of a plant and a foodstuff derived from a specific plant. One plant sometimes produced more than one African vegetable during its life-cycle and one part could be a different African vegetable at different times during its life-cycle. The various products derived from the different plants were given local names, were known as African vegetables and therefore were identified as such when enquiries were made about African or local vegetables. The leaves of a number of known exotic crops, commercially produced for their fruit or tubers, were prepared and consumed becoming a part of the local food culture. Consequently the leaves were given local names and considered locally as African Vegetables. These are entirely acceptable trends in indigenous knowledge classification systems which are encountered in other parts of the world but differ from the generally simpler classificatory systems usually practised by conventional scientists at formal academic and research institutions (Mettrick, 1993; IIRR, 1996; Grenier, 1998).

[13] The use of the plant as a foodstuff over a protracted period – in this case at least since the 1930s – allowed it to qualify as an African vegetable.

Local residents attached highest priority to those plants that could provide a household with more than one product (foodstuff, condiment or flavouring), such as the pumpkin/squash plant[14], which can provide three products at different times during its lifecycle. Second highest priority was given to those plants whose leaves could be dried and stored for consumption during the winter months. Perceived nutritional value and the ability of the plant to be drought tolerant to some degree were given subsequent priority. Taste becomes a preference after these factors. For example elderly respondents said that although both Tinyawa leaves and fruit (peas) were dried they preferred the dried peas. These were considered to be tastier than the dried leaves and could be eaten alone or added to other dried leaves to add flavour and sustenance. Many of the respondents were elderly people; therefore it is possible that they were more pragmatic in the criteria they used for ranking plants as foodstuffs. During discussions we noticed that the youth definitely preferred exotic vegetables, such as cabbage and spinach, to African Vegetables. However, elderly people preferred the latter as they said they could produce it locally with their limited resources, because they had grown up with these plants and foodstuffs.

During the survey 82% of the respondents reported having African Vegetables in their fields during the preceding twelve months and 79% said that they actively cultivated some of these crops. While all the respondents reported consuming these vegetables during the past year only 96% had actually stored any for consumption during the winter months. Tinhwembe was the most popular African Vegetable that was actively cultivated with 79% of the households cropping it and 95% of them drying and storing the leaves. Tinyawa (cowpea) was the next popular crop with 74% of households cropping it and 95% storing the leaves. The fruit or peas can also be dried and stored. 40% of the households cropped Mandhanda (Okra) and Marhanga (Bottle Gourd). However, only a small portion dried and stored the leaves from these plants, 19% and 9% respectively. 28% of the households actively cropped sweet potato and while the leaves were eaten fresh (Tshimbu) only one person mentioned drying and storing them. The tubers (Mihlata) were also seldom stored. Watermelons were cropped by 31% of the households who ate the leaves (Makalavatla). Of the households surveyed 21% dried and stored the Makalavatla leaves.

Many of the most common African Vegetables were not actively cropped but occurred as volunteer crops after the first summer rains. These are indicated in Table 3, along with the percentage of households that dry and store the leaves of these plants.

Table 3: Most Common Seasonally Volunteering African Vegetables

Tsonga Name	Common Name	% Dried and stored
Guxe	Jutes Mallow	88%
Muxiji	Black Jack	47%
Thyeke	Amaranthus	43%
Rirhudzu	Cleome / Spiderflower	43%
Nkaka	Balsam Apple	42%
Xiyakayana	Wild Gherkin	34%
Ngwelani	Creeper - unidentified	31%
Muphywe	Unidentified	25%

African Vegetables in Berlyn and Molati

The extension officer listed the following crops as summer grown crops: maize, groundnuts, jugobeans, cowpeas, Marhanga (bottle gourd/calabash), and watermelons. Winter crops include: spinach, cabbage, onions, beetroot, carrots, green peppers, tomato, sweet potato (a few). The latter are produced at the Vegetable Garden Projects or those few households who have their own private water supply.

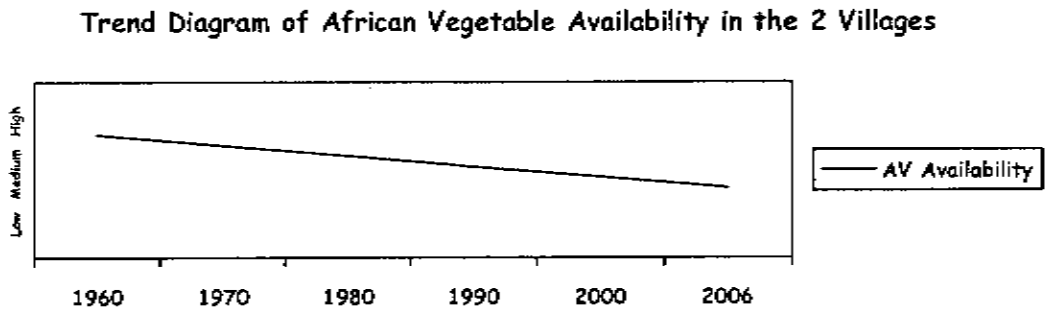
African vegetables start growing after the first rains, and can be harvested from two weeks after the first rain. Many people encourage the plants to grow by turning the topsoil. Plants that grow wild include Guxe (*Chorchorus* sp.), Xiyakayana (*Cucumis anguria*), Rirhudzu (*Cleome gynandra*), Risanya, Mupshwye, Nkaka (*Momordica* sp.), Muxiji (*Bidens pilosa*), Vilolo (*Talinum* sp.) and Nkeketi

[14] Interestingly, this was the only plant that some residents might provide with irrigation during the cropping season, although they remarked that this practice and the amount of water was extremely limited.

(Convolvulus farinosus). Traditional crops planted include Mavele (maize), Tinhwembe (pumpkin), Tinyawa (cowpeas), Matimba (sugar cane), Makalavatla (watermelon) and Mariwa (the pale fleshed indigenous watermelon). Timanga (peanuts) along with pumpkins and cowpeas are so entrenched in the Shangaan food culture that they are discussed as part of the African vegetable group. The hills behind the villages supply quite a lot of wild food in the form of fruit and leafy vegetables. A fern tree that grows on the mountain also supplies the branches they need for brooms.

Trend Diagram 2 indicates that the relative availability of plants and crops known as African vegetables has decreased since the 1960s. At workshops participants pointed out that it appeared now as if they had half the amount of African vegetable plants growing in the veldt than they did in the 1960s. This decline is considered to be a result of erosion, poor rainfall patterns and overgrazing of livestock. There are some plans to reduce the latter but in winter it is hard to do so as the livestock die as forage in any form is scarce. Measures include tethering livestock and rotating this on a daily basis so that they are not able to overgraze. However, not everybody complies with this practice. Other research in Africa has shown that plants that are not used are not looked after and get lost. This is probably another contributing factor.

Trend Diagram 2: African Vegetable Availability



Tinhwembe (Cucurbita spp.)

The cucurbit leaves are called Tinhwembe. This group includes the squashes and the white boerpampoen (called pampoen). Most of the household gardens produce pumpkins, as it is an easy crop to grow and seeds are readily exchanged between households. This crop is very popular due to the multiple uses of the plant. Mainly young leaves, young fruit and flowers are used and mixed together for the pot. The immature fruit are cut into smaller pieces to shorten cooking time. The leaves can be harvested for a long time, as the plant continues growing, and the growth spurt after good rains supplies the households with many young leaves. Many women wait until the plant starts flowering before they start harvesting leaves, as they feel it will otherwise affect their yield. The leaves are harvested for fresh use and they also start drying at this time. Fresh leaves are used from January until May while dried leaves are then used until they are depleted. If a lot of leaves are dried, a household can still have leaves when they are ploughing at the beginning of the next season. The higher the rainfall, the more leaves can be dried. In an average year dried leaves are typically consumed by November. Leaves are sometimes chopped and then dried in the sun for 3 days. According to residents these dried leaves can be kept for up to two years. Tinhwembe leaves are blanched and dried as follows: the leaves are washed and the hairs removed. Place the pot on the fire, add one cup of water to the pot and boil. Add the leaves and close the pot. Cook for 5 minutes, stir and close. Cook for a further 5 minutes then remove the pot from the fire. Spread the leaves on a washed sheet of zinc and dry in the sun for 2 days. Turn the leaves as regularly as possible as the leaves then dry faster. Place the zinc sheet on top of drums to prevent animals from eating or contaminating them. Dried leaves are kept in sealed containers in a cool place until needed. The pumpkin seeds are not eaten and are only used for seed. After they have been removed from the fruit, cleaned, dried in the sun they are in containers with wood ash to absorb any moisture. Pumpkin leaves and flowers are the most common fresh African vegetable found at the informal markets in Letsitele and Nkowankowa.

Thyeke (Amaranthus spp.)
Amaranth is a very common dryland crop in the two villages. Seeds are not typically collected as the plants grow wild. Some women will collect seeds in the surrounding area and broadcast it in their gardens if it does not grow there anymore. The young leaves are harvested from seedling stage (about 2 weeks after the first rains) until the plant starts to flower (harvested from October to December). Leaves become tough once flowering starts, and then harvesting of the leaves stops. Amaranth flowers very fast, thus making the harvesting time very short. Generally, households can only dry enough for one month's supply of dried leaves. Many women do not dry amaranth as it loses its taste when it becomes old. The dried product also powders quickly, thus not making it a good dried product. According to research it is suggested that amaranth leaves should not be stored for a long time as they lose nutrients (Burgess, Maina, Harris & Harris 1998:147). Various amaranth species have been documented, and all of them are eaten.
Amaranthus spinosus is used to produce a local snuff. The whole plant is harvested and dried when the seeds are visible on the plant. Sun drying takes about one week, after which the seeds and most of the leaves have fallen off. The stem and a few leaves are then crushed and added to the crushed rolled tobacco that they buy on pension day. This mixture is placed in a small, well-sealed, container. It is sometimes sold at pension days. Traditionally only older men and women used snuff, but people have commented that younger people are also using the snuff. *Amaranthus spinosus* is harvested as single leaves, while the other amaranth is harvested in the form of young branches of leaves. Amaranthus is one of the oldest food crops in Africa, Asia and South America, with evidence of cultivation reaching as far back as 6700 BC (Agogina 1950, Macneish 1971). These plants are characterised by their ability to adapt to new environments, their competitiveness with other plants and their broad climatic adaptability. Such characteristics make it an easy crop to cultivate and domesticate (Feine, Harwood, Kauffman & Senft 1979). Amaranth plays an important role in the diet of people in Africa, Asia and South America (Grubben 1976).

Guxe (Corchorus spp.)
Guxe is a dryland crop that grows wild and has almost no existing seed system. A few individuals broadcast seeds at the start of the summer season. If the plants should not grow in areas they are wanted, some women would harvest seeds in the surrounding area and broadcast the seeds where they want it. This usually happens around December, when the first seed is formed, with the resulting plants to be harvested in May. Guxe is harvested from seedling stage and can be harvested about two weeks after the first rains. A smaller amount of plants still grow in winter, and can supply some fresh leaves. Guxe is only available fresh from September to December in a dry year, but during a wet year it is available until May, with dried products lasting until August. No leaves are dried during a dry year, as there are usually only enough plants for them to be eaten fresh. The amount of leaves that are dried depends on the seasonal rainfall. When the rainfall is high the leaf yield is high and they can dry more leaves. Guxe is relatively drought tolerant, thus rainfall is not so important once it has started to grow. One lady we interviewed actively broadcasts Guxe where she plants pumpkins, and harvests Guxe leaves until the pumpkins take over, when the former is smothered by the latter. Some women recognise two types of Guxe (big leaf type and medium sized leaf type), while one individual recognises three (thin leaves, medium leaves and big leaves). Those individuals, who do make a distinction, seem to prefer the big leaf Guxe. Only two species are known to grow in South Africa (*Corchorus tridens* and *Corchorus olitorius*), and classification showed only *Corchorus tridens*, although *Corchorus olitorius* might not have been available during the identification stage.

Rirhudzu (Cleome gynandra)
Cleome grows wild, it is rainfed and self-seeds. Should it not grow in their gardens, many women will harvest seeds from their neighbours and broadcast them in their gardens. Many women broadcast seeds in their garden before the first rain, as this is a highly favoured plant due to its taste. It is a fast grower and harvesting usually starts about two weeks after the first rains when seedlings are harvested (usually October). Harvesting of leaves stops as soon as the plant starts to flower (usually January), as leaves become tough and fibrous. Rirhudzu flowers very fast, thus making the harvest time for them very short. They can usually only dry enough for one month's supply of dried leaves. Dried leaves are used during the winter months from April until June. Some women believe that you must harvest many leaves in one pick because if you pick individual leaves the plant will die.

Nkaka (Momordica balsamina)
Nkaka grows wild and is generally not planted. In some instances women protect plants from livestock during winter by placing drums or thorn branches over them. Nkaka is not irrigated. Nkaka is

harvested about one month after the first rain. Leaves are eaten when very young, but older leaves are used in small quantities as a spice as the leaves then become "hot". These "hot" leaves are added to other leaf mixes, and cooked in the normal way as a relish. Fresh leaves are usually available from December to April, and dried leaves are available from May until November. Leaves are dried when the plants start to spread. When younger than this, it is only used as fresh leaves. Leaves are stronger when the plant begins to spread, thus these older dried leaves keep longer than the younger dried leaves. How many leaves are dried depends on the rainfall. When it is high the leaf yield is high and they can dry more leaves. Fruits are eaten when green, and as soon as they turn yellow to red, they are left to seed themselves. In some cases the seed is removed and spread in areas where they would like the plant to grow, usually along fences, as this plant is a climber. Some women believe you must harvest many leaves in one pick because if you pick individual leaves the plant will die.

Mandhanda (okra)
Mandhanda is a very popular crop, and both the leaves and green fruits are eaten. The plant can seed itself, but most women keep seeds successfully. Okra needs water to grow and can grow through the winter if there is a ready supply of water. One lady has planted ocra around her slow leaking tap and protected it from livestock with thorn branches. Leaves are harvested from seedling stage and are available from December until June. The quantity of leaves dried depends on the rainfall. When it is high the leaf yield is high and they can dry more leaves. Ocra can handle drought quite well, thus rain is not so important once it has started to grow. The fruits are eaten when green, but after April to May the fruits start to dry and are not consumed but kept for seeds.

Mihlata and Tshimbu (sweet potatoes)
There are three types of sweet potatoes lines with red, white or yellow skins respectively. The red skinned type (also known as "Two-month Mihlata" as it can be planted for two months) has only recently been introduced, but the old women have always known white skinned "Three-month Mihlata" (planted in March and harvested in June). The yellow skin variety is harder and sweeter than the others and is uncommon to the area. The red and white skinned sweet potatoes are softer and less sweet. Their leaves are harvested and mixed with Muxiji (*Bidens pilosa*). Tubers are only eaten fresh for two months (June, July), as they are tasteless during other times (the tubers are said to be old and watery). Tshimbu, sweet potato leaves, are only harvested fresh from March until July, and not dried as sweet potatoes vines are planted mainly for the tubers, not for the leaves. Generally there seems to be no preference for a specific line, and many plant what they can get. Propagation of the lines is known (make 20cm cuttings, place in soil with all leaves attached, and will be established within two weeks), and no problems are experienced with keeping the lines maintained. They can plant any time, but tubers can only be harvested in June. The plants look quite healthy, but yields seem to be low. This is probably due to no or low fertilisation and viruses that are not visible to the naked eye lowering the yield.

Tinyawa (cowpea)
Most women have successful seed systems and broadcast or plant the seeds after the first rain. This is a dryland crop, making it an ideal crop for this semi-arid area. Fresh leaves are harvested from January to March. Tinyawa leaves are only dried for winter during a particularly wet year, not in a normal year as the leaf yield is too low to support seed production and drying of leaves. They start drying leaves when the plants are spreading. Prior to this stage the leaves are consumed fresh. Leaves are stronger when the plant begins to spread, thus they keep longer than the younger dried leaves. Cowpea leaves are tough, and need quite extensive preparation before they are cooked. Children do not like the leaves, but do eat the seeds as oil is added to the dish. After December no green cowpea pods are eaten as they are kept for seeds. After February the plant dies and the pods are harvested. Sometimes the seeds are removed from the pod for storage.

Tindluwa (Bambara nuts) and Timanga (peanuts/groundnuts)
Tindluwa is becoming less popular due to its limited use. It is planted in January (ideal to substitute the peanuts if the rains are late) and harvested in May. Limited seed systems exist. Though popular as a snack, it is being replaced by the multipurpose peanuts. Peanuts are easy to store, are used as a snack and are added to food to help increase the nutritional value. It is also used to improve the taste and nutritional value of all the dried leaf dishes. The seeds are easy to store and many women have successful seed systems. Peanuts are planted in November and December (cannot be planted later) and harvested in Berlyn during March and April. In Molati they are harvested between April and June. They use different peanut varieties, plant them at the same time but harvest them at different times.

The preference is for the bushy type as it is easier to grow than the spreading type that needs more water. The seeds for the bush type are also more readily available in the commercial markets. Note: All parts of the peanut plant can be used. The peanut, grown primarily for human consumption, has several uses as whole seeds or is processed to make peanut butter, oil, and other products. The seed contains 25 to 32% protein (average of 25% digestible protein) and 42 to 52% oil. A pound of peanuts is high in food energy and provides approximately the same energy value as 2 pounds of beef, 1.5 pounds of Cheddar cheese, 9 pints of milk, or 36 medium-size eggs (Woodroof, 1983). Groundnuts are particularly vulnerable to bad storage conditions. A fungus growing on groundnuts produces aflatoxin which can harm animals and humans (Burgess, Maina, Harris & Harris 1998:137). If ingested by dairy cows, it can seriously affect humans indirectly. Very low levels of aflatoxin can cause serious side effects and symptoms. People in the villages should be sensitised to the health hazard of this fungi as peanuts are an important part of their diet.

Makalavatla (watermelon)
Watermelon is planted in November and December, and harvested from March until May in Berlyn, and from May until June in Molati. The leaves are cooked and the fruit is enjoyed as refreshing midday meal or snack during the hot summer days.

Xiyakayana (unidentified)
Xiyakayana is only grown by a small number of women and can be harvested about 2 weeks after the first rain. Only the leaves are harvested. Leaves are dried when the plants start to spread. When younger than this, the fresh leaves are harvested for immediate consumption. Leaves are stronger when the plant begins to spread, thus they keep longer than the younger dried leaves.

Risanya (unidentified)
Risanya leaves are harvested from the seedling stage until the plants die. No seed systems exist for this plant. People either like it or they do not, and the consumer's age is irrelevant as it is enjoyed by both young and old. Risanya leaves are dried as follows: The pot is washed. Leaves are harvested and washed. Water is put into a size 2 pot and boiled. Leaves are added and the lid replaced. Left for 10 minutes and then stirred. It is cooked for a further 4 minutes. Removed from the fire and the leaves are then spread on washed zinc sheets, placed on top of drums. On a clear day it will dry in one day, on a cloudy day two days. Once dried it is stored in a sealed bucket.

Phuphuruka (Kale)
Kale is a well-known winter crop in the villages, but can only be grown where water is available. With the irregular water supply in Berlyn, it is generally not grown. The distant water sources in Molati also prevent many people from planting this highly nutritious crop. In Berlyn it is planted from February to April and harvested from March to May. In Molati it is planted in March and harvested in May.

Muxiji (*Bidens pilosa*)
Muxiji is a dryland, self-seeded plant. Muxiji will generally only be harvested if it is the only plant available. This is a last resort plant and not popular due to its bitter taste. When harvested some women harvest all the leaves, while others harvest only the young leaves until the plant starts to flower. Leaves are harvested fresh from October to December. Leaves become 'hot' when the plant flowers. Muxiji flowers very fast, thus making the harvest time very short. They can only dry enough for one month's supply of dried leaves. This plant is widely distributed, available all year, has excellent keeping quality and an attractive appearance before and after cooking. When eaten the resinous altertaste makes this an unpopular food (Morton 1962)

Vilolo (unidentified)
This plant is a creeper with small purple flower, and not known by most of the villagers we encountered. A couple of elderly women showed the plant to us. It grows wild, is rainfed and no seed systems exist within the two villages. The leaves are mixed with guxe (*Corchorus* sp.) and are not consumed on their own. No leaves are dried. It is very difficult to find, is not well-known, not sold and this plant will probably disappear from the plate within the next five to ten years.

Nkeketi (unidentified)
This plant is a creeper with heart-shaped leaves, no flowers were seen, but seed has been seen. Many villagers do not know Nkeketi. It grows wild, is rainfed and no seed systems exist. The young, light green leaves are eaten fresh, and some people use the plant for pig fodder. The leaves are tasty

when young, but as soon as the seeds are formed it is no longer considered tasty. The leaves are mixed with amaranth. No leaves are dried. The plant is quite difficult to find, not known by the younger generation (except as pig fodder) and will probably disappear from the plate within the next ten years.

Ngwelani (unidentified)
The plant is a climber that grows in trees. It is very difficult to find, and there are only a handful of trees in which it has been found. Harvesting is difficult and many people either do not know the plant or do not know where to harvest it. Ngwelani is not prepared often as it takes about an hour to prepare. Ngwelani leaves are dried as follows: collect as many stems as possible and place the stems and leaves in a number 6 pot. Add 2 litres of water and boil. Cook with the lid on for 30 minutes. Remove the stems (the leaves are loose and will fall off). Spread the leaves on washed zinc, which is placed on drums in the sun for 1 day. It is stored in a sealed bucket. Flowers have never been seen and no seed system exists. This plant will probably disappear from the plate in the next five years. Its growth habit and limited distribution make this a difficult plant to protect. The stem is used to form the base structure of some locally woven baskets.

Matimba (soetriet)
Clumps of this local sugar cane are found in many gardens, but a limited seed system is in place. The plant is eaten raw as a sweet snack.

Marhanga (bottle gourd/calabash)
Calabash is planted in November and December, and harvested in March and April. Limited seed systems are in place. Only the Marhanga fruit is eaten, not the leaves. The youth do not eat Marhanga, and some of them do not know the plant. The fruit is sometimes used to make containers, but this knowledge is seems to be disappearing as very few people recall this and no calabash containers were seen.

Mariwa (indigenous watermelon)
The crop is planted in November and December and harvested from March to May in Berlyn and May till June in Molati. The youth do not eat Mariwa; some do not know the plant. The plant will probably vanish from the plate in the next five to ten years.

Gumbu-gumbu (Sonchus oleraceus)
The leaves are tough and few people eat it because it takes a long time to prepare (about an hour). Adults eat it, but children do not like it. Leaves are eaten fresh and dried. No seed systems exist. Gumbu-gumbu is dried as follows: wash the pot. Add 1 cup of water to the pot and then add the washed leaves. Place the pot on a hot fire. Cover with the lid and leave for 10 minutes. Stir and replace the lid. Cook for 5 minutes. Remove from the fire and spread the leaves on washed zinc which is placed on drums. On a clear day it will dry in one day, on a cloudy day it will dry in two days. Dried leaves are stored in a sealed bucket. In its dried state the leaves can be kept for up to a year.

Muphywe (unidentified)
Muphywe is a plant that occurs locally, the leaves of which are consumed fresh or dried. However, it was not common and not many of the people we spoke to ate it although they new about the plant. It is dried as follows: add 1 cup of water to the pot. Replace the lid and boil the water. Add 4 litres of tightly packed leaves. Replace the lid and cook for 15 minutes. Stir, replace the lid and cook for 15 minutes. Remove from the fire. Spread the leaves on washed zinc in the sun for 2 days. Dried leaves are stored in a sealed bucket indefinitely until they are finished.

Swikwembyana (butternut) and Swikwaribani (gem squash)
Strictly speaking local people did not consider these plants as African vegetables as they were hard to grow and required external inputs. Nevertheless they were mentioned during discussions and their use qualified.
"Swikwembyana is mainly grown by white farmers who can afford the chemicals and who can irrigate", was a comment frequently heard in Mulati and Berlyn. When the vegetable garden projects had water, the crop was grown as they could irrigate. When grown, Swikwembyana leaves are harvested twice while the fruits are harvested throughout the year. Many villagers asked for production guidelines for butternut. One lady commented that eating too much Swikwembyana leaves could be detrimental to your health. Exactly what she meant by this she would not divulge.

Swikwaribani needs irrigation and agrochemicals. It only grows for two months and is then harvested, as the fruits are eaten while still smooth. Many find it a difficult crop to grow, as it germinates poorly. The vegetable garden projects grow it when they have water, but individuals feel it needs too much water and agrochemicals to be grown successfully, as these are scarce. Most women buy the crop from farmers if they want to eat it. The leaves are not eaten.

Indigenous Knowledge about African Vegetables

Knowledge of the different groups of plants is available from both males and females. In all villages leafy vegetables tend to be the domain of the women. Knowledge of fruit and cereals seems to be in the male domain, with children and youth having only rudimentary knowledge of these plants. However, most women had knowledge of most plants, including grains and cereal crops. The formal schooling of the children was blamed for the lack of their knowledge, as small boys go to school and no longer spend days in the veldt looking after livestock and surviving on their knowledge of wild plants. The girls only tend to know the common and abundant traditional vegetables such as amaranth, cleome, cucurbits and actively cultivated vegetables (pumpkins, cowpeas, etc.) as they spend their days at school and have to do homework before dark, due to a lack of electricity. Due to indigenous knowledge being labelled as 'backward knowledge', the youth tend not to be interested in the knowledge and plants. Notably they are not interested in the rituals or taboos associated with the food crops. Current schooling curricula also seem to emphasise Western norms rather than including those that are important to rural households. Some elder women reported that although they adhered strictly to rituals and taboos and had vast knowledge about crops they would not interfere in their married children's practices. This seems to contribute to a breakdown in knowledge sharing as it is no longer passed on from one generation to the next unless it is specifically asked for. Such requests seem to be rare with some of the younger residents admitting their lack of interest in practices and also lack of belief in rituals and taboos. Where awareness of the value of these plants has been created, the interest amongst the youth was also heightened (Vorster, Jansen van Rensburg, Mashele & Ndlela, 2003). Raising awareness of traditional crops and African vegetables would help to improve the status of these 'poverty foods' and 'backward knowledge', thus making them more acceptable to the younger generation. This is an important step that should not be ignored where this kind of labelling has taken place.

African Vegetables: A Local and Inexpensive Source of Nutrition

Nutritional Problems in South Africa

Given their relative poverty, many residents in rural areas in South Africa often suffer from grave deficiencies in vitamins and minerals. This results in many children and adults suffering from undernutrition. A number of wild plants and other crops are high in the main vitamin and minerals, the deficiency of which results in undernutrition. Their increased consumption could alleviate undernutrition in South Africa.

Vitamin A deficiency can lead to night blindness, xerophtalmia (dry-eye disease) and eventually blindness. Children who lack vitamin A are more likely to die from infectious diseases than their healthier counterparts. Stunted growth is another symptom. Children with low levels of vitamin A tend to have low attention span, and tend to under perform at school. Yellow and orange fruit and vegetables and dark green leaves tend to be good sources for this vitamin. Bioavailability of this vitamin is enhanced when combined with zinc, fats and protein (Maundu, Ngugi & Kabuye 1999:3).

Vitamin B (riboflavin) deficiency causes skin and eye disorders. Many wild foods, especially leaves, are good sources. Wild leafy vegetables have sometimes been found to have significantly higher levels of this vitamin than cultivated varieties (Maundu, Ngugi & Kabuye 1999:3).

Vitamin C is readily available from fruit and fresh vegetables. Vitamin E is abundant in vegetables such as purslane (*Portulaca oleracea*) (Maundu, Ngugi & Kabuye 1999:3).

Iron is essential for the manufacture of haemoglobin, and low levels can lead to anaemia, particularly in women. Dark green traditional leafy vegetables are a good source of iron (Maundu, Ngugi & Kabuye 1999:3).

The section on medicinal values illustrates that people in the study area, especially the elder women, are well informed about the benefits of the plants they consume and use for medicinal purposes. On a number of occasions they emphasised that African vegetables were healthier than exotic or domestic vegetable crops. In the villages the most popular leafy exotic vegetable was cabbage. In Table 4 its

nutritional content is compared with five African vegetable crops, all of which are found in the two villages. Generally the five African vegetables have higher nutrient values than cabbage.

Table 4: Comparison of the nutritional content of five African vegetables and one domesticated vegetable

	Amaranth	Spider plant *Cleome gynandra*	Cowpea leaves *Vigna inguiculata*	Jute/Jews mallow *Corchorus olitorius*	Pumpkin leaves *Cucurbita maxima*	Cabbage *Brassica oleracea var. capitata*
Iron (mg)	8.9	6.0	3.9	6.3	15.9	0.7
Protein (g)	4.6	4.8	4.1	5.2	4.2	1.7
Moisture (%)	84.0	86.6	87.6	81.0	87.3	91.4
Calories	42	34				26
Carbohydrates (g)	8.2	5.2	6.8	10.3	5.0	6.0
Fibre (g)	1.8					1.2
Ascorbic acids/Vit C (mg)	64	13				54
Calcium (mg)	410	288	221.1	548.5	382.9	47
Phosphorus (mg)	103	111	80.1	136.4	119.2	40
ß-carotene/Vit A (mg)	5716		2249.35	3662.99	1694.55	100
Thiamine	0.05		0.05	0.07	0.12	0.04
Riboflavin	0.42					0.1
Folic acid (mg/100g)	122		107	90		

(Source – Adapted from Food and Agricultural Organisation of the United Nations, University of Pretoria and North West University)

Nutritional Value of African Vegetables and Traditional Food Crops

Traditional foods contribute to household food supplies on a seasonal, emergency and supplemental basis. During times of political upheaval in the old Transkei (from 1960s to 1990s), many villagers left their villages and fled to the forests, where they survived by collecting food from the veldt (Vorster & Jansen van Rensburg 2005). As supplements they add flavour to dishes, thus enhancing and diversifying the flavour of the dish (Maundu, Ngugi & Kabuye 1999:3). Some traditional food plants have been analysed for nutrients, and have shown high nutritional contents.

Vegetables form the major part of the non-grain starch staples, vitamin, mineral and protein containing food. They are low in fat and high in moisture content. The high moisture content cause vegetables to be highly perishable, and due to seasonality in South Africa, they can be limited during certain times of the year (Chottah n.d.). Amaranthus/ Marog/ common pigweed/ gewone misbredie is the most commonly used green leafy vegetable that is found in many places in South Africa. This plant provides almost half the protein recommended daily allowance (RDA), and more than the RDA for iron, calcium and vitamin A per 100g serving (E van den Heever, personal communication.).

Generally undernutrition is addressed by providing calories, fat, protein and several micronutrients. Foods needed for this include crops such as groundnuts, beans, peas, dark green leafy vegetables (including miroho harvested in the wild), carrot, pumpkins, tomatoes, capsicum, mango, paw paw, citrus and avocado (Burgess, Maina, Harris & Harris 1998:197). All these foodstuffs were available in the study area with most being locally grown in household gardens.

Aneamia is a shortage of iron and needs to be addressed by crops that provide iron and folate (animals, poultry, fish, etc.) and crops that provide vitamin C needed to increase the absorption of iron (amaranth, kale, carrot, capsicum, tomato, guava, banana, citrus, potato) (Burgess, Maina, Harris & Harris 1998:197).

Vitamin A deficiency is addressed by eating plants rich in vitamin A (orange fruit and vegetables, dark green vegetables such as spinach, amaranth, and kale) and ensuring that there is fat in the diet that increases the absorption of vitamin A (Burgess, Maina, Harris & Harris 1998:197).

Table 5: Nutritional value of traditional foods.

Nutrient content / 100g boiled	Iron (mg)	Zinc (mg)	Selenium (µg)	Viatmin C (mg)	Vitamin A (µg re)	Carotenoids (µg)	Vitamin E (mg)	Protein (g)
White maize, fresh	3.6			0	0			5.0
White maize flour ground	2.5			0	0			10.0
White maize refined flour	1.1			0	0			8.0
Thyeke *Amaranthus* spp.	4.6 *	0.81	0.3	1	399	2394	0.26	1.9
Muxiji, *Bidens pilosa*	5.7	0.86	1.71*	12	934	5605	2.39 *	3*
Mihlata, Sweet Potato leaves *Ipomoea batatas*	0.6	0.26	1.3	2	92	552	0.96	2.3
Tinyawa Cowpea leaves *Vigna spp.*	1.1	0.24	1.5	18	58	348	1.71	2.8
Calabash Marhanga *Lagenaria* spp.	0.3	0.7	3.2	4	-	-	-	0.6
Imbilikicane *Chenopodium album*	4.3	0.3	1.9	14	643	3859	2.31	3.3
Tinhwembe Pumpkin leaves *Cucurbita maxima*	3.2	0.2	0	1	249	1494	0.96	2.7
Ikabishi Cabbage *Brassica oleracea*	0.4	0.17	0.6	20	2	10	0.2	1.0
Tomato	0.6			26	74			1.0
Mango	1.2			42	400			0.6
Paw paw	0.6			52	200			0.6
Capsicum peppers	2.6			140	290 green 458 red			2.0
Groundnut	3.8			1	3			25

* are estimated values

Sources: Adapted from Kruger, Sayed, Langenhoven & Holing. 1998 and Burgess, Maina, Harris & Harris.1998:203

Locally Produced and Consumed Traditional Foodcrops in Berlyn and Mulati

Maize is the most important staple in these two villages. Cobs are often boiled or roasted for snacks. Maize is ground or beaten to form flour, which is then used to make the porridge. Most households produce insufficient quantities of maize so they purchase milled maize to make porridge from shops and supermarkets. Sometimes a beer is also made from the maize during harvesting rituals. It is a good source of protein and if eaten in large amounts, of some B-vitamins and some minerals. Processing reduces the nutrient content, but also the anti-nutrients (phytates) which prevent the absorption of non-haem iron and zinc. Maize has replaced sorghum and millet in most households (Burgess, Maina, Harris & Harris 1998:99). Most residents eat maize in place of cassava as the taste is preferred.

Amaranth leaves are used in villages as a relish for the vushwa (maize porridge). People tend to prepare the leaves in one or two ways, making the dish a 'boring' one with almost no variation. The

leaves are boiled in water, with no oils added[15]. The children prefer an oilier base and therefore do not like the dish much. It is, however, still one of the plants being used by the younger generation today as one of the five most consumed traditional leafy vegetables. Leaves are very rich in vitamins A and C, protein, iron, folate and fibre (Burgess, Maina, Harris & Harris 1998:148).

Kale (Phuphuruka) is grown in both villages during the winter in households and project gardens if water is available. Kale does not like very high temperatures, thus making it an ideal winter crop. The need for water is, however, a limiting factor in the cultivation of this crop. The crop is high in vitamin A, C and folate. Kale grows easily and supplies fresh leaves over a long period of time. Leaves should be eaten fresh (Burgess, Maina, Harris & Harris 1998:152). If a more constant and greater water supply is established in the villages (longer fresh water access or water recycling techniques), this healthy plant could be promoted on a larger scale.

Watermelon (Makalavatla) is planted by some of the ladies who buy the fruit and then use the seeds for their own gardens. The fruit is eaten as a snack or desert and consists mainly of sugar and water and is not a useful source of micronutrients. In the summer this is in fact a welcome addition to the diet, as it is an easy food to eat during the high temperatures that characterise the area. The leaves provide vitamin A (Burgess, Maina, Harris & Harris 1998:158).

Pumpkin/squash leaves (Tinhwembe) are a popular relish in both villages and the surrounding area. This is the crop that is sold fresh by most 'traditional' food vendors in the surrounding areas. Leaves, immature fruit and flowers are used in the preparation of the relish. The leaves are rich in vitamin A and usually contain more protein than the fruit. Very dark orange fleshed fruit, such as ripe pumpkins and some squash, are a good source of vitamin A. The seeds are rich in protein and oil (Burgess, Maina, Harris & Harris 1998:160).

Cowpea seeds are a good source of protein, calories and folate. The leaves provide vitamin A, vitamin C and folate (Burgess, Maina, Harris & Harris 1998:135).

Sweet potato tubers are a good source of calories and have higher protein content than yams and taro/madumbe. Yellow varieties with high vitamin A content have been developed at ARC-Roodeplaat in an effort to address the vitamin A shortage in a food-based solution that is more sustainable than food fortification. The leaves are rich in vitamin A and C (Burgess, Maina, Harris & Harris 1998:128).

Cassava leaves are a good source of vitamin A, some vitamin C and iron. Unfortunately the long cooking time in plenty of water, required to remove toxins and soften the leaves, destroys most of the vitamin C (Burgess, Maina, Harris & Harris 1998:124).

Groundnuts are eaten raw, roasted or ground. The latter is added to relishes, soups and stews. In Molati and Berlyn groundnuts are an important cash crop that is very popular with all age groups. This is noticeable on the monthly pension day by the number of people buying and selling the crop in its different post-harvest forms. Groundnuts are rich in good fats, therefore a good source of concentrated calories. They are a useful source of protein and B-vitamins, including folate. Groundnuts increase the energy content of children's meals (Burgess, Maina, Harris & Harris 1998:137)

Mango's grow in the villages and are eaten fresh when ripe and as atchar (a pickled dish) when unripe. This is a very popular, easily sold commodity at pension days. Income generation or saving of money could be addressed here by teaching people to make their own atchar. This, however, could have negative implications on the other people who sell this, so the marketing and production system should be analysed before such steps are taken. The ripe fruit is an excellent source of vitamin A (Burgess, Maina, Harris & Harris 1998:186), and we noticed children eating lots of this fruit as a snack in the summer period.

Paw-paws are easy to grow and many households have at least one paw-paw tree in their household garden. The fruit is eaten as a snack or dessert and is a good source of vitamin A and C (Burgess,

[15] Everybody we spoke to in the village noted that when preparing cabbage, a lot of sunflower oil was added during cooking to give it flavour and because the youth particularly liked the taste of the oil. Elderly people considered this to be unhealthy.

Maina, Harris & Harris 1998:187). The growing of these trees should be encouraged to help address any vitamin A and C shortages. People tend to get tired of the fruit, and other possible types of fruit trees should also be considered to help add variety to the diet.

Maintaining Nutritional Value During Food Preparation

Nutrient availability is affected by the type of plant and the environment in which the plant grows (cultural practices, soils, atmospheric conditions, and season). The average nutritive value of vegetables can be influenced by anti-nutritional factors. Some of these factors can be reduced by cooking. They usually occur in minute amounts and are usually then not toxic. Soil conditions can, however, cause the amounts of anti-nutritional factors to be toxic.

Nutritional value of foods starts to deteriorate as soon as the food is harvested and continues with storage and preparation. To help ensure the minimum loss of vitamins, there are certain practises that can be followed to limit such losses (Chottah n.d.).

1. Trimming: minerals and vitamins are usually in the outer layers, so trimming should be done sparingly. Peeling potatoes can lead to a 12-35% loss of vitamin C, while peeling carrots can lead to loss of vitamins B_1, B_2 and nicotinic acid.
2. Washing: wash vegetables before they are chopped
3. Cooking:
   - Ideally vegetables should be steamed;
   - Alternatively boil vegetables in as little water as possible to help minimize losses of minerals and vitamins;
   - Cook until just tender (see Table 6, which provides a boiling guide for some common vegetables);
   - Serve the cooking liquids with the vegetables;
   - Serve immediately.

For vegetables to preserve as much of the nutrients as possible the following tips should be looked at (Faber, Laurie & Venter 2006):

- Cook dark green leafy vegetables, finely chop them and mix with other food to make them more acceptable to children
- Mash vegetables for smaller children
- Grate carrots to enhance vitamin A absorption
- Promote effective cooking methods to enhance vitamin A bio-availability
- Add a little fat while preparing the food, as vitamin A is a fat soluble vitamin

Tomatoes should be cooked simultaneously with African leafy vegetables as the vitamin C in the tomatoes aids with the absorption of the iron in the leaves (S. Laurie, personal communication). We noticed that when preparing miroho local residents added the tomatoes later during the cooking process. This reduces the amount of vitamin C released thereby affecting iron absorption. This should be discussed with those preparing food so that the tomatoes are added at the beginning of the cooking process, thereby making the food more nutritious.

Table 6: Boiling guide for common vegetables

Vegetable	Boiling Time (minutes)
Lima beans	25-30
Snap beans	12-16
Broccoli	10-15
Brussel sprouts	15-20
Cabbage (shredded)	3-10
Carrots (young)	10-20
Cauliflower (separated)	8-15
Kale	10-15
Lady finger	10-15
Onions	15-20
Peas	12-16
Potatoes (depends on size)	25-40
Sweet potatoes	25-55

Processing and Nutrition

Food processing has two primary aims: to generate income and to supply foods for a longer period so as to maintain a healthy diet. Processing starts with harvest and ends when the processed food is consumed. In the case of traditional foods, processing is used to extend the storage time (Fellows1997:4).

Food spoilage is caused by the following (Fellows1997:4):

- Micro-organisms
- Chemical reactions (i.e. fats becoming rancid)
- Enzymes (occur naturally and cause changes in flavour, colour or texture)

All fresh foods have micro-organisms on their surfaces. There are three main types important for food preservation (Fellows1997:4-5):

- Micro-organisms that cause food poisoning: safe handling and hygiene can help address this.
- Micro-organisms that cause food spoilage: the rate that these organisms spoil food is affected by temperature, water content of the food, use of chemical preservatives and acidity of the food. Food should be kept in a cool place, away from sunlight or heat. When food is heated above 60°C, most micro-organisms and enzymes are destroyed. Careful handling can prevent recontamination. Food should be carefully packaged and stored. Removing the water from the food will inhibit spoilage caused by micro-organisms and enzymes. Foods with high acidity (pH value 4.5 or lower, many fruit products) are considered safe from food poisoning. Spoilage will be caused by moulds and yeast which are visible. Food with pH values above 4.5 (low acid foods such as meat and milk) should be processed with care as food poisoning is a very real threat.
- Micro-organisms that are beneficial for food processing.

Table 7: Some high and low acid foods

	High acid foods	Low acid foods
Fresh foods	Fruits	Meat, fish, milk, eggs, vegetables
Processed foods	Pickles, jams, fruit juices, yoghurt, wine	Bread, dough, canned meat, fish, milk
Spoilage micro-organisms	Yeasts, moulds	Moulds, bacteria
Food poisoning micro-organisms	None	Moulds, bacteria, viruses

Source: Fellows 1997: 6

Three potential sources of contamination for processed food are unclean equipment, water supply problems and people (Fellows 1997:8). Food should also be kept off the ground and protected from insects and rodents, as these can infect foods with micro-organisms. Raw material must be kept cool and away from sunlight until the processing begins. They should be processed as soon as possible after harvest (Fellows 1997:10). Foods should be cleaned and sorted before processing.

Blanching involves the rapid heating of food in boiling water/ steam for a set time, followed by a rapidly lowering of temperature to almost room temperature. Softening and loss of flavour is limited, however, some water-soluble vitamins and minerals are lost in this process, especially in hot water blanching. It destroys enzymes and some micro-organisms in vegetables and some fruits, but is not intended to preserve food. Blanching is used as a pre-treatment to drying or freezing, as these processes do not destroy enzymes. If the food is not blanched, enzymes can cause loss of flavour, nutritional value and colour during storage. Micro-organisms can also survive and grow when the food is used (Fellows 1997:14; Chottah n.d.; Burgess, Maina, Harris & Harris 1998:37). The quality and shelf life of these dried vegetables varies considerably, with contamination of the food by harmful micro-organisms such as *Escherichia coli* occurring (Mpuchane and Gashe 1995).

The main purpose of drying is to remove the water needed for enzymes and microbial growth in order to preserve the food. Sun-drying is traditionally carried out in places where the climate in an average year is conducive to drying and storage of food. Humidity must not be high, thus allowing food to be dried fast with minimum spoilage. Where moisture is a problem, sundriers need to be introduced (Fellows 1997:16; Chottah n.d.; Burgess, Maina, Harris & Harris 1998:37). Drying may destroy much of the folate and vitamin C and some of the vitamin A. However, drying breaks down cells in the plants, thus nutrients can be digested more easily (Burgess, Maina, Harris & Harris 1998:37).

Hot air or hot metal surfaces are used for drying. It is important that water is removed from the surface of drying food through evaporation. The water inside the food slowly moves to the surface and then evaporates. The speed at which food dries depends on the environment in which it dries. Hot, moving, dry air is the best for fast drying, but this is not the best for fruit and fish. Fruit and fish form a layer of minerals and sugar on the surface (called 'case hardening'), whereby the moisture is then sealed in. This encourages spoilage during storage (Fellows 1997:17).

To improve preservation the following should be done (Burgess, Maina, Harris & Harris 1998):

- Pre-treatment: immediately after harvest sprinkle vegetables with or immerse in cold water
- Wash vegetables to remove dirt and micro-organisms
- Blanching involves exposing vegetables very quickly to heat so as to inactivate the naturally occurring enzymes. Blanching improves the quality and shelf life, and also the colour of the dried vegetables.

Storage of processed foods should be done with care. Food should be stored in cool places and away from sunlight and the hot outer wall of the dwelling or storage shed. It should also be stored off the floor and sealed to be out of reach of rodents and insects (Fellows 1997:24). It was noticed that many households we visited followed these practices to varying degrees.

Uses of African Vegetables – Consumption and Medicinal Uses

Traditional Food Plants in South Africa

Cereals and cereal products have formed the staple food of most people for millennia. The cycle of sowing and harvesting has led to the incorporation of many cultural rituals in agriculture. Pearl millet, finger millet and sorghum are still indigenous cereals that are in common use in South Africa. Wild grasses are also used in some rural areas, while others have been used during times of famine. Cereal grains are often converted into malt which is mainly used to brew beer (Van Wyk & Gericke 2003:9).

Seeds and nuts are almost as important as cereal crops (Van Wyk & Gericke 2003:19). Many legumes have seeds that are directly consumed as food and include dry beans, broad beans, chickpeas, lentils, lablab, mung bean, pigeon peas, cowpeas and jugo beans. Many legumes fix atmospheric nitrogen by means of their root nodules, thus helping to enrich the soil.

There is a wide variety of wild fruit and berries available during any particular year (Van Wyk & Gericke 2003:33). Children and adults commonly eat these fruits and berries when they are doing various chores (collecting wood and water, herding, etc.) in the rural areas (Maundu, Ngugi & Kabuye 1999:3, Vorster & Jansen van Rensburg 2005a). Some fruit have become very important in the survival of local communities (tsamma in the Kalahari), while others also serve other purposes such as the containers formed from the dried fruit of the calabash (*Lagenaria siceraria*). Some fruit are sold widely throughout Southern Africa and indigenous fruits are increasingly becoming commercialised (Van Wyk & Gericke 2003:33) and being processed, such as Marula.

Underground organs of wild plants (rhizomes, tubers, stems, bulbs and roots) are widely used as a source of starch, and are often processed. The most well known examples are cassava roots (*Manihot esculenta*), madumbe (*Colocasia esculenta*) and stems of the African cycad or bread palm (*Encephalartos* species). However, in many areas those indigenous vegetables previously used as starch have been largely replaced by sweet potatoes (*Ipomoea batatas*) and potatoes (*Solanum tuberosum*) (Vorster & Jansen van Rensburg 2005b).

Green vegetables are very important in the diet as they supply important nutrients. They are rich in minerals, amino acids and vitamin A and C. Some are eaten fresh, but many are used as potherbs. Leaves are traditionally cooked and eaten with porridge as a relish (Van Wyk & Gericke 2003:63), while the Xhosa in the Eastern Cape mix it in the porridge (Vorster & Jansen van Rensburg 2005a). The leaves of a species or mixture of species used in this way are called Morogo, wild spinach, spinach or Imfino. The Tsonga word is Miroho. Some leaves are eaten in the raw state as a snack.

Many traditional food plants grow wild. Where these plants grow they can be harvested by everybody, including the poor. Broadcasting of some popular plants in homegardens and fields takes place in some areas, but this practice seems to be confined to elderly women (Vorster & Jansen van Rensburg 2005a).

Some traditional food plants are harvested and sold while others are cultivated for household use with any surplus being sold occasionally (Maundu 1999:5, Vorster & Jansen van Rensburg 2005a). Leafy vegetables are very important to women and children in poor rural areas as a source of nutrients and also in a few areas as an extra source of independent income (Maundu 1999:5, Vorster & Jansen van Rensburg 2005a).

Cultivation of wild species is very limited in South Africa. The Shangaan grow cassava that they brought with them when they moved from Mozambique to settle in South Africa. Madumbe is cultivated in some sub-tropical areas where their tubers are sold. Limited use is made of the leaves (Vorster & Jansen van Rensburg 2005b).

Wild traditional plants can be conserved in the areas where they grow: they can be left when other plants are weeded out during agricultural management activities; they can be collected in the wild and transplanted in household gardens; or they can be managed in their natural habitat (Maundu 1999:6, Vorster & Jansen van Rensburg 2005b). There is considerable scope in domestication and breeding of wild plants. These underutilised, well adapted plants could help address some of the food security constraints experienced by many rural households as a result of water shortages and drought.

African Vegetables identified during the study were used predominantly for food consumption purposes while a handful were considered to have medicinal properties. Slightly more than 82% of households reported some African Vegetables growing in their home gardens between June 2004 and June 2005.

African Vegetable Consumption

During the survey 108 (100%) of the respondents replied that they eat African Vegetables at some stage during the year with 95% indicating that these vegetables are important foodstuffs for their households. Reasons for eating African Vegetables are as follows:

- Are locally available and plentiful (90%);
- They grow easily under local conditions (97%);
- They are freely available and easier to produce in comparison with exotic vegetables such as cabbage, which require irrigation (95%);
- The taste is preferred to that of exotic vegetables (96%);
- They are believed to be nutritious (98%);
- Some of them can be locally and easily dried and stored for consumption at a later date when they are not freshly available (94%). 94% also reported that the dried vegetables were the main source of vegetable when fresh vegetables were scarce in winter. As a result of drying and depending on the volume harvested per household respondents said that dried vegetables could be the main source of vegetables consumed for up to six months (25%) with 29% indicating that they could be consumed for twelve months of the year if they had harvested and dried sufficient quantities.

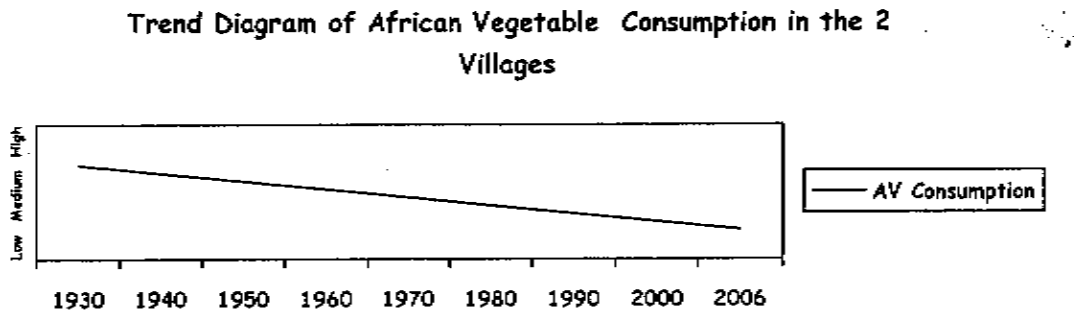
Most households surveyed generally consumed three main meals a day (93%) with 72% typically consuming African vegetables at two of these meals. While bread was usually consumed at the first meal of the day by 95% of the households, maize porridge was consumed at the other two meals by 89% of the households. When they could afford to do so households tended to consume red meat (79%), chicken, mainly necks, feet and heads (82%) and fish, mainly canned fish or fish heads (76%) at two of the daily meals. The regularity of consuming any type of meat depended largely on a household's access to food resources and income. Our observations suggest that red meat was rarely eaten and that this figure might well be inflated. Slightly less than 5% of the households indicated that they consumed bush meat at some stage and 56% said that they rarely consumed bush meat. 39% indicated that they never consumed bush meat.

Calendar 2: Seasonal consumption patterns of African vegetable fresh and dried leaves

Crop	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Guxe	F	F	F	F	F	D	D	D	D	F	F	F
Tinhwembe	F	F	F	F	D	D	D	D	D	D	D	F
Tinyawa	F	F	F	D	D	D	D	D				
Mihlata						F	F					
Nkaka	F	F	F	F	D	D	D	D			F	F
Mandhanda	F	F	F	F	D	D	D	D				F
Rirudzu	D										F	F
Thyeke	D										F	F
Muxiji	D										F	F

D=Dried, F=Fresh, Blank Space=Not consumed in any form

Trend Diagram 4: African Vegetable Consumption



Trend Diagram 4 illustrates that prior to the 1930s village residents and even those living on the farm Berlyn consumed a high quantity of crops and plants they identified as African vegetables. It also illustrates that this trend has decreased over the years. According to villagers this is a result of the gradual inclusion of crops identified as exotic vegetables into their diet. While many of these crops are not grown they are available in local shops and markets.

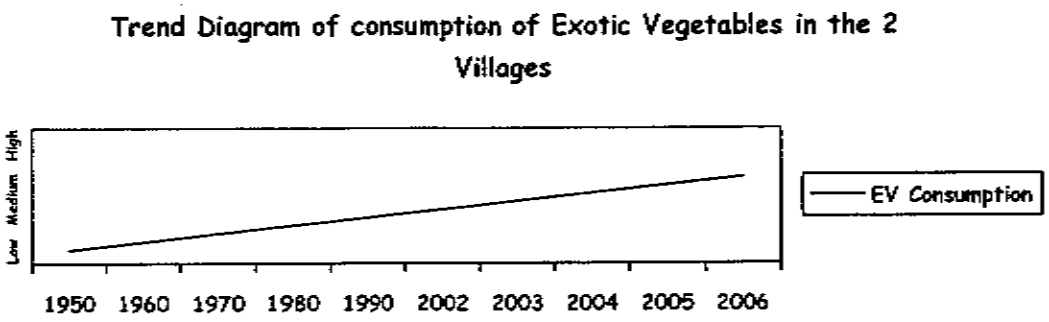
Exotic Vegetable Consumption

During the survey 98% of the households reported eating exotic vegetables. 58% said that they were readily available locally but unlike African vegetables they had to be purchased from the local shops because very few people actually grew them and in winter this was virtually impossible for almost all the households. Consequently, 93% of the respondents considered them to be expensive in comparison to African vegetables. 89% said that they did not grow easily because of the lack of sufficient water and necessary agrochemical inputs. 86% said that they liked the tasted of exotic vegetables. 92% believed that they are nutritious but only 38% said that some of them could be dried and stored for later consumption. One person mentioned drying cabbage and spinach leaves. 49% of the households felt that exotic vegetables were important to their households as a foodstuff. The remaining 51% said that they were not important to the household for the following reasons:

- Expensive (16%);
- Household members grew up eating African Vegetables and prefer them (2%);
- Unhealthy (10%);
- Require irrigation water in order to produce them and water was scarce (23%). 92% of the respondents reported that they never irrigated African Vegetables while all 108 (100%) indicated that they would have to irrigate any of the exotic vegetables which they might produce.

79% of the respondents indicated that they preferred African vegetables to exotic vegetables as a foodstuff. 80% said that African vegetables were more important in ensuring that the household has sufficient food to eat while only 2% said that both were important.

Trend Diagram 5: Exotic Vegetable Consumption



Trend Diagram 5 illustrates that those crops known as exotic vegetables were gradually introduced into the local diet from the 1950s. These crops were initially exclusively purchased from markets in the 1950s but now a handful of farmers in the villages grow some of these crops. The majority of the villagers purchase these vegetables from local shops and markets. The trend shows a gradual increase in the inclusion of these foodstuffs into the local diet. The fact that they are more readily available now has made them popular with the youth, further strengthening the consumption trend. Most people we spoke to who were under the age of 40 years preferred to eat exotic vegetables when they could afford to do so.

Medicinal Properties of African Vegetables

A number of plants identified as African vegetables were said to have medicinal properties. These were not always easy to determine as the Inyangas that we spoke to said they preferred to only divulge general information as they used their knowledge for professional purposes. We obtained information about a few African vegetables and some other plants found in the area.

Nkaka was identified as being able to heal measles, alleviate stomach cramps and reduce high blood pressure. The remedy for the first two ailments was prepared as follows: Boil leaves for an hour, drain the water, let it cool down then drink until symptoms disappear. For reducing high blood the infusion was made as follows: Place about 1 liter of compressed leaves in boiling water and boil for two minutes. Drain and use as an infusion which must be drunk twice a day.

Tinyawa Fruits were used to heal ear infections. The cowpeas are ground and then this mixture is placed in the infected ear where it must be left for two days. It is said to heal the ear infections very quickly.

Xiyakayana is said to have medicinal properties. In the past people gave it to the dogs to make them more aggressive – the purpose for this is unknown and was not disclosed during the study. Traditional healers use the fruit to make a laxative, but they say it is very dangerous to use. The fruit is boiled and strained to ensure that all seeds are removed, as the seed is highly toxic and can result in death if consumed. Only a few traditional healers use the fruit due to the dangerous nature of the medicine.

A few of the older women believed that Thyeke, when used as a snuff, helped to stop nose bleeds and headaches. The whole plant is harvested and dried when the seeds are visible on the plant. Sun drying takes about one week, after which the seeds and most of the leaves have fallen off. The stem and a few leaves are then crushed and added to the crushed rolled tobacco that they buy on pension day. This mixture is ground again and then stored in small airtight containers. It is sometimes sold at pension days. It is sniffed as required. It is also sniffed by the elder women as snuff and is shared amongst them. At all our workshops in Berlyn many of the women were using snuff.

A number of other plants were also attributed with medicinal properties and are recorded here. Garlic was said to alleviate coughs and to improve a person's appetite. The garlic is boiled in water and then left to cool down. Once it is cool enough then it is drunk.

The inner part of the maize cob, known locally as 'Nkhuhlu' is said to cure children of skin rashes and measles. A whole is made through the 'Nkhuhlu' and cord is placed through the hole. It is then hung around the neck of the sick child until the rash disappears.

Two local trees, which we were unable to identify, Msuzana and Mpongo-mpongo were believed to cure Flu and coughs. Here, again the leaves were boiled in water, drained and once it had cooled down this infusion was drunk by the person afflicted with the Flu.

The Mango tree was said to have some properties that relieved pains and stomach cramps. The roots were harvested and cleaned. Then they were boiled in water. The drained infusion was drunk as soon as it was cool enough to do so.
The roots of the Pawpaw tree were also attributed with medicinal properties. It was said that they cured diarrhea, internal sores and skin rash. The roots were harvested and cleaned. Then they were boiled in water for an hour. The drained infusion was drunk as soon as it was cool enough to do so.
The Inyangas mentioned that sisal (*Agavaceae sisalana*) leaves are harvested to make medicinal mixtures. It is believed to be a good cure for some sexually transmitted diseases (STDs). One of the aloe species, locally known as Mahangana, is also used as an ingredient of a mixture used to cure STDs.

Cropping and Harvesting Practices

Access to Agricultural Resources and Inputs in Berlyn and Molati

According to the respondents 88% of their household foodgardens were managed and maintained by adult female household members. Those responsible for the household garden spend on average 2.63 hours a day (with the median being 3) and an average of 3.65 days per week (with the median being 4) working in the household foodgarden. However, 30% indicated that members spent five days per week working in these gardens. Girls help with harvesting in the home garden. If a women works, the girls will help looking after the home garden; both collect water and fire wood. Girls will also help get the family ready for the day and prepare meals. Should the children not be old enough (12+ years) the working wife will do the work over weekends. As more young women than men in these two villages work outside the villages, this implies that many school going girls are busy with chores in the afternoon and early mornings. Should there be no girls to do this, the working women would be doing all these chores over weekends, thus severely limiting their time for other things. Agriculture for younger working women is not a real possibility, as they have to leave very early and come home after dark. Very few men, both young and old, were involved in the household gardens beyond ploughing and planting of some crops such as maize. This should be taken into consideration when looking at agricultural development possibilities for these two villages.

Only one household owned a tractor. This household also had a plough and some other implements for the tractor. 6.5% of the households owned donkeys and had ploughs that could be drawn by the donkeys. Households owned the following handheld implements:

- Spade (82%)
- Hand-held hoe (83%)
- Fork (57%)
- Rake (66%)
- Pick-axe (61%)
- Watering can (4%)
- Hosepipe, sprinkler or drip system (14%)
- Handheld pump sprayer for agrochemicals (7%)

This data suggests that most households are not in the position to actively pursue agricultural activities requiring modern technologies and associated inputs to the extent that they do not have more than the basic implements with which to perform basic agricultural activities. Donkeys were hired out at between R60 and R80 to plough a household foodgarden although the price could increase if a household had a larger than average side garden. The tractor was sometimes hired to plough the few larger fields.

9% of the respondents were members of a local development project while only 5% were members of an agricultural or farmers' association. This indicates that there is very little opportunity for the majority of the residents, who are not members of a project or association, to get agricultural information as most engagement in this area is done through the vegetable garden projects.

94% of the households owned one house in the village. While 5% owned two houses, 1% owned three houses. 68% of the households had access to one (57%) or more fields in the village upon which to grow crops or graze animals. 94% of the households only had access to one household foodgarden. The remaining 6% had access to 2 or 3 such foodgardens. Household foodgardens were on average 853 m^2 with the smallest being 100 m^2 and the largest being 4550 m^2.

95% of the households grow crops. These are diverse and the reasons for their cultivation vary from household to household. 89% said that they grow grain such as maize. 83% said that they grow legume crops such as beans, peanuts and cowpeas. 8% grow exotic vegetables in contrast to 87% who grow African Vegetables. 61% of the households grow fruit. No other crops were grown. Those households that grow crops gave the following reasons for growing crops:

- Main source of household food (5%)
- Main source of income (2%)
- Extra source of food for the household (83%)

Home foodgardens are therefore very important as an extra source of household food.

87% of the households said that in the past year they had used all the land that they had access to for farming. Those who did not use all their land gave the following multiple responses.

- The household did not have enough money to buy inputs (5%).
- There was a general lack of water for irrigation purposes (6%).
- There was not enough time to farm effectively (2%).
- Some land was purposely left fallow for seasonal crop rotation practices (1%).
- Too old to work the land (1%).
- Not interested in cultivating all the land (3%).
- Land is considered to be of poor quality (2%).

Water Harvesting

As mentioned in the overview of the study area water is a severely limiting factor for agriculture and for households. To place agriculture in the right context, the water situation needs to be understood. The community gardens at Berlyn and Molati both had boreholes and pumps when they were first initiated, or soon thereafter. Unfortunately these were stolen. However due to various donors (local and abroad) the pumps were replaced by the beginning of 2006. This means that the 30 or so households that have members working in these projects will be able to access vegetables that require water. The purpose of these projects is to produce vegetables and other produce for sale in the surrounding areas. Household water must be collected at certain points in the villages. These can be quite far away from the household, making water an extremely scarce commodity. Children also collect water, mainly after school. If a woman works, the girls will help looking after the home garden, collect water and fire wood. The demand for household use is great, preventing people from collecting water for cropping purposes. The grey water is generally too polluted to use on plants. Some women collect their water early in the morning while others hire people with donkeys to collect the water for them.

One innovative local resident has devised a system with which people can collect water from the dry river bed. He dug holes and placed open ended steel drums (approximately 25 litre capacities) into the holes, spreading coarse gravel on the bottom. This acts as a filter and has the purpose of ensuring that the water is clear and free of sand and silt. The water is not brackish. Children dip containers such as bowls in the drums and scoop the water out and pour it into buckets and containers which they carry home. As the water is scooped out, more water is drawn from the riverbed into the drum, gradually filling it up. The water is clear as it is drawn into the drums. He keeps the system in good order for other community members to use. This is an innovation worthy of mentioning, both for its originality and for the fact that it is shared so freely with other community members who do not have to buy water from other sources, such as shops or the water van that comes around occasionally. However, the demand for water is great and prevents people from harvesting water for agricultural purposes. In essence then, sufficient water for household agricultural purposes is a serious constraint, especially as it is often scarcely available for other household requirements, including hygiene and consumption.

Fertiliser and Manure

In Berlyn and Molati many of those interviewed tended not to use manure on their home garden plots as they need water when they use manure. Manure and plant matter decompose easier when wet and support earthworm life. The earthworm is important because it aerates and fertilises the soil. When the Berlyn community garden had water, they used manure. When using manure they do not see grasses and weeds, whose seeds and seedlings might be borne by the manure, as being a problem. They reported that each person must be aware of the constraints when using manure and take responsibility to do the necessary weeding. Manure is not used when they grow exotic vegetables.

However, it is considered useful when growing maize and peanuts. They purchase fertiliser, which they use when growing exotic vegetables. This is because the extension services have shown them when and how to apply the different fertilisers at different times during the season for the exotic vegetable crops they grow. Those who use kraal manure (from cattle, donkeys and chickens) in their home gardens do so because they are aware that it makes the soil fertile. They spread the manure on their plots just before they expect the first summer rains. The rain soaks the manure into the soil. After the rain they then work the manure into the soil by using hoes or donkeys. When they plant in the vegetable garden projects they make furrows, apply the fertiliser/ manure and then irrigate. The next day seeds are planted, covered with soil and irrigated. On the home gardens some people follow similar practises while others plough the manure and the fertiliser, which has previously been spread on the ground, into the soil while simultaneously planting seeds. The fertiliser is usually spread thinly over the field on the same day that they will plough. The kraal manure is usually spread a couple of days before ploughing, sometimes this may even be a week or two. But there is no hard and fast rule about this. After the first rain the manure is collected from the kraal. This is a mixture of goat, cattle and donkey manure and depends on the livestock one has. The manure is also a mixture of fresh and old manure as it is only gathered up when needed. The manure is then placed on the land in heaps and spread out over the land a few days prior to ploughing. Ploughing and planting only takes place after the first rain at the beginning of the summer season.

One lady uses kraal manure that she gets from somewhere else. She does not know which animals provide it, but knows that it mainly consists of cattle faeces. She obtains it long before she plants. In March she spreads the dry manure over the field and works it in when she prepares the soil. She prepares the soil by hand and uses 20 wheelbarrows manure in a (20x9m) and (28x6m) plot. She then leaves this until the first rains come, thereafter she ploughs and plants.

Another woman sometimes uses goat manure that she collects from her own kraal. She spreads 15 wheelbarrows full of manure in June and July. Her plot is about 35x35m. When she ploughs the manure is worked in. She does not use artificial fertilisers or compost.

Some farmers do not use manure due to the likelihood of an increase in the weed population and the subsequent increased labour required for weeding the plot. Many do not have the time or inclination to work in the manure a few months before the next crop and fresh manure will burn the crops.

The application of too much manure and manure that is very fresh can result in the soil being burnt, i.e. planted seedlings being burnt. This is because fresh manure has high levels of ammonia and salts. The use of fresh kraal manure requires continuous rain so that it can be kept moist and thereby lowers the ammonia and salt levels. If this does not happen then the heat of the sun makes it burn the soil. Villagers are aware of the effect that the use of fertilisers or manure has on the soil and plant growth. However, costs are an inhibiting factor so most households do not seem to use fertiliser. Composting might be a possible answer to small home gardens. The problems of transferring weeds and grasses when manure is used, is clearly understood.

A farmer who has access to three large fields and various mechanised implements uses 3:0:3 fertiliser which he buys from the co-op in Letsitele. He has many resources and can afford this. He scatters this on the field while he is ploughing so that he can plough it into the soil. He does not use manure as he says that this causes a lot of weeds. The problem is that the cattle graze all over the area and they eat grass and sometimes the seeds of various weeds. If he uses cattle manure as fertiliser he needs to spend more time and money on weeding. He farms on approximately 4 hectares of land while most home gardens are significantly smaller with the mean being 853 m^2.

Besides being a source of fertilisation for agricultural purpose manure is also used for other purposes in the villages. A common use was to decorate parts of the homestead to form a hardened patio or area to receive visitors. It is mixed with sand to form a cement-like mixture that dries very hard in the sun. It was used to cover the floor and also to make ridges to sit on. In some instances we noticed that ornamental trees and shrubs had been planted and the manure in this area had been shaped to form circular bunds to trap the water around the plants. Another common use was the spreading of manure on the floor of some of the dwellings. A fair amount of manure is used in these processes as we noticed some people replacing or repairing their outside patios at least three times during the study.

Tilling

Tractors and mechanised implements are scarce, and there is one farmer who is regarded as wealthy because he has a big house, utility vehicle, two tractors and various implements. He would first test part of the field to see if it was hard enough to plough. He would do this by ploughing a small portion. He does not plough immediately after rain because the soil is muddy and the tractor and the implements do not grip. A tractor occasionally ploughs the vegetable garden projects. Animal traction is used almost exclusively in the household gardens of both villages if the household can afford to pay for this service. Donkeys tend to plough larger fields (costs about R60), while smaller fields are usually ploughed by hand using hoes. The women plough from 7am until about 10:30am. After that it gets too hot for them to work in the sun although we occasionally saw one or two of the elder women were still ploughing by hand at about 2:00pm.

Typically farmers will plough about 2 weeks after the first summer rain but there is no hard and fast rule as it depends on a number of factors, most notably:

- On hard and stony soil you can plough a day after it has rained as the soil is dry and not muddy;
- On softer soil you need to wait a few days for the soil to dry out, and then you can plough. If the soil is damp then the plough gets stuck and does not make good furrows. Also the soil does not cover the furrows properly;
- For the same reason they do not plough on a day when it is raining;
- The household also needs to have money to purchase the seeds and the fertiliser if they are going to use these inputs. In such cases ploughing and planting only takes place after income has been received. For many this will be after pension day.

Key factors that influence when to plough and plant are money for inputs, the weather and in particular rainfall, soil type and moisture content. All these aspects are recognised, understood and managed to some degree by the villagers. However, further assistance with water harvesting and soil moisture retention practices could well improve production in summer months. These might even help with prolonging cropping seasons so that crops can be harvested later.

Understanding Intercropping

Farmers have been intercropping for thousands of years, but the practice has only been investigated by researchers in recent years. Intercropping falls within the practise of multiple cropping and can be described as the growing of two or more crops simultaneously on the same plot for a significant part of their growing season. The crops can be annuals, perennials or a mixture of the two (Mettrick 1993:172).
In the semi-arid environment with highly variable rainfall, integrating a wide variety of crops is a means of risk management for smallholder farmers. Intercropping staple crops such as maize and millet with secondary niche crops like bambara, pumpkins, cowpeas and peanuts helps to stabilize the farming system against environmental shocks and changes. An intercrop can act as a physical barrier, slowing the spread of host-specific diseases and pests. Farmers can supply a minimum level of food for their households by intercropping crops that mature at different times. Diversification of cropping systems helps smallholder farmers to spread the risk of crop failures (McClintock 2006).

There are various types of intercropping (Mettrick 1993:172):

- Mixed: no distinct rows visible.
- Row: crops are planted in rows.
- Strip: crops are planted in strips wide enough to permit independent cultivation, but narrow enough for the crops to interact.
- Patch: the component crops are planted in patches.
- Relay: growth of crops overlap for part of their growing cycle.

Research has shown that intercropping can provide yield advantages when compared to monocropping. This does not mean that intercropping generally leads to yield advantages. When annual crops are intercropped, it often does not result in yield advantages. Ideally component crops should be used that compete for resources at different times or in different ways. This helps to minimize competition between these component crops. There are three broad types of competitive relationships between intercropping components (Mettrick 1993:173):

1. Mutual inhibition: all crop yields are lower than under monocropping conditions.

2. Mutual cooperation: yields of each crop are higher than under monocropping conditions.
3. Compensation: one crop yields less and one crop yields more than under monocropping conditions.

Mutual inhibition is rare, some cases show mutual cooperation but the most commonly found case is compensation. To make the most of intercropping, the inter-crop competition should be minimised and the degree of complementarity between crops should be maximised. The main growth requirements are light, food and water, thus the characteristics that should be looked at between the possible components should be canopy arrangement, root depth and plant shape. Factors that should also be looked at include drought resistance, shade tolerance, ability to fix nitrogen, etc. The best intercropping results will be obtained when the crops differ in resource requirements and plant characteristics (Mettrick 1993:173).

Intercropping has the following advantages:
- Better use of light if the peak demand times of crops differ.
- Optimisation of nutrient use if the crop rooting systems use different soil layers.
- A better ground cover will inhibit weeds.
- Improve yield stability, as one crop can compensate if the other crop fails.
- Labour demand is spread.
- One crop may physically support another (i.e. maize and beans.)
- Land shortage is not such a problem with this system.

Intercropping has the following disadvantages (Mettrick 1997:174):
- The system is labour intensive.
- Pest and disease control can be difficult.
- Chemical and mechanical weed control is difficult.
- Mechanization is a problem.

Farming Systems Used By Farmers in Molati and Berlyn

Maize is the most popular crop grown by almost all the villagers. It is planted in November and December, harvested as green mielies (roasted on the fire or boiled during the day and at night) from January to April. It is harvested in May and June for the flour product. Some farmers who plant enough will sell their produce. Many households expressed a desire to produce more maize as they are used to it, enjoy the taste and prefer grinding their own maize to the milled flour purchased from supermarkets, as the taste is superior. Growing more maize will also enable them to keep more seeds for the next season, but poor rainfall is inhibiting the maize yields. The larger farmers tend to concentrate on cash crops such as exotic vegetables and maize, with the African leafy vegetables tending to be weeded out in their cropping system. Home gardens seem to be the main domain for African vegetables as exotic vegetables need water which is not available for irrigation and is even difficult to obtain for household purposes. The maize cropping system is important as this is the structure within which many of the African vegetables grow.

In the vegetable garden projects members tend to plant the way extension has taught them. This means that crops are usually monocropped, irrigated (when the pumps are there), fertilised and sprayed. The participating farmers feel they have enough space to monocrop, while at home they do not. Following the theft of the water pump in Berlyn the members intercropped traditional crops and African Vegetables during the summer of 2005/2006. They needed to grow variety for risk spreading and nutrition. Farmers will plant different rows with different crops. Soil preparation for the April planting takes place during late February/early March. Cabbage, spinach, beetroot, onions, tomatoes and kale are planted during the winter in the Berlyn community garden. Tinhwembe is planted in spring and the Wit Boerpampoen in March/April. From April onwards they plant all bean types (green and dry beans).

The farming systems used in these communities are diverse and often very individually determined. It answers the needs of the particular farmer as identified for that season. During the study no planned crop rotation was found. The intercropping addresses the land shortage, spreads risk and suppresses some weeds. One lady explained why she prefers to plant the crops in rows rather than to broadcast – mixed intercropping. She feels that the crops/plants need space to breathe. If you broadcast it can happen that a few seeds might fall in the same spot which might hinder the other plants' growth and

productivity. When you plant in rows all plants have a chance to accumulate enough food (nutrients) since they are away from each other. When weeding, many women weed out most wild plants except their preferred African vegetable crop during the first weeding. This gives these crops an advantage when the others start to regrow, as no further weeding is done after this initial weeding activity. The African leafy vegetables are commonly found as volunteer crops between the planted and broadcast crops.

The Umfundizi's wife in Molati learnt a waterharvesting technique, infield rainwater harvesting (IRWH), for maize at Glen Agricultural College in the Free State Province. The Neder-duitse Gereformeerde (NG) church in Letsitele felt the church had to do something for its sister church in Molati. They selected a number of women to attend a workshop/course in Bloemfontein at Glen Agricultural college where they were taught this new method. They plant the maize in rows, 2 seeds in one hole. The distance between the maize rows is 2 meters. You basically plant two rows of maize 3 m apart, with a basin (subdivided) between these two rows. The one row is on a ridge with the basin on the one side and the hard path from where water drains into the next row's planting on the other side. The hard path is 2m wide. The path must stay hard, thus ensuring rainwater runoff into the holding basins. This method does not allow weeds among the plants because its is reported by the researchers that the weeds will take away the plant food from the maize. This lady decided to compare the traditional method and the new method with each other to determine which if there is any difference in the yield and quality of maize produced using the two methods. At the end of our study she considered the newer method better than the normal method of growing because the plants get a chance to breathe and have enough nutrients. They are planning to use this method during the winter season for the exotic vegetables. However, it is important to note that even though she says she is comparing the two methods, she is not intercropping her maize in the control, as would happen in traditional planting systems. She is now comparing two monocropped systems, making this not a true reflection of the norm. Several things could not be done as she had been trained to do, such as mulching or using stones in the basins to lower evaporation, as these did not fit into the system as they were not readily available locally. We also noticed that instead of designing the basins across the contours she had placed down the slope with the result that less water was controlled and runoff occurred with the lower basins somewhat eroded.

Some individual practices found include the following:

- When the maize is small it is mulched with grass, which then becomes a source of plant food as it decomposes into the soil.
- If the rain is late and planting can only take place in January, one woman reported that she will plant maize and Bambara because peanuts must be planted in November and December and not in January. In this instance Bambara is not fertilised/manured and is planted one seed per hole that she has made with her hoe. She plants approximately 60 cm apart within the row, and plants every alternate row with Bambara nuts.
- Some farmers plant Tinhwembe/pumpkins specifically in areas where there are termite hills. The plants grow well in these places. This illustrates that farmers are aware of the fact that the presence of small animals and organisms in the soil contributes to soil fertility and thus plant production. The presence of termites suggests that there is adequate air in the soil enabling them to go about their activities, including the breaking down of organic matter into humus. The termite tunnels also allow for added water retention and permeation in the soil and enable roots to penetrate the soil.
- The person doing the planting walks behind the ploughing team and sows the seeds. The distance between the maize rows and peanut rows are about 45cm to 60cm. When the ploughing team returns the plough covers this area where seeds planted.
- One lady was observed broadcasting maize before the donkey span started to plough. When ploughing every alternative row was planted with maize by walking behind the donkey span. On the return journey the unplanted row's soil was used to cover the maize seeds planted. One day after planting the maize cowpeas, peanuts and pumpkins are broadcast in the same plot but in different areas that do not overlap.
- A handful of villagers reported that Blue death insecticide is occasionally spread between the cowpea to control insects.
- One lady first broadcasts the crops, and then she uses a hand hoe to plough over the area. As a result there are plants that grow from the same hole. She finds this method simple and quick. Unfortunately, this method can cause high inter-crop competition. The woman is active in the vegetable garden project, where she follows all the 'rules' as determined by the conventional

training provided by the extension officer. This raises the question about the effectiveness of the training. Do they follow the 'rules' in the community garden because they feel they have to? It seems as if training leaves the extension personnel in a dominating consultative role, as project members are not trained on principles to ensure that they know why they do something. Principles are actually crucial, as villagers then have the understanding needed to enable them to make well informed decisions regarding multiple crops and situations.

- One lady allows her Biriviri (chilli) plants to grow for a number of years, and plants the other crops around them. She is also active in a vegetable garden project and receives regular training. The plant already looked very diseased when we first saw it, and by leaving it in the field she is creating a host for pests and diseases. Once again the idea of training people in principles is raised here.
- Sunflowers are planted in a specific area. The yield is used to feed the pigeons that are sometimes eaten.
- The two villages struggle to plant tomatoes as they do not have sufficient water. When asked if they can use the grey water for the plants, they answer that they had never thought of this. One lady did report using her greywater (dishwashing water) on specific plants. The recycling of grey water might be an answer to the water needs of a few highly prized plants (tomatoes, okra, chilli), and could enable them to plant a few plants during winter. Training on which type of water to use should be given, as not all grey water can be used. Similarly only leafy plants or those whose fruit is produced above ground are safe to consume when this method of water harvesting is used.
- The African vegetables are managed in the field in different ways. In one instance a field was left deliberately to enable the African vegetables to grow. In many cases weeding is done around the most preferred African vegetables once. No further weeding is done and the other African vegetables then start to grow again. The most preferred African vegetables include Thyeke (amaranth), Nkaka (*Momordica*), Guxe (*Corchorus*) and Rirhudzu (*Cleome*). The plants that are left could be just one African vegetable type or could be a variety of African vegetables. The most popular crops left, which we noticed, were Guxe (*Chorchorus* spp.) and Rirhudzu (*Cleome*). In one instance we also noticed Muxiji (*Bidens pilosa*). By showing women how they can increase their African vegetables leaf yield with slight modifications, these efforts will be even better rewarded, as they can then harvest those same plants over a longer period.

Some common farming system observed in Molati and Berlyn:

- Intercropping single or double rows of peanuts and maize. This type of planting had been found in most of the fields of the people interviewed and visited. Peanuts and maize are planted in rows so that the roots of the plants do not get intertwined. This would happen if the seeds were just broadcast. If it happens then it is difficult to harvest the peanuts. Some farmers will only intercrop maize with peanuts. If this lady reduced her spacing between the two crops, the roots would become intertwined. Experience has taught her the correct distance. Peanuts have strong taproots with several lateral roots and nodules developing (www.hort.purdue.edu/newcrop/afcm/peanuts.html). When planting too close problems start when the pods are formed.
- Cowpea and peanuts must not be intercropped. If this is done the peanuts usually have a poor yield and quality. They tend to be smaller in size than usual. Another farmer explained that the roots of the cowpeas are creeping and they can disturb the growing of the peanuts by getting entwined with them and absorbing more nutrition, thereby preventing the peanuts from developing optimally. "the peanuts become thin". These are very astute observations. Cowpea is an aggressive grower that competes with the peanuts for growing space. The cowpea plant will completely overwhelm the peanut, thus inhibiting growth, nutritional uptake and photosynthesis, leading to the poor performance observed.
- Peanuts and maize like each other. Many people believed that they grow well together. This not surprising as peanuts are a legume that is nitrogen fixing, thus improving the maize yield.
- One woman stressed that her land is very small and in order to get a sufficient variety of necessary foodstuffs (diverse diet and nutrition) she must intercrop. She experimented once and noticed no difference in size and yield between intercropped and monocropped peanuts and maize, so now she intercrops, enabling her to get greater volumes of both.
- Cowpeas and Bambara nuts are also not planted together as the Bambara nuts become small/stunted when intercropped with cowpeas. Again, cowpea is an aggressive grower that competes with the Bambara for growing space. The cowpea plant will completely overwhelm the Bambara, thus inhibiting growth and photosynthesis that leads to the poor performance observed.

- It was reported that peanuts and Bambara grow well together. The bush type peanut plant will not interfere with the growth of the Bambara plant. Peanuts grow at 45-75cm spacing while Bambara grow 10-20cm within row and 20-40cm between rows.
- At a certain time during their growth period Bambara nuts need to have extra soil placed around the stem to ensure that they bear lots of fruits (this process is called *ku sela*). It is believed that if this is not done then the Bambara nuts will not bear a good quality and quantity of fruit. Accordingly the difference between doing this or not doing it can be seen by the size and moisture of the fruit at harvest time.
- Soetriet can be intercropped with maize, peanuts, ocra, pumpkin and Bambara nuts. Note: these are small clumps that do not exert much pressure on the surrounding plants. Their growth habit is not as invasive as spreading / creeping plants.
- Pumpkins are not always intercropped and are planted on their own. Pumpkins are sometimes broadcast or planted between maize. This is quite a common practice. The aggressive, spreading habit of these plants make them poor companion plants for other low growing plants. Recall that they are known to smother Guxe. Plants such as maize would not be greatly affected in this intercropping system.
- Intercropped maize, peanuts and cowpeas and pumpkins or combinations of this in one parcel of land. However, the cowpeas/pumpkins are not planted within the maize and peanuts as intercrops. The cowpeas/pumpkins are planted as rows between maize rows and are separated from the peanuts by at least two rows of maize (*see note on cowpea / peanut intercropping*).
- Sometimes if maize is broadcast, a day after planting maize, cowpea and pumpkin are planted in specific places between the maize and separate from each other. These are both aggressive growers who would compete with each other for light, nutrients and space.
- Mandhanda (okra) is broadcast between the maize
- Plant 2 rows of maize and one row Marhanga, with a mixture of African leafy vegetables volunteering. As calabash grows like pumpkin and squash it intercrops well with maize.
- One lady broadcasts maize and Bambara as mixed intercropping. She plants one seed Bambara per hole that she has made with her hoe. She plants 60 cm apart within the row, and plants every second row. Nkaka grows wild. Although Nkaka is a spreader it is not an aggressive grower, thus enabling these three plants to grow well together.
- Broadcast maize, pumpkin and Marhanga
- Broadcast maize, okra, watermelon and pumpkin. Peanuts are planted where no watermelon or pumpkin has been broadcast.
- Broadcast maize, cowpea/ peanuts, ocra and watermelon/ pumpkin. Peanuts/cowpeas are planted where no watermelon or pumpkins have been broadcast.
- Timanga (peanuts) is grown in a broadcast, monocropped system in the Berlyn vegetable garden project. The value of peanuts per area is higher than that of maize. Peanuts are easy to sell, popular and are multipurpose food (snack, part of a meal to increase its nutritional status). It is often shared within the extended family. A small plot has been left for the growing of broadcast maize.
- Another community garden plot has been divided into a patch intercropping system. The four patches consist of a small row of pumpkin, a patch of broadcast maize, a large patch of high value peanuts and a small patch of pumpkin. This, like many of the other practices illustrate that farmers are aware of the various values of their crops and many make decisions based on value and other factors.
- Maize, pumpkin and cowpea are intercropped and African leafy vegetables occur voluntarily. However, the pumpkin and cowpea are grown separately from each other.
- Sweet potatoes are grown in patches, and tend to stay in the same patch from year to year. This happens because the tubers are never harvested and stored as seed, but left in the soil to stay active right through the year. As a result of this practice it is possible that virus diseases might be more prevalent here, as the plants are still active in the high aphid incidence periods. Aphids transfer many diseases and these viral infections lower the yield potential of these plants. There seems to be no introduction of clean material, thus just introducing clean material might already raise yields without making any other changes.

Table 8: Different intercropping systems found in Molati and Berlyn

Crops	Maize	Cowpea	Peanut	Bambara	Pumpkin	Sugar cane	Guxe	Mandhanda
Maize	-							
Cowpea	Y	-						
Peanut	Y	N	-					
Bambara	Y	N	Y	-				
Pumpkin	Y	N	N	N	-			
Sugar cane	Y	Y	Y	Y	Y	-		
Guxe					Y		-	
Mandhanda (okra)	Y (BC)		Y	Y				-
Marhanga	Y (BC)	N	N		Y	Y		

Y=Yes, N= No, BC= broadcast as opposed to being sown and spaced in rows

Planting distances observed within the farming systems include the following inter-row spacing:

- Maize (50 - 60cm), maize (20-30cm), peanuts (30cm), peanuts (20-30cm), maize - and so it continues (two rows maize, one or two rows peanuts). For researchers working under optimal conditions the recommended spacing between maize rows is 0.9-1m.
- Maize (40cm) maize (40cm) peanuts (40cm) maize - and so it continues (two rows maize, one peanuts)
- The distance between the maize and pumpkin is between 15 - 50cm. The intensity of planting of the pumpkins determines the effectiveness of these distances. The closer the pumpkins are planted together, the further away the maize row should be so as to minimise intercrop competition. Due to the low rainfall status of the area, it could be better to have a well-covered (mulched) soil, as it minimises evaporation. Too many plants will, however, use up the water meant for the maize.
- The intra-row distance for maize is 20/30/40/50cm. Differences were found between fields of the same person, and it was explained that it depended on who planted. Research recommended spacing within maize rows vary from 15-44cm when the rows are 0.75cm apart (Du Plessis 2003.). They use a high plant density for dryland.
- The intra-row distance for peanuts is 50cm.
- The intra-row distance for Bambara is 60cm.
- Maize and pumpkin are planted 15cm apart

The number of different farming systems listed show how each has been adapted to the individual needs, fields and climate. Collaboration between research and farmers to evaluate the most common systems, might lead to some improvements in yield. This should be done by using the principles of Participatory Technology development.

Seed Practices

Farmers and Genetic Resources

It is increasingly recognised that farmers play a crucial role in the conservation and management of genetic and other natural resources. These methods are generally also seen as more environmentally friendly than many Western-based models of agriculture (GRAIN 1992:7). By promoting the use of these plants, conservation of local varieties is promoted. This will ensure that the local varieties also keep up with the changing agricultural and socio-economic needs and continue to evolve, thus retaining their value (GRAIN 1992:11, Mooney 1992:132).

Weedy and wild relatives of crops often grow in wider ecological conditions than their cultivated relatives. This is achieved with the wide range of genes that enable them to survive these harsh ecological extremes. Plant breeders and farmers have been using these genes to their advantage for generations, thus improving the crops (Montecinos & Altieri 1992:107). These genetic resources have

the potential to address agricultural, technological and medical problems (Kiambi & Opole 1992:57, Mooney 1992:132).

Of course one needs to take cognisance that the increasing need for housing and food can result in increased pressure on the environment and the depletion of natural resources in the future, even in those areas currently rich in natural resources. However, these threats, along with climate change and the HIV/Aids pandemic are likely to be most significantly felt in marginal areas where the natural resource base is already under threat. To some extent the villages of Molati and Berlyn are in such an area as rainfall and water are already problems along with soil erosion and insufficient natural forage for livestock during winter. Residents have noted the decline in available African Vegetable species in terms of types and quantity of those that are still available.

In other parts of Africa the awareness-raising of traditional crops and trees helped to pass on knowledge to wider groups of people through training and training programmes (Kiambi & Opole 1992:59).
Traditional conservation systems have eroded due to (GRAIN 1992:11):

- Erosion of cultural systems.
- Erosion of genetic diversity.
- Greater demand on farming systems due to:
  - Rural population growth;
  - Expanding urban population.
  - Forces outside the small scale farmers' control such as markets and national policies.
- Political instability, such as armed conflict, and natural disasters also erode conservation systems.

Loss of indigenous knowledge is also attributed to these factors, illustrating the close link between the plant use, conservation and associated knowledge.

Genetic Resources in Molati and Berlyn

The seed systems in both the communities are not very functional, as mainly the older people store seeds. Some members mentioned their concern about the loss of seeds of traditional lines. They state that only a few younger women are interested in seed systems. Interviewing some younger women confirmed this fact, as they mostly buy their seeds. The crops they plant and the areas are not as large as those of the older women. More young women than men have off-farm jobs, also accounting for some of the increased food buying practices instead of local production.

Exotic vegetable seeds are usually bought, as they do not know how to harvest and store these seeds. Maize, cowpeas and cucurbit seeds are the easiest to store and are commonly stored by most of the women. Where seed does not survive or have been lost due to damage, neighbours tend to help with the supply of pumpkin seeds. Maize and cowpea seeds that have been lost must be bought. Watermelon, Marhanga (calabash) and Mariwa seeds are not sold, and the women find these the most difficult ones to keep. Should seeds get lost, a neighbour can sometimes help with seeds, but due to the dying practice of seed storage, this is becoming a concern.

Table 9: Seed sources in Mulati and Berlyn:

Crop seed	Seed bought	Seed kept	Seed exchanged
Tinyawa (cowpea)	Many older women buy	Age 40+, many keep	Age group 40+, many exchange
Mavele (maize)	Age group 40+, many buy	Age group 40+, many keep	Age group 40+, many exchange
Rirhudzu (*Cleome gynandra*)	No	No	Few older women will collect and spread
Guxe (*Corchorus* spp.)	No	No	Few older women will collect and spread
Nkaka (*Momordica balsamina*)	No	One old women stores	Many old women exchange
Tindluwa (bambara)	Age group 40+, few buy	One older woman keeps	One older woman exchanges
Makalavatla (watermelon)	One older women buys fruit, keeps seeds	Few older women keep	Old women exchange
Marhorho (sorghum)		One inyanga keeps	One inyanga exchanges
Timanga (peanuts)	Age group 40+, many buy	Few old women keep	One inyanga exchanges
Tinwembe (Cucurbits)	No	Age group 40+, almost all keep	Age group 40+, many exchange
Phuphuruka (kale)	Age group 40+, few buy	Age group 40+, many keep	Age group 40+, many exchange
Mandhanda (Okra)	No	Age group 40+, many keep	Age group 40+, many exchange
Mariwa	No	Few older women store	Old women exchange
Marhanga (calabash)	No	Few older women store	Old women exchange
Matimba (Local sugarcane)	No	Old women store	Old women exchange
Swikwembyana (Butternut)	One old woman buys	No	No
Green pepper	One old women buys	No	No
Mukhwariba	Old women buy	Old women store	Old women exchange
Onions	Few older women buy	No	No
Swikwaribani	Few buy	No	No
Mphoho	No	One inyanga keeps	One inyanga exchanges
Cabbage	Age group 40+, many buy	No	No
Spinach	Age group 40+, many buy	No	No
Beetroot	Age group 40+, many buy	One younger women keeps	One younger woman exchanges
Tomatoes	Age group 40+, few buy	No	No
Carrots	Age group 40+, many buy	No	No

Cowpea varieties are readily bought, sold and exchanged by most age groups. Generally no problems are experienced, except if no precaution is taken against insects. The seeds are constantly attacked by small beetles which can cause huge damage to the seeds, making them unsuitable for planting.

Pumpkin seeds are commonly kept by all age groups, and exchanging seeds with family and neighbours is common. Women do not experience problems with the storage of these seeds, as they are easily cleaned and stored. After two months fruit become hard and they are kept for seed.

Maize seed is commonly kept by all age groups, and seems to be the most important crop to be planted by most villagers. Women over 40 years of age prefer the taste of the flour that they have pounded themselves, but they comment that the younger generation prefer to buy the maize porridge from local shops and supermarkets with the money obtained from the child grants.

Some women have established seed systems for Phuphuruka (Kale). These women find it easy to harvest and store seeds from plants they have, and they can harvest seeds effectively from this source for years. Not everybody knows how to store the seeds. It was identified by some as a plant which they do not know how to keep the seeds but would like to learn.

Bambara nuts are not as popular as they were before peanuts were introduced, and this is reflected in the production decline and seed storage of this crop. Only a few women still plant it, thus the demand for seed is low. The crop is sold commercially, and the few women who use the crop only keep a few seeds. Peanuts are replacing this crop as they are more versatile. Some peanut varieties from Zimbabwe have been introduced in recent years. There were several requests for receiving information on the effective storage of peanuts. However, many women can already store the seeds effectively. Therefore farmer to farmer knowledge exchange should be facilitated.

Once the Mandhanda (okra) fruit start to dry they are kept for seed. The seeds can not be bought, but there is an active seed system in both communities due to the popularity of the crop. The leaves are well liked and most women keep seeds and exchange them. The seeds are easy to harvest and store. Some women keep a plant growing right through winter by planting it close to a water source. This keeps the seedbank (seeds present on and in the soil) in the area stocked with naturally spread seeds that will grow after the first rain.

Makalavatla (watermelon) can be bought and the seeds from the fruit can be used to add to their seeds. If they have lost their seeds, buying a watermelon overcomes the problem.

Nkaka (*Momordica* sp.) is generally not kept as seed, but there are several systems to ensure that the plant survives in their gardens. Fruit that are not harvested when green will become ripe and fall close to where the plant is currently growing. Some of these seeds survive to ensure a next crop. Sometimes the seed is removed from the ripe fruit and just informally spread along the area they want it to grow. Few women collect and keep the seeds and plant it the next season. Some place a barrel or thorn branches over the plant during winter to ensure that livestock do not eat the plant. These plants survive through the winter.

Most of the women do not broadcast seeds of the African leafy vegetables. If the plant does not grow in their garden some women collect seeds from neighbouring plots to spread in the areas they want it to grow.

Carrot, tomato, beetroot, onions, green pepper, cabbage, chilli, gem squash, butternut and spinach seeds are generally bought. Some of these crops can be harvested for seed, but the correct timing and storage methods are vital and were not always known locally.

Storage and Drying of Seeds

Drying of seeds in the villages takes a number of forms. Most commonly seeds are harvested when still raw and are then dried in the sun for three or four days, sometimes this can take longer. Another common method, highly dependent on the crop, is that the seed pods are left on the plant to dry until such time as the pods are ready to burst open. The pods are removed and the seeds are gathered. If not dry enough then the seeds are placed in the sun for a couple of days and then stored, otherwise they are stored without further drying.

Table 9: The different storage methods of seeds as described by the various key informants in Mulati and Berlyn

Crop	Different storage methods
Tinyawa (cowpea)	• Collect seeds, store with wood ash in bottle. • Seed are dried in the sun for 3-4 days. They are placed in a bottle and the lid is closed tightly. Seed are kept for 2-3 years. Can keep the seeds as long as they look good/ healthy. • Seed are kept in a tightly closed bottle to which a few drops of paraffin are added. Seed keep for two years. • Place maize, pumpkin and cowpea seeds together in a tightly closed plastic container after adding wood ash. Some add a few drops of paraffin. Keeps for 3 years. • Mix the cowpea and maize seeds together and place in a tightly closed bottle or plastic container. Add wood ash or a few drops of paraffin to the seeds to keep insects out. Keep seeds for 2 years. • Tinyawa (cowpeas) and Mavele (maize) seeds are stored together in a clay pot with some wood ash. Kraal manure and mud are mixed to seal the lid to the pot, and will be broken open when it rains • Harvest dry pods, peel, store seeds in closed bottle with wood ash

Crop	Different storage methods
	added. Keep for a season.
Tinhwembe (Cucurbits)	• Collect seeds, store with wood ash in bottle. Keep for 10 years if bottle is closed tight. • Seed are dried in the sun for 3-4 days. They are placed in a bottle and the lid is closed tightly. Seed are kept for 2-3 years. Can keep the seeds as long as they look good/ healthy. • Seed are kept in a plastic container. Wood ash is added. The seeds keep for two years. • Place maize, pumpkin and cowpea seeds together in a tightly closed plastic/ glass container after adding wood ash (some add a few drops of paraffin). Keeps for 3 years. • Place seeds in a tightly closed bottle to which wood ash has been added. Keep seeds for 2 years. • Remove the seeds from the fruit. Clean the seeds and place in the sun to dry.
Mandhanda (okra)	• Collect seeds, store with wood ash in bottle. Keep for 10 years if bottle is closed tight. • Seed are dried in the sun for 3-4 days. They are placed in a bottle and the lid is closed tightly. Seed are kept for 2-3 years. Can keep the seeds as long as they look good/ healthy. Mixes beetroot and Mandhanda seeds due to space, she separates them when she wants to plant (easily distinguished). • Store mixed seeds (Phuphuruka, Mandhanda, Mukwariba) in a plastic bag, nothing added. Can keep for two years. • Place seeds in a tightly closed plastic/glass container after adding wood ash. Keeps for 3 years. • Mandhanda, Phuphuruka and Marhanga seeds are placed into a tightly closed bottle. Keep seeds for 2 years.
Mavele (maize)	• Collect seeds, store with wood ash in bottle. Has no shelf life, prefer to buy and plant when rains. • Seed can be kept for one year. They are placed in a 5 litre container for storage. Nothing is added. • Keep seeds in a 20 litre plastic water container with a few drops of paraffin added. Seeds can be kept for 3-4 years. • Store mixed seeds (Tinyawa/ cowpea, Tinhwembe/ pumpkins, Mavele/ maize) in a plastic container, add some wood ash or a few drops of paraffin. Keeps for 3 years. • Mix the cowpea and maize seeds together and place in a tightly closed bottle or plastic container. Add wood ash or a few drops of paraffin to the seeds to keep insects out. Keep seeds for 2 years. • Tinyawa (cowpeas) and Mavele (maize) seeds are stored together in a clay pot with some wood ash. Kraal manure and mud are mixed to seal the lid to the pot, and will be broken open when it rains and time for planting.
Mariwa	• Collect seeds, store with wood ash in bottle.
Swikwembyana	• Collect seeds; keep in tightly closed bottle to which wood ash has been added. Can keep for 2 years. • Seed are dried in the sun for 3-4 days. They are placed in a bottle and the lid is closed tightly. Seed are kept for 2-3 years. Can keep the seeds as long as they look good/ healthy.
Tindluwa (Bambara nuts)	• Collect seeds, keep in tightly closed bottle. Can keep for 2 years.
Makalavatla (watermelon)	• Collect seeds; keep in tightly closed bottle to which wood ash has been added. Can keep for 2 years.
Marhanga (calabash)	• Collect seeds; keep in tightly closed bottle/plastic container to which wood ash has been added. Can keep for 2 years. • Mandhanda, Phuphuruka and Marhanga seeds are placed into a tightly closed bottle. Keep seeds for 2 years.
Timanga (peanuts)	• Seed are kept in a 20 litre water container with nothing added and can be kept for two years. • Store seeds in a plastic container, can store for 4 years.
Phuphuruka (kale)	• Seed are dried in the sun for 3-4 days. They are placed in a bottle and the lid is closed tightly. Some add wood ash, some don't. Seed are kept for 2-3 years. Can keep the seeds as long as they look good/ healthy up

Crop	Different storage methods
	to 2 years. • Store mixed seeds (Phuphuruka, Mandhanda, Mukwariba) in a plastic bag, nothing added. Can keep for two years. • Mandhanda, Phuphuruka and Marhanga seeds are placed into a tightly closed bottle. Keep seeds for 2 years.
Beetroot	• Seeds are dried in the sun for 3-4 days. They are placed in a bottle and the lid is closed tightly. Seed are kept for 2-3 years. Can keep the seeds as long as they look good/ healthy. Mixes beetroot and Mandhanda seeds to save space and she separates them when time to plant (easily distinguishable).
Matimba (local sugarcane)	• Seeds are kept in a tightly closed glass bottle with nothing added. Some do add wood ash. Seed keep for two years. • Keep stalk with seeds under the thatch roof outside. Keeps for 3 years.
Mukwariba	• Seeds are kept in a tightly closed glass bottle with nothing added. Seed kept for two to three years. • Store mixed seeds (Phuphuruka, Mandhanda, Mukwariba) in a plastic bag, nothing added. Can keep for two years.
Dried beans and peas	• Keep dried beans and peas in the same tightly closed bottle. Nothing is added. The seeds are separated once she wants to plant. Seed can keep for three years.
Mphoho	• Place seeds separately in a tightly closed bottle. Keeps for 3 years.
Marhorho / sorghum	• Keep stalk with seeds under the thatch roof outside. Keeps for 3 years.
Nkaka (*Momordica* sp.)	• When the fruit become red, they open it and take the seeds out, clean it, put it in the sun, place it in a bottle and add wood ash. Close and keep for two seasons or the seeds become damaged.

Seeds are not sold, but many are exchanged or given away to friends and family, especially if they have lost their supply. This occasionally happens. Neighbours sometimes help the Inyanga to collect seeds, with her giving them the seeds she has not used.

The containers used by the women vary considerably. Some prefer not to use plastic containers as the rodents damage the containers and gain access to the seeds. This was seen in some households, where rodents had almost eaten through the caps. Many use glass bottles or tins. Some use plastic bags, but this practice is limited as the possibilities of damage are very high. One lady uses a clay pot in which she places her maize, cowpea and soetriet seeds, and then seals it with mud. Her daughters are not interested as they find the method old-fashioned.

Many women add wood ash to the seeds. The use of a few drops of paraffin in a container, and the use of naphthalene (mothballs) has also been noted as the practice of individuals. The lady using the naphthalene has seen this practice elsewhere, and she states that this works better than wood ash and seeds can be used for up to three years.

Many easily identifiable seeds are stored together to help save storage space. The seeds are separated when planting starts. This practice enables storage of seeds in the house, thus the constant human activity keeps most insects and rodents at bay.

Areas for Research Support on Seed Systems

Community members requested assistance with the following seed storage information needs:

- Timanga (peanuts) (younger women)
- Tindluwa (Bambara) (younger women)
- Cabbage, (older women)
- Green pepper, (older women)
- Beetroot, (all age groups)
- Onions (older women)
- Spinach (older women)
- Carrots (older women),
- Tomatoes (older women)
- Phuphuruka (kale) (older woman)

It was found that much of the seed system information already exists in the villages, but there seems to be very little sharing of information amongst the women. Only one interviewee reported successfully harvesting and storing beetroot seeds. She does exchange beetroot seeds with other community members and plays a leadership role in the Molati community garden. Not sharing her knowledge about exotic seed storage seems to enhance her position of power within the vegetable garden group. This should be considered when transferring seed storage information to the community.

Some of the exotic seeds can be stored effectively, while hybrids varieties, including some maize varieties, need to be bought. Generally no knowledge of seed systems for the exotic vegetables is known in either village. These vegetables are quite new to the area, and little local knowledge has developed for these crops. This is exacerbated by the water constraints and the result that most farmers cannot plant at home and experiment with these crops. The distinction between these different sources of seed, how and when they can be harvested, cleaned and stored, can be transferred from genebank divisions of the science councils and universities. Seed hygiene is an important aspect that needs to be addressed.
The establishment of an effective nursery of key crops on small scale might help many subsistence households to increase their access to healthy and nutritional plants.

Only a few women collect seeds of Thyeke (amaranth), Guxe (*Corchorus*), Rirhudzu (*Cleome gynandra*), Muxiji (*Bidens pilosa*), Vilolo (*Talinum* sp), Nkeketi (*Convolvulus farinosus*), Risanya (unidentified), Ngwelani (unidentified), Muphywe (unidentified), Gumbu-gumbu (*Sonchus oleraceus*) and Xiyakayana (*Cucumis anguria*). When the plants are not growing in areas where they are wanted, then the women might collect some seeds from plants in other areas and broadcast them in their plots. This practice does, however, cause them to forfeit the first harvest after the rain, as they have to wait for the crop to seed before they can collect seeds. The next crop tends to flower faster due to the days getting shorter, thus also limiting the effective harvesting period for the different crops. Assisting local residents to effectively harvest and store small quantities of their preferred plants will help prevent this loss of yield.

One of the ladies mentioned being able to store cucurbit seeds for up to 10 years. Research has shown that the germination rate of the seeds rapidly declines after the third year, thus causing loss of potential yield due to non-emergence of the seeds. Optimal times of storage for these seeds need to be known by the keepers of seeds in order for them gather more for seed purposes so that yield can remain constant.

Usually no selection is done before seeds are stored. Seeds are only selected before they are planted as only undamaged or slightly damaged seed is used. Selection of plants or fruits before the harvesting of seeds could help to improve the quality of the seeds for the next generation. Discussions around these issues could help re-establish the selection process that has been lost in these communities. One woman mentioned that she did select certain maize kernels for storage because of their better appearance.

One of the ladies uses naphthalene to help protect her seeds against insect damage. The use of this product is unknown, and both the possible positive and negative effects of it are also unknown. Communication with genebanks in various counties (Kenya, Tanzania, Uganda, Mali, Senegal, South Africa) and institutions (AVRDC, ARC, NARS) has not delivered any results. Internet searches have shown naphthalene to be toxic (prevents insect damage) but also carcinogenic. As long as the seed is not consumed this should not be a problem. The effect of the naphthalene on the germination of the seed has not been tested, and the lady who uses the method has not used it for very long. So far she has not seen any effects on the germination rates. Some woods and tobacco that is burnt, also release naphthalene, thus making them good sources of insect repellents. The concentration of the naphthalene in these products are, however, not so effective. Research needs to be done on the long-term effects that storage of seeds with naphthalene has on the germination rates and health of the consumer. Care must be taken that none of the seeds stored in this way should ever be used as food, as frequently happens with cowpea and peanuts. The use of paraffin is also an unknown, and research on the effect of this on seeds needs to be done.

Peanuts are taking over from Bambara nuts in preference, and several women have asked for information on effective storage of the seeds. The use of paraffin and naphthalene for the storage of these seeds with some of the women raises some concern, as the seeds from this is sometimes used as a snack during the long winter months. The effect of these chemicals on the seeds and the safety concerned with the eating of seeds stored together with these chemicals is unknown. Research needs to be done on these aspects.

Promoting seed systems by having a seed fair could help promote the practice of seed storage, but will also enable information exchange between the community members on systems that already work. Alternative methods and new methods can be introduced in an informal way through the research and genebank groups. This seed fair would also help raise the awareness about the importance of seed systems, and the role it has to play in the future of food crops in terms of genetic resources. Improving the status of the practice may also encourage younger people to become interested.

Rituals and Taboos

Introduction

At some level it might be considered Eurocentric to include rituals and taboos in the study. We do so out of necessity as most of the producers and those most knowledgeable about African vegetables are elderly women who still practice various rituals and obey taboos to a large extent. This is even when they are unwilling or unable to divulge the purpose of a particular taboo or ritual. Any future agricultural research and development in the villages will need to work with these women so it is significant for these purposes that some of the rituals and taboos are mentioned and where possible explained. Presently, extension officers and training consultants are working in two agricultural projects in the villages. These are focused on the introduction and production of exotic vegetables and generally we noted that there are no evident taboos associated with these crops. Attempts to work with farmers in enhancing current practices related to traditional crops would require an awareness of rituals and taboos to ensure that collaboration can be achieved and knowledge shared. Awareness and respect are good manners. As mentioned earlier the social aspects of agricultural practices cannot be ignored and nor should they be separated from the technical aspects. They are what make the knowledge system effective. As we point out there are often good reasons why taboos are adhered to and why rituals are practised. However, it is also evident that the younger generation is unwilling to follow these for a number of reasons, largely due to changing social circumstances.

It is extremely difficult, and to a large degree probably unnecessary, to define what is meant by the term ritual. Similarly it is problematic to distinguish it neatly from a ceremony on one hand and from practical action on the other. Various anthropologists have attempted to regard it as a form of behaviour, a ceremony characterised by its spiritual/religious purpose (Seymour-Smith 1990). It intertwines and relates physiological and psychological realities to abstract principles and social relationships in complex ways. This seems to be the way in which rituals relating to agriculture were construed in the village. However, some anthropologists have suggested that it is a means of stressing authority between various groups in society such as men and women and elders and the youth, as the practice of rituals prevent original responses thereby ensuring conformity (Seymour-Smith 1990). Given the youths' general rejection or at least avoidance of both rituals and taboos in the villages this does not seem to be the case with rituals relating to agriculture.

Taboo is somewhat easier to define as it covers a wide variety of local ritual avoidances and prohibitions related to the symbolic and socio-cultural context in which they occur. Amongst others, taboos can include the prohibition of eating certain foods at all times or at specific times and the avoidance of certain people or certain practices during certain times. In the two villages practices considered taboos in agriculture were prohibitions. What follows now is a list of some of the agricultural related rituals and taboos that were discussed during the study.

Agricultural Rituals

According to local women rituals were largely practiced to ensure that the crops would grow well during the season and where necessary they would harvest enough to enable not only sufficient food but also seeds for the next season. Prior to planting a beer was made from maize meal and poured on the ground at the ancestral shrine. If it is not possible to make a beer then snuff is placed on the ancestral shrine. Although the ritual evolves around the planting and harvesting of maize it is done to ensure that all crops, not exclusively the maize, will be blessed by the ancestors and will produce a good yield. This will ensure sufficient food for the household and other people in the villages. When the maize crop is ready to be harvested the women pick the best ears of corn and make a beer using these ears of corn. This is done by soaking the maize kernels overnight, grinding them and mixing with fresh water. This is then poured on the

ground at the ancestral shrine to thank the ancestors for giving them a harvest. The ancestors are called by name to come and enjoy the offering. Praises will be said to the ancestors (*ku phahla*) and they will be thanked for the good yield the household has received. Those present clap their hands as the speaker is talking to the ancestors because not everybody can communicate with the ancestors. Usually this person is an elder such as an aunt or uncle. After this ritual they go back to the fields and start to harvest for themselves. After harvesting they pick good looking produce (healthy looking, no spots no rotten produce) from the fields for them to keep seed for the next season. Households practice this ritual individually.

Strong practitioners of the Christian faith might not practice this ritual but will pray to God before planting to ask for a good harvest. Prior to harvesting they will again pray to God, giving thanks for the harvest. Some of the elder people mix the practices in the sense that although they might be Christians they still make offerings to the ancestors for agricultural and other purposes. However, younger residents mentioned that they typically practised Christian rituals.

A beer made from Marula fruit is a popular and traditional beverage made and consumed during late January and early February each year. There is still a ritual performed regarding the Marula beer. December is usually the month in which Marula fruit starts to ripen. Local people start collecting Marula fruit in late December early January. They only collect the fruit that falls from the tree. They do not pick the fruit off the tree. Once the fruit has fallen from the tree this indicates that it is ready to be brewed. If the fruit is still attached to the tree (its mother) this indicates that it is not yet suitable for brewing. By early January people start to collect as many Marula fruit as possible. These are stored until they have all turned yellow. The yellow colour indicates that the Marula fruit is ripe. While the fruit is still green in colour the outer layer is hard because it is unripe. They use a fork to open the Marula fruit and take out the pip. If the fruit is green then it is difficult to penetrate the fruit and remove the pip with a fork.

Marula fruit are stored in a bath bowl and when the time is ripe (fruit are yellow) water is poured into it and the fruit are rinsed. The Marula are pricked with the fork and the hard pip is removed and placed into a 20 –25 L bucket of water. They do this until the bucket is full of Marula pips. They take a porridge ladle and stir the pips hard until they turn white and do not have any flesh on them. The pip produces its own sap. After that they use both hands to squeeze the pip until it no longer produces a sap. The pip is now thrown away and all that is left in the bucket is the liquid from the Marula pips. Clean water is added to this liquid and they are mixed together. They pour the liquid into a bucket and close the lid securely. The liquid ferments and produces the froth which the lady removes regularly. When the beer is ready they take a cup, scoop up some Marula beer and go to the household's ancestral shrine. Here an elder pours out the beer while calling and talking to the ancestors about the beer. The beer for the ancestors is the same as that consumed by the household. By doing this they tell the ancestors that now is the time to drink the harvest of the Marula beer. As a sign of respect the ancestors 'drink' the beer before other members of the household. If one household has Marula beer before another, members of the latter may not drink that beer until they have given some of their household's beer to the ancestors. This offering ensures that none of the household members are going to clash with their ancestors. Local people got the knowledge of making beer from their ancestors and must therefore show them respect. The ancestors are very important because if they do not tell them about the Marula beer and allow them to drink first the ancestors can cause trouble in the family. Sometimes you might find that family members are fighting one another for no apparent reason. Or you might find that there is an illness. These can symbolise dissatisfaction on the part of the ancestors and they will need to be appeased. Thus to prevent this ancestors must be remembered at certain times.

A number of other rituals were observed but because they have no direct or indirect relationship to agricultural activities, food consumption and African vegetables they are not recorded here.

Agricultural Taboos

A number of prohibitions relating to agricultural activities and food consumption were identified and are recorded here. These taboos have different purposes but overall the main common purpose was to ensure that crops, and in particular African vegetables, grew optimally. A few were directly related to the health of female village residents. Ignoring taboos is said to have a negative influence on agricultural productivity. Avoiding prohibitions might help in attaining desired yields for the whole family or community concerned. If one obeys the prohibitions the agricultural productivity is going to be better and all parties concerned will be in a better situation. Taboos must also be regularly respected for the agricultural productivity to improve year after year.

Villagers are prohibited from ploughing immediately after the first summer rains. This is to ensure that the crop residues and where manure has been spread are given time to decompose, allowing nutrients to be worked into the soil when they do plough. This illustrates knowledge of soil fertilisation principles. If this prohibition is not adhered to then the resulting harvest will be small and unsatisfactory to the detriment of the household and the village at large.

In the villages Bambara nuts are planted at a specific time (usually January) and if they are planted before or after this specific time then there will be poor rainfall. It is therefore taboo to plant outside of this time. Doing so will affect all the crops giving the villages a poor harvest. By not respecting a taboo people are seen as being selfish.

One villager informed us that nobody is allowed to walk over the plants, especially the African vegetable crops, in the plots. This especially applies if the person is an outsider to the village or from another house or family because it is not known where they slept the previous night (referring to both women and men) or in the case of women if they are menstruating. There are paths around the plots for them to walk on. If they go into the field they must walk in between the plants and not over them. If a person is aware that they are 'unclean' they must refrain from going into the plot or field. Only the owner has the right to enter the field. Failure to adhere to this prohibition is that the crops will get 'burnt' by the person's uncleanliness and the entire family will starve as a result of poor or no yield.

Women who are menstruating or are breastfeeding are considered to be unclean or 'hot'. This heat and 'dirtiness' can 'burn' or contaminate the African vegetables resulting in a poor harvest. Consequently, menstruating women are prohibited from working in the garden or field for the days that they are menstruating or 'on the moon', as it is referred to locally. Breastfeeding women are prohibited from working in the gardens for two months. Once she feels ready to enter the garden she must mix some of her breastmilk with garden soil and cast it into the garden. This will counteract her 'dangerous state' and enable her to work in the garden without negatively affecting the plants. If a menstruating woman wishes to enter the garden she must mix some of her urine with soil and then scatter this in the garden. If a woman has had a miscarriage she is expected to stay away from the garden for at least a month. After this period has lapsed and if she feels able to resume work in the garden she must urinate in the soil and scatter this on the garden. If a woman lives on her own and must attend to the garden single handed then she will mix her breastmilk or urine with the soil and scatter it after only a week or two. The gardens or fields of women with families will be tended by other female family members. Discussion around these taboos relating to 'uncleanliness' quickly identified that one purpose of the prohibition to enter the garden was for the health of the women. During the stages described above they are considered to be weak and unhealthy, therefore they need to rest and regain their health during these periods before they can resume normal chores.

The younger generation tend to question the relevance of the taboos in the current day. They argue that if a single woman cannot go inter her garden because she is menstruating then she will starve. The young women we interviewed reported that disobeying these taboos did not affect the crops or the harvest. As an elder woman noted the youth are exposed to many things and question everything. In her day she said this was not possible because things were different and one obeyed the elders without question.

One elder woman said that she and some other women were able to counteract the effects of male and female 'uncleanliness'. According to her, the broadcasting of synthetic fertiliser, specifically SASOL 2:3:4 (30) + Zn 5grms/kg, before ploughing counteracted the negative effect of the state of 'uncleanliness'. This fertiliser provided the plants with extra strength which was able to resist the impurities that resulted in men or women being unclean or weak. The fertiliser prevents the transference of 'uncleanliness' and weakness to the plants and their growth was not negatively affected. Strangers could walk in the garden and pregnant and menstruating women could now work in the garden. It is interesting to note how a scientifically developed product has been incorporated into the belief system in order to neutralise the negative effects associated with not obeying local prohibitions.

When Miroho is eaten it must be allowed to cool down after cooking before being consumed. It is said that if one burns their mouth on hot Miroho the other African vegetable plants in the gardens will feel the person's pain and will be afflicted by this. Consequently, they will wither as a result of the heat and the pain. The result is either a poor crop or the complete loss of the remainder of the crop.

Pigeons may not be eaten by girls of childbearing age who have not yet had a baby, as this can cause the loss of milk when their time comes to breastfeed. Residents could not explain the meaning or purpose of this taboo.

While some taboos had clear purpose to the villagers others did not. They simply followed these avoidances as this was what they had been told when they were young. The modern youth on the other hand tended to question a number of rituals and practices suggesting that while they might have been practical in previous years they were no longer practical in current times. Despite this a few rituals and taboos are strictly practised by elder residents and this needs to be noted by outsiders engaging with them.

Economic significance of African Vegetables

Other Research Findings in South Africa

Campbell (1986) and Shackleton et al., (2000) identified that there is a greater reliance on wild foods during drought periods because arable exotic crop production has either failed or decreased substantially. Use of wild resources is often a safety net in times of misfortune or poverty. In times of unemployment or when the breadwinner is or deceased people use more of the wild resources than when the breadwinner is employed (Hunter and Twine 2005).

Dovie, Shackleton and Witkowski (2002) found that the average household in Thorndale (a village in Bushbuckridge) consumed 0.22 ±0.028kg edible herbs/African leafy vegetables (ALVs) per day. Over 90% of households harvested edible herbs, with women being the main harvesters. Most of the ALVs were harvested in farmers' fields and disturbed sites around the homestead. More than 60% of the respondents in the study perceived a decline in ALVs in the area. Fuelwood and ALVs were found to be the most important natural resources in the area.

High and Schackleton (2000) conducted a survey in a village in the Bushbuckridge area in Mphumalanga. During this study they looked at the comparative financial evaluation of wild plant resources (read African leafy vegetables / morogo) harvested from home gardens and arable plots. The average value of morogo per home garden was R626 ±R516. The total mean value of the morogo consumed was R517 ± R492. The mean total value of morogo sold per household was R109 ± R256. A per hectare value of between R990 and R1580 for wild plants compared favourably with the domestic plant value of R2200-R3580 per hectare per year. This study highlights the direct (sales) and indirect (savings by not having to buy) financial implications of wild plants in the rural areas.

A study done in 2 villages in Limpopo Province and one village in KwaZulu-Natal highlighted the differences between the uses of edible herbs in these three villages. This was ascribed to the types of food available in the villages. The village that consumed the lowest amount of edible herbs per person also had access to fish and ilala palm that is not available to the other villages (Shackleton, Shackleton, Netshiluvhi, Geach, Balance & Fairbanks 2002). This highlights the inability of researchers to draw a general picture on the use of African vegetables across South Africa.

Sales of African Leafy Vegetables in the Study Area

Molati and Berlyn villagers regard dried African leafy vegetables as a very important part of their diet in the six (6) months of May to October – depending on rainfall patterns - when fresh food is not available. They have to buy exotic vegetables if they do not have enough dried Miroho, and they usually buy cabbage. If they do not have to buy cabbage because they have enough Miroho, they then use the money to buy other food such as chicken, bread, etc. or they save the money for other expenses. They say they eat better if they have dried Miroho.

Some African Vegetables are sold in the nearby towns of Letsitele and Nkowankowa. Sales are conducted at the taxi ranks or other large public places. Guxe (Corchorus) and Thyeke (Amaranth) were the main African Vegetables sold in these towns. However, we did notice Tinhwembe leaves and okra pods (Mandhanda) being sold on a few occasions. While these vegetables are generally sold fresh in bags, some informants reported that out of season one might occasionally come across dried African

Vegetables. Like the fresh produce these are normally sold to urban residents who do not access to them in their gardens.

The Letsitele informal market area has a few vendors that sell African vegetables. One woman was selling pumpkin leaves (R3 a bunch) and flowers (R1 a handful), Muxiji leaves (R3 a bag), and ground peanuts at R2 for a small bag (small sandwich bag size) daily. Sometimes green okra pods are sold at R3 for a one-kilogram bag. The other woman sold a big bunch of pumpkin leaves and flowers for R5. She sells pumpkins and cowpea. In winter the vendors sell exotic vegetables. They did not want to share their marketing chain with us, as they were scared of competition. The pumpkins seem to have originated at a farmer who has better access to water.

Two customers at the Letsitele market provided the following information:

- They come to Letsitele from Nkowankowa, as the vegetables are much cheaper
- In Nkowankowa small amounts are being sold for high prices
- They are happy with the quality but would like to have more variety than is available

One woman was selling ALVs next to the Nkowankowa police station in October 2006. She was the only African vegetable vendor in the area. She sells pumpkin leaves and flowers together (R3/ bundle), Guxe (Corchorus) for R3/ 1 litre (double handful), spinach (R3/ bundle), kale (R3/ bundle) and peeled peanuts. In January and February she sells kale and spinach. She was vague about her source of plants. She keeps most of her stock in huge blue plastic bags that she keeps closed to ensure they stay fresh. Her displayed produce look very attractive.

There are 18 stalls at the Nkowankowa taxi rank. Five out of the eighteen stalls sell ALVs. The prices throughout the market are the same for the produce. The sizes are smaller, but not enough to warrant the cost of especially driving to Letsitele to buy. The prices do not fluctuate over the season. One woman had a tub of water in which the produce was kept and she was almost sold out because her produce still looked fresh. Only one person had produce that was not looking good, and she was not selling anything. It looked like yesterday's leaves that are being sold today. There is evidence that buyers are critical of the produce, and the freshest looking ones are sold first. Pumpkin leaves and flowers are sold for R3/ bundle. All stalls had this and it was the most popular product. Most of the stalls sold Guxe at R3/ double handful. One stall sold red amaranth at R3/ 2 litre compressed leaves size. Tinyawa (cowpeas) are sold when available. Some stallholders cannot find Cleome and would sell it if available. One stallholder said she sells pumpkin, cleome, Muxiji (*Bidens pilosa*) and amaranth in the summer time. She sells spinach and Mukwariba in winter. Powdered peanuts cost R4/ 1.5 cup. Only one stall holder sold pumpkin flowers separately at R2/ handful. Only one lady sells Nkaka when available. If the plants do not sell rotting might become a problem due to the sun and the heat. Keeping the plants in water does help to improve their shelf life, but this facility is not always available.

Trade on pension day in the two villages is very active. The same merchants trek from one pension payout point to the next throughout the villages in the area during the course of the day. There are a few who are specific to only the one point (some locals). Most vendors are from outside the community and have bakkies with which they transport their products. Maize seeds are sold, both traditional (R20/ 4 litre container) and pesticide treated (red colour) bought seeds. Peanuts are sold peeled and unpeeled, the peeled in plastic bags (R10/ +- 300g) and the unpeeled loose or in bags (R20/ 2 litre container). Tomatoes are R5 for about 2kg. Some are packaged, others are in crates and packaged on site. Many women like the ones in crates, as they say the handling (from one point to the next) between the pension points damage the pre-packed tomatoes more. They are all a mix between red and green tomatoes. Many are the jam tomatoes (oval in shape), with some of them small and round. The quality varies with it ranging from not so good to excellent. One vendor told us that she buys ZZ2 boxes that she then repacks. Dry beans are sold for R10 / 2kg. Butternut is R16 for about 10 medium sized fruit. Few vendors sold pumpkins or squash. Some local vendors sold Tinhwembe at the price of R5/2 litre compressed leaves.

All three areas of sale show that selling of African vegetables can be profitable, but in most cases transport is needed. Shelf life of fresh produce is a problem and waste can be high if there is a lot of competition. The market for African vegetables need to be studied to identify the best vegetables, prices, location and presentation method. When compared to other crops, the profit margin on African vegetables is low, and the status of the crops needs to be raised to help increase the prices. When compared to cabbage that sells at R5 per head, the pumpkins are inexpensive. By popularising the crops the prices will also increase.

There is some concern about the effect of changing African vegetables from a household crop to a cash crop. Several cases (personal communication during several conferences and experience in East Africa) have shown that men take over cash crops, thus leaving women with fewer crops available for their home gardens. Women would probably lose the small amount of money they do make from sales of these crops. Higher prices and the development of less tolerant and adaptable varieties could remove them as a ready source of food from rural households. Research in this area is already being undertaken by the ARC – Roodeplaat with funding from the Department of Agriculture (Naidoo 2006).

Areas for Potential Collaboration of the Two Knowledge Systems

One of the primary purposes of this study was to look at how indigenous knowledge and scientific knowledge relating to agricultural production could integrate in order to optimise the two knowledge systems so that the local situation with regard to poverty can be improved. Official agricultural activities generally and also in the study area tend to overlook the benefit of indigenous knowledge and practices while exclusively focusing on the transfer of conventional technology[16]. By in large this is inappropriate as virtually none of the households have the resources to use this technology. Also those who are involved in the projects practice one type of agriculture at the project site and another in their home gardens and fields. To us this seems ironic. Similarly by focusing more on indigenous knowledge and supporting and enhancing the principles inherent in this knowledge more households could receive the benefits of conventional agricultural technology. An effective mixture of the principles inherent in the two systems would go a long way to achieve this.

During the discussions at focus group workshops and also during informal interviews with residents we identified a number of areas where they requested support and information. These are described below.

Seed Systems:
Many ladies stored seeds and some requested further information on this aspect, especially with some of the exotic vegetables. Sharing information on all aspects of exotic and traditional vegetable seed systems: how and when they can be harvested, cleaned and how long they can be stored. Promote seed systems for traditional leafy vegetables to lessen the chance of losing one yield cycle. Promote the re-introduction of selection of fruits and plants for seed harvesting where applicable. Promote seed systems and production information of the most popular leafy vegetables to help increase winter and spring food security. Effective nursery establishment on a small-scale within home gardens would help many subsistence households to increase their access to healthy and nutritional plants. Hold a seed fair to improve awareness of the importance of seed systems in rural villages looking at their advantages and potential. This can be a forum where the farmers and the researchers can work together and learn from each other. Support to seed systems in the area would contribute to species conservation and increase biodiversity. Given the fairly common use of paraffin, and the occasional use of naphthalene, in the seed storage process we suggest that further research be done on the effects of this use.

Appropriate Training:
The case of the water harvesting method used for the planting of maize highlights the need for follow-up visits by specialist to help with adaptation of technologies to the local conditions. The technology is currently not being used optimally, and might actually be causing a loss of total yield per area as intercropping is not used in this system, although it is normally practised. Researchers, extension and farmers need to work together to determine the effectiveness, and to make adaptations where needed.
The appropriateness and timing of training in communities should be decided together with the community members for whom it is intended. The case of the seedling training as mentioned in the report is a worrying example of both bad timing and inappropriate technology for a community garden with no water. The pump was only obtained a number of months later in early 2006. This means that trainees were unable to practice what they had been shown. Appropriate training would be that which is scheduled at the most suitable times and which is of benefit and relevance to most households

[16] The reader should bear in mind that our intention was never to assess the current Provincial Department of Agriculture projects. In fact when we selected the field site we were unaware of their purpose and only new that two projects were located in the area. Here we do not assess the projects but suggest ways in which technology could serve the majority of the residents as opposed to the few people, about 35 who are involved in the two projects.

Livestock Care:
During the study and the survey we spoke to a number of male residents and they indicated a concern about their livestock, especially cattle. In winter forage is scarce and a few men mentioned cattle dying from disease at this time. Livestock information seems to have been lost at several levels and to varying degrees. The following are suggestions of areas that need to be looked at more intensely: breeding and selection of all livestock, dipping practices (found to be ineffective in many communities, probably also here), livestock management, stocking rates, feeding alternatives in winter. Farmers should know when to decide to sell, rather than let their livestock die. We also suggest that the services of the donkey expert in Makhado be contracted. She can provide advice and support to local donkey owners and users. This would be especially with regard to nutrition and the repairing and fitting of harnesses, carts and ploughs to ensure maximum comfort and optimum efficiency.

There were some other areas that we felt local residents should receive information so that they could include this in their practices. These include the following:

Utilisation of African Vegetables:
It is clear from research on African leafy vegetables that these crops make a significant contribution to food security and household nutrition. However, there are some possibilities of this being undermined if the crops are not protected – kept free of aflotoxin and mycotoxin contamination – during cropping, harvesting, processing (drying) and storage. Improved hygiene and food safety during drying and storage would reduce contamination and losses. This could be done by introducing a number of health safety principles to the residents so that they can utilise these. Create awareness on the different methods of preparation that will help to increase the nutritional content of the food (eg. add a little fat, chop, optimal boiling times, etc.). Supply alternative recipes as used by other women in other communities to interested women in Berlyn and Molati. Promote balanced diet gardens to help ensure healthier and more varied diets. This could include options for small-scale cropping in winter. Promote production of yellow fleshed sweet potatoes as these are high in betacarotene from which vitamin A is derived. Promote kale as a nutritious crop in winter gardens. Increase awareness about sweet peppers/ bell peppers / capsicum/ chilli peppers. Assist the villagers with the production of butternut, which they have requested.

Cultivation:
Local residents are very aware of the principles of their soil preparation and cropping activities. However research might be able to improve this within the constraints of the resources which are available to them. Pension and other social grants are often used to purchase some inputs such as seed and fertiliser. Research could optimise production and possibly reduce the expenditure on these items. There is a need to evaluate the possible use of liquid manure in the communities and also the use of grey water. Trench/door gardens, raised beds and micro-gardens might prove viable alternatives and enable basic food production with minimal effort, even in winter. This will enable households with sick members and working women to still produce some crops if they so desire. It is possible that planting patterns can be optimised, even with some form of rotation, and here farmers and researchers can combine their knowledge.

Soil and Water management:
The study indicates that there are in fact two primary areas that need to be addressed in order for those previously mentioned requests and suggestions to achieve optimal benefit. Without addressing these two areas, soil and water management, those previously mentioned will probably become unnecessary as it is possible that agricultural production will decline and people will move towards other sources of livelihood. Some villagers mentioned that already they are unable to produce some crops. We can recall that already the youth is adverse to a number of traditional crops and very few seem to be involved in any sort of agricultural production. If water and soil management are optimised in the local situation then residents will not only be able to optimise their cropping of traditional foods and African vegetables but will most probably be able to introduce some exotic vegetables into their home gardens. This will enable them to diversify their diets. Such crops might even be sold for income generation purposes, thereby taking food security beyond mere household consumption. The handful of farmers who have access to water in winter along with other resources are already doing this, but there is scope for more people to become involved. The information and training transferred by the Department of agriculture would then benefit more households. This information could be shared by means of farmer to farmer extension throughout the villages and surrounding areas.

Data collected during the course of the study indicate that water is a problem for two reasons. It is scarce and when it does rain then it often promotes erosion as management practices, although practised to some degree, are inefficient. This means that the water needs to controlled and the soil managed so that it can maximise the use of the limited water supply. The water needs to be controlled so that it is absorbed by the soil. Also alternative sources of water need to be investigated. On the other hand the soil structure and nutrient quality needs to be improved so that it can optimally utilise the scarce water, regulate its absorption and thereby improve its ability to produce more and better quality crops. These two practises go hand in hand and need to be done together. It is clear that farmers understand the principles behind this based almost entirely on their indigenous knowledge. However, agricultural research could assist in some cases to enhance this knowledge and to improve the management practises of the farmers. Also collaborative or participatory research could help find solutions for other problems relating to these two primary constraints as well as the other requests noted in the report.

With regard to water and soil management the following are suggested as initial practices to be shared with and discussed in collaboration by farmers and researchers:

Water harvesting strategies should be discussed and introduced to the farmers, and people should be encouraged to test the methods for themselves, thus ensuring that they use the most appropriate techniques for their resources and conditions. Here a number of options are available and include terracing, stone bunds, trench or raised beds, semicircular bunds, furrows, and even small dams or catchments for those living adjacent to the hillside. Water retention methods for decreasing water loss during thunderstorms would increase yield potential by decreasing the loss of topsoil. These methods would also reduce the loss of seeds in the seedbed. As mentioned previously water recycling methods could be investigated for non-root and tuber vegetables.

The soil's nutrition along with its ability to absorb and retain sufficient water for production purposes needs to be improved. Practices such as mulching, composting, and the use of liquid and green manure need to be investigated. Working sufficient organic matter into the soil will improve its nutrient content by encouraging animal and micro-organism life in the soil and the subsequent conversion of organic matter into humus. This will also ensure that the soil is of the right texture so that it retains sufficient moisture for crop production and simultaneously reduces water and top soil run-off.

Understanding the Integration of Knowledge Systems

We have indicated the various areas where indigenous knowledge and formal agricultural research can collaborate but the key concern is how this is to be done so that science and indigenous knowledge can integrate to the maximum benefit of the villagers and to ensure that indigenous knowledge is not subsumed by scientific knowledge and its associated complexities. At one level the research has shown that food security, including the sales of traditional foods and African vegetables, is the domain of older women in the villages and surrounding areas. To this end it is important that any intervention, based on the results of the study, which attempts collaboration with the villagers focuses on elder women in the villages. Such an intervention should also encourage the younger generation and this would most probably focus on those already involved with the two existing projects as well as others who are actively engaged in producing food from their household plots. Because many of the women are elderly and still practise customary rituals and taboos with regard to agricultural activities these need to be acknowledged and respected. This means that researchers and extension staff need to ensure that their activities do not ignore these but actually encourage them. This mindset along with the awareness that indigenous knowledge has provided food security for generations and is vital to survival should enable researchers to effectively collaborate with farmers to develop locally appropriate technologies for the requirements listed in this section. Due to the lack of resources the approach should also be one of low input and simple, cost-effective technologies. Very few of the village residents are in the position to go commercial on a large scale but appropriate attitudes and technologies would go a long way to ensuring collaboration so that residents become self sufficient and are able to diversify their production of crops. Of course this needs to be investigated.

The current study was a preliminary investigation of the potentials for collaboration. Because these are high we recommend that a second phase be started in 2007 with the residents of the two villages in which they identify primary areas of technology research and development in conjunction with an appropriate research team. Such a second phase will enable the understanding of how the knowledge systems integrate. This process should be recorded so that the inherent principles along with the technology are

available for other villages in the area. What works and what doesn't and why needs to be recorded and understood in order for the integration of science and indigenous knowledge to be understood and lessons learnt. Process recording and monitoring will enable the identification of what works, what doesn't work and why this occurs. A proposal to this end is being formulated and invokes the participatory approaches of Farmer Field Schools and Participatory Technology/Innovation Development. It also includes the presence of a social scientist on the team to carry out the process monitoring or implementation research in order to investigate and understand the process of integration of the two knowledge systems.

Conclusion

Residents of the villages of Berlyn and Molati have a strong base of indigenous knowledge relating to crop production which they use to produce, prepare and store food to supplement household food requirements, i.e. for household food security purposes. African vegetables are important to their food and nutritional supply and this includes those which are grown as traditional food crops and those that appear voluntarily on a seasonal basis. However, the study illustrates two concerns with regard to agriculture and indigenous knowledge. Both concern the present day youth. Very few of the youth are interested and actively involved in agriculture, with most preferring to consume exotic vegetable alternatives such as cabbage. We literally encountered a handful of young women who were involved in agriculture. We did not meet any young men who were interested in agriculture. Most of the youth to whom we spoke were not interested in indigenous knowledge relating to agriculture, despite the fact that 89% of households produced food crops for own consumption. Those who divulged some aspects of indigenous knowledge knew far less than their elder counterparts. This is a concern as local food security is largely reliant on pensions and other social grants and the indigenous agricultural knowledge provided by elderly residents.

Despite a significant awareness of local conditions and crops it seems that in the agricultural projects in the two villages indigenous knowledge is not being used sufficiently, except in instances where the water pumps had been stolen and people planted local drought resistant crops and vegetables. This was done at their own initiative to make use of the land for household food purposes. Project activities primarily focused on the transfer, rather than the development, of technology relating to exotic crops that required large volumes of inputs and are highly reliant on borehole irrigation. Given that approximately 35 individuals and even fewer households were involved in these projects it is uncertain what contribution they can make to overall food security and poverty alleviation in the two villages. Our concern is largely due to the fact that irrigation is a key factor in conventional crop production and it is clear that when the pumps were stolen people were devastated and consequently produced very little that could be sold. This affected their livelihood sources and their food security, as income is an important component. Similarly, high external inputs are also a characteristic of conventional agriculture but almost no households have access to these.

This study demonstrates that most local households rely on their indigenous knowledge about agricultural practices to ensure that they can produce an alternative source of food for the household within the constraints imposed upon them by poverty and their physical environment. However, given developments in agricultural research there seems a good likelihood that agricultural research can collaborate with some of the members of these households to collaboratively develop technologies that will enhance current endeavours and enable them to optimise their production. Given the knowledge of agricultural principles and some of the local innovations practised by some farmers it is clear that integration is a possibility. It makes sense to work with the more innovative of the farmers/household members as this will enable a more precise understanding of the proposed integration between the two systems of knowledge. This is primarily because these people are experimenters who continuously strive to improve their knowledge and understanding. Also they will stress the importance of their knowledge system as they are aware of its dynamism. This should enable equity during the collaboration and integration.

To ignore existing and developing local or indigenous knowledge regarding agricultural production will affect the food security of these villagers and others in similar circumstances.

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APPENDIX A

What follows is a list of the people who attended the workshops we organised and agreed to our interviewing them, both formally and informally, during the course of the study. This report is largely a recording of their indigenous knowledge and ideas, for which we are extremely grateful. Those individuals who participated in the household survey are not listed here as they were granted confidentiality, although they remain anonymous their contribution is recognised and valued.

1. Elisa Mkhari
2. Angelina Phukula
3. Letty Mhlongo
4. Rose Ngobeni
5. Sophy Makaringa
6. Somisa Phakula
7. Letty Nkwashu
8. Lea Ntshama
9. Mthabini Mkhari
10. Margareth Mavutana
11. Charles Thobejane
12. Alfred Baloyi
13. Nelson Nkwashu
14. James Ngobeni
15. Jack Malubane
16. Josias Ramewela
17. Margareth Khosa
18. Salva Nkwashu
19. Selina Nkanyane
20. Maria Nyathi
21. Esther Ngobeni
22. Mildred Nkwashu
23. Lucky Zitha
24. Windy Mashele
25. Sophy Chauke
26. Timali Mashele
27. Mercy Mhlongo
28. Joyce Sekgobela
29. Elias Malatje
30. Shalati Hlungwana
31. Mamaila Mathebula
32. Mthavini Mkhari
33. Nyabana Nkhwashu
34. Betty Thobejane
35. Mercy Mhlongo
36. Lestina Chauke
37. Agness Senyolo
38. Jane Mhlongo
39. Lydia Sitha
40. Alina Mantsina
41. Jeaneth Mashele
42. Dorah Monguve
43. Anicky Mamyike
44. Diana Machubele
45. Mabjala Ratselana
46. Nelly Rikhotso
47. Manana Mushwana
48. Nomsa Mushwana