Integrating Indigenous Knowledge for Food Security: Perspectives from the Millennium Village Project at Bar-Sauri in Nyanza Province in Kenya.[1]

Awuor Ponge[2]
Institute of Policy Analysis and Research (IPAR – Kenya), ***and***
Institute of Education (IoE), University of London
John Adams Hall, 15 – 23 Endsleigh Street
London, WC1H 0DP. United Kingdom.
Mobile: +4477 67550948 E-Mail: [pongeweb@yahoo.co.uk]

A Paper presented to the African Research and Resource Forum (ARRF) and the Economic Policy Research Centre (EPRC) for the International Conference on Enhancing Food Security in the Eastern and Horn of Africa regions. A Conference held at the Imperial Royale Hotel in Kampala, Uganda on 16 – 17 November 2011.

[1] Funding for this research was made available from the Tokyo Foundation under the Sasakawa Young Leaders Fellowship Fund (SYLFF) through a scholarship for the Master of Arts Degree in Development Studies at the University of Nairobi. This research was supervised by Prof. Njuguna Ng'ethe and Dr. Rachel Musyoki, both of the IDS, University of Nairobi. Special thanks to Prof. Ian Scoones, Prof. John Thompson and Dr. Sally Brooks of IDS, University of Sussex, Brighton, UK, for personalised guidance during the report compilation stage. I acknowledge the facilitation by the African Research and Resource Forum (ARRF) for the preparation of this paper for presentation at the conference and revision after peer review for eventual publication.

[2] Awuor Ponge is an Associate Research Fellow and the Monitoring and Evaluation Officer at the Institute of Policy Analysis and Research (IPAR – Kenya). He graduated with a Master of Arts Degree in Development Studies from the Institute for Development Studies of the University of Nairobi. Presently, he is pursuing a second Master of Arts Degree in Education, Gender and International Development at the Institute of Education of the University of London. He is also a Visiting Lecturer in the Department of Development Studies, Faculty of Arts and Social Sciences at the Catholic University of Eastern Africa (CUEA).

Abstract

Recent development in the field of agriculture and rural development has seen a steady rejuvenated recognition of indigenous knowledge for sustainable development. However, this recognition has not downplayed the role that modern scientific knowledge has played. It is therefore justifiable to advocate for a marriage-of-convenience between the two knowledge systems for effective output and eventual sustainability. The role of indigenous knowledge in sustaining the livelihoods of Kenya's poorest people has often been neglected in the agricultural and rural development sector. The use of local knowledge in enhancing food security and improving agricultural productivity, however, is increasingly becoming an important issue in the Millennium Village Project at Bar-Sauri in Nyanza Province in Kenya. According to FAO, 'food security' means that food is available at all times; that all persons have means of access to it; that it is nutritionally adequate in terms of quantity, quality and variety; and that it is acceptable within the given culture'. Food security activities in essence emphasise food production and improved access to food in a locality. In the context of the Millennium Village Project at Bar-Sauri, the concern with food security is at the household level. Since agriculture has been seen as the vehicle through which poverty can be alleviated, it goes without saying that agricultural production must be enhanced to ensure not only food security for the people, but to see the village transition from simple subsistence to self-sustaining commercial activity in line with the initial goal of the MVP. Indigenous Knowledge can help to alleviate poverty if it is effectively applied in agriculture and supported by appropriate technology interventions that consider peoples' circumstances. Sustainable productivity of crops for food security usually entails efficient utilization of locally available resources. This includes the utilization of abundant traditional (local) knowledge in crop production such as internally derived inputs, recycled nutrients, crop rotations, improved management of pests and diverse cropping. It is unlikely that the intervention of the MVP will lead to food security on its own without taking cognizance of the role of indigenous knowledge. It is also clear that indigenous knowledge on its own cannot be a panacea to the crop production shocks. However, it is important to appreciate that the two are complimentary in their strengths and weaknesses and combined, they may achieve what neither would alone. There is therefore, need to value indigenous peoples' knowledge and practices in investment projects, and build on these assets by supporting pro-poor research that blends traditional knowledge and practices with modern scientific approaches.

KEY WORDS: Food Security, Indigenous Knowledge, Sustainable Development, Millennium Village Project.

Table of Contents

List of Tables

Table of Figures

INTRODUCTION

Overview

Indigenous peoples are entitled to the recognition of the full ownership, control and protection of their cultural and intellectual property. They have the right to special measures to control, develop and protect their sciences, technologies and cultural manifestations, including human and other genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs and visual and performing arts [United Nations Article 29] (United Nations, *n.d*). The President of the World Bank in 2000, James D. Wolfensohn remarked that indigenous knowledge is an integral part of the culture and history of a local community and that we need to learn from local communities to enrich the development process. So important is indigenous knowledge that the guru of participatory development Robert Chambers has emphasised on the need for the integration of this with modern scientific knowledge. He argues that rural people's knowledge and scientific knowledge are complimentary in their strengths and weaknesses and that combined, they may achieve what neither would alone (Chambers, 1983:75).

The background of this study is based on the major objective of Sustainable Agriculture and Rural Development (SARD) which is to increase food production in a sustainable way and enhance food security. This will involve: education initiatives, utilization of economic incentives and the development of appropriate and new technologies, thus ensuring stable supplies of nutritionally adequate food, access to those supplies by vulnerable groups, and production for markets; employment and income generation to alleviate poverty; and natural resource management and environmental protection (United Nations, 1992). The assumption at the onset is that once a people are food secure, then they can have surplus for the market.

According to Abioye, Yetunde & Egberongbe, (2011) it is estimated that over 900 million people around the world suffer from the pangs of hunger while even a larger number experience malnutrition, majority being in lower income developing countries. Strategic programmes and initiatives have been adopted at different levels to tackle the challenges of food security and prevent imminent global food crisis.

Indigenous knowledge, particularly in the African context, has long been ignored and maligned by outsiders. Today, however, a growing number of African governments and international development agencies are recognizing that local-level knowledge and organizations provide the foundation for participatory approaches to development that are both cost-effective and sustainable (Warren, 1992). One of the strategies for developing the agricultural sector is to harness the potentials of indigenous agricultural knowledge which has continued to gain recognition and whose potential contribution towards achieving the millennium development goals, particularly MDG 1 on the eradication of poverty and hunger has been acknowledged. (Abioye *et al.,* 2011: 2).

The Millennium Village at Bar-Sauri

The Millennium Village Project at Bar Sauri in Nyanza Province of Kenya is one of the Millennium Village Projects set in one of the poorest regions of Kenya. It is a perfect example of development agency paradigm. Bar-Sauri MVP was the first to be established in Kenya. It was established in August 2004. Within a period of just two years after initiation, the village had seen remarkable progress that saw the village rise from chronic hunger to more than triple the crop production. (UN Millennium Promise, 2008). The village was also able to sell its produce to nearby markets.

The assumption at the initiation of the MVP was that with little initial support, the economies of the village would make the transition over a short time from subsistence farming to self-sustaining

commercial activity. Due to the anticipated increment in productivity, the logical assumption was that income would equally rise. This higher income would, in turn, raise household savings, which would ultimately accelerate investment. With time, this kind of investment should be able to finance the cost of some of the interventions that are currently initiated by the MVP (UN Millennium Promise, 2008). Inspite of the tripling of crop production, Bar-Sauri is still a poor village, and from the recent country status report (Kenya, 2008) which paints a grim picture about achieving the first MDG in Kenya, there is need to ensure that any development project initiated in the region is sustainable. It is against this background that we want to demonstrate that with appropriate adaptation and leveraging with other knowledge resources, indigenous knowledge can make a significant contribution in reducing poverty and improving livelihood and in effect help in achieving the MDG 1 of the Eradication of Extreme Poverty and Hunger.

The major farming activities taking place in the Bar-Sauri Millennium Village Project include fish farming, horticulture, the growing of maize and beans as the chief crops, livestock rearing, dairy farming and poultry keeping. However, a lot of prominence has been given to the cultivation of maize and beans as this has been seen as the likely channel through which poverty in the area could be alleviated. The village of Bar-Sauri has been synonymous with poverty over the years.

It is important to also note that 26.7% of the farmers in Bar-Sauri do not have any form of education. This could later explain why there were constraints in adapting to the modern farming methods. However, despite the fact that the farmers did not have any form of education, they were still able to use the indigenous methods of crop production and to mitigate the challenges that were associated with these. For those with primary education and above, at least the transition and integration of the two methods has been relatively a smooth affair save for the production shock which have led them to use both the indigenous and the modern strategies to address the same.

Conceptualisation of Key Terms

Indigenous Knowledge is conceptualised in this study as the accumulated set of common sense knowledge and ideas of the local people about their everyday realities of living. It is the local knowledge that is unique to the given community and forms the basis for their local level decision-making in agriculture and connects people directly with their environment. This knowledge is passed down from generation to generation by word of mouth and generally relies on intuition. It is usually associated with the low prestige of rural life. Indigenous knowledge usually includes the cultural traditions, values and beliefs of the local community.

Food Security means that food is available at all times; that all persons have means of access to it; that it is nutritionally adequate in terms of quantity, quality and variety; and that it is acceptable within the given culture'. Food security activities in essence emphasise food production and improved access to food in a locality.

Problem statement

According to a report from the MDG office on the progress of the MVP at Bar-Sauri (Kenya, 2008), the village has made little progress in the achievement of MDG 1 on 'Eradicating Extreme Poverty and Hunger'. In the MVP, agriculture and particularly crop production are given prominence as the driving forces through which poverty can be alleviated and food security assured. Whereas the use of Indigenous Knowledge is seen as an alternative way of promoting development in poor rural communities (Briggs, 2005), in the Country Status Report of the MVPs however, there is no mention of the role that Indigenous Knowledge plays in the sustainability of the achievements so far, especially in regard to crop production and food security.

Available literature on the subject of Indigenous Knowledge (Brokensha, Warren & Werner, 1980; Compton, 1989; Gupta, 1992; Warren, 1990) is all in agreement that Indigenous Knowledge is pivotal for sustainable resource use and balanced development. It is also agreed in the literature that crop production and food security cannot be enhanced if the indigenous knowledge of the people is neglected. Crop production itself cannot be sustainable if poverty and hunger is not eliminated. One way of eliminating poverty and hunger has been identified by the MVP as increased crop production. This study will therefore attempt to assess the extent to which the integration of indigenous knowledge will lead not only to the enhancement of crop production, but also to the sustainability of the production.

The value of indigenous knowledge in the MVP is especially in the indigenous vegetable training, which captures the value of traditional vegetables production and utilization, processing, marketing of indigenous vegetables and the preparation and use of manures such as compost (UN Millennium Promise, 2006). However, there is no conscious translation of this value to grain crop production. This study will therefore attempt to make this a conscious effort to general crop production without limiting it to vegetables only.

It is emerging that there is an unconscious interaction of the two knowledge systems in the actual implementation of the MVP. Lalonde (2005) noted that development of indigenous knowledge or the change in the application of acquired ecological knowledge is predicated upon conscious efforts by both individuals and the local community to better understand and live within the dynamic carrying capacity of the local ecosystem. This study will therefore attempt to generate supportive knowledge to argue the case for integration efforts in understanding the dynamics of crop production in the new environment.

Finally, this study is an attempt to fill the gap of available local information and data on the use of Indigenous Knowledge to enhance food security, thereby ensuring that the village not only achieves the MDG 1 through enhanced crop production, but that this production is sustainable in the long run.

Research Questions

The study is based on the knowledge that there indeed was and still is, indigenous agricultural knowledge in Bar-Sauri. The role of indigenous knowledge in agriculture is also, in one way or the other, related to crop production and food security or insecurity in the region and the eradication of poverty and hunger. The broad research question therefore is:

What are the Indigenous Knowledge strategies that enhance food security in the Millennium Village Project?

To arrive at an answer to this broad question, this study seeks to provide answers to the following specific questions:

1. What are the specific indigenous knowledge strategies used by the people of Bar-Sauri?
2. How is the indigenous knowledge integrated in the current farming methods for food security?
3. What are the effects of the integration on crop production and food security?

Study Objectives

The overall objective of the study is:
To identify the Indigenous Knowledge strategies that enhances food security in the Millennium Village Project?

This study shall be guided by the following specific objectives:

1. To identify the specific indigenous knowledge strategies used by the people of Bar-Sauri;
2. To assess the extent to which indigenous knowledge is integrated in the current farming methods for food security;
3. To find out the effects of integration on crop production and food security.

Justification of the Study

The recognition of the importance and value of Indigenous Knowledge and practices in agricultural development is almost lacking in the Kenyan context and more especially with regard to the MVP as a developmental intervention. This study appreciates that sustaining food production and achieving the MDG 1 on Eradicating Extreme Poverty and Hunger will require more than just the adoption of modern scientific inputs. This study will therefore be appropriate as it will show the urgent need to juxtapose the two knowledge systems in order to come up with an integrated model that will ensure the sustainability of the MVP in terms of enhanced food production.

There is little literature on the use of indigenous knowledge in the Millennium Village Projects, leave alone the integration of the two knowledge systems. This study will therefore, go along way in adding knowledge to any subsequent study of the Millennium Village Projects and any developmental intervention that is likely to impact on the rural communities. The study will enhance the knowledge the extension workers impart on the local community and also ensure the preservation of their cultural and biological diversity.

Since agriculture is given prominence as the driving force through which poverty can be alleviated and food security assured, this study will hopefully encourage the people of Bar-Sauri to appreciate their own traditional methods and the role of the methods in enhancing production in combination with the modern farming methods. It will raise their self-esteem as they will gain confidence in their own ability to innovate, experiment and adapt known and new technologies. If successful, this integration approach would be fairly easy to replicate in the neighbouring villages and elsewhere.

Since agricultural production is affected by a plethora of problems ranging from environmental degradation to unreliable rainfall, this study will make available local knowledge of coping strategies, not only to the development practitioners involved in the MVP but also to policy-makers, government agencies and NGOs in order to facilitate formulation and design of strategies that can enhance agricultural production and ensure sustained food security.

Indigenous knowledge as part of the culture of the people of Bar-Sauri will be of crucial importance to the researchers, extension workers and field officers involved in the MVP project because there are so many cultural practices that affect the farming practices and in effect agricultural production in this region. Understanding these will assist future interventions in instituting appropriate programmes that take cognisance of the value of indigenous knowledge and the culture of the anticipated project beneficiaries.

RESEARCH METHODOLOGY

Unit of Analysis

The unit of analysis was the specific individual farmer. In every homestead, only one respondent was interviewed. The study targeted the head of the homestead; usually the man, but special emphasis was put on the female because of the available information that women play a crucial role in maintaining livelihoods, cultural continuity and community cohesion and that they are

indeed custodians of indigenous knowledge (Olatokun & Ayanbode, 2008). If the head of the homestead was not available, the next available person was interviewed but in order of age seniority. The homestead was used instead of the household because no two respondents would come from the same homestead. The order of age seniority was purposively adopted based on an assumption that those who are older generally have more information regarding indigenous knowledge as compared to the young.

Population and Sampling

The research was spread in a period of one month in August 2009 and covered each of the small villages in the bigger Bar-Sauri Millennium Village, which is made up of a conglomerate of eleven 'small villages' and a population of about 5, 000 inhabitants. This population is big and it would be unrealistic to purport to cover the whole population in the study of such a short time as this. The study therefore, was restricted to the administrative Bar-Sauri village. Each of the eleven 'small villages' has at the most 150 households. From each village, at least five households were sampled and then an over-sample of one household each for five villages. Sixty respondents were interviewed spread evenly between the old and the young and between the male and the female. The research also took into account the different success levels of the farmers with regard to their crop production. Interviews were conducted for the farmers to find out their success levels before and after the initiation of the MVP for comparative purposes of both the farming systems adopted and levels of production. Success levels here were based on the observation of such physical features as an iron-sheet-roofed house, ownership of livestock, well managed fencing system for security as contrasted with grass-thatched roofing, no livestock kept and unkempt or no fencing system.

In total, twenty-four men were interviewed making 40% of the total number of respondents as compared to thirty-six women making 60% of the total respondents. The main reasons for over-sampling women were because they were the easiest to get at home because most of the time, the men were busy with other duties outside of the home including looking after the animals. Secondly, it is available in the literature that women are the custodians of indigenous knowledge, and more especially the elderly women. So the study concentrated more on elderly women and only in cases where these were not found could the younger ones be interviewed.

Data Collection Methods

The methods of data collection that were employed for this study included pre-testing the questionnaire and the modification of the research instruments. Thereafter, there was the actual administration of the household survey questionnaires, structured interviews, in-depth and open ended interviews, purposely selected Key Informant interviews, a Focus Group Discussion, direct participant observation and secondary data analysis especially literature that was made available by some of the Key Informants and researchers in the field. Questionnaires and detailed discussions with farmers were supplemented by field observations during which any peculiar observations were probed further and the respondents were able to explain in one way or the other. Generally, the information gathered through observations were on the conditions of the crops in the farm, the storage devices used by the community, the nature of the soils and the kind of crops in the soil types, the kind of fallow cover used by the farmers and also if there were any weeds in the farms and how these were controlled.

The study adopted the purposive sampling strategy where snowballing method was used to get the required number of farmers and the indigenous knowledge experts who were mainly the elderly women. Snowballing method was also used to identify the Key Informants for follow-up study. During the survey, a standard questionnaire was used with structured and unstructured questions which generated both quantitative and qualitative data. For the Key Informants, specific open-

ended guiding questions were used for each of the informants. For the Focus Group Discussion also, a set of open-ended question guide was used and more information generated through probing of the issues emerging from the discussions.

Data Analysis Methods

The quantitative data generated through the survey questionnaires were analysed using SPSS where the data was entered to get details about the number of farmers using the indigenous methods, the modern methods and even those integrating the two. It has also been possible to compare these to find out the effects on agricultural production of farmers who have not integrated the two farming methods and those who are integrating. Through cross tabulation, it has been possible to find the relationship between those who plant specific seed types and why the farmers engage in farming. Information has also been generated about the different occupations of the respondents and why they engage in crop production. Through cross tabulation, the relationship between the level of education and adoption of the respective farming methods has been established. The level of education and the marital status also tell much about why farmers engage in farming in the first place.

All the qualitative data was analysed through the use of tabling and sorting for specific relevant themes and grouping them together. Microsoft Word was used and this was able to categorise the specific identified themes that were coded and then merged to come up with information for each specific thematic category. There were also some descriptive statistics that came out from the SPSS like the frequencies, descriptions and validation of variables and also cross tabulation to find the relationships between specific variables.

Since the core of the study was with gathering qualitative data based on the study questions, the quantitative data has been used purposely to compliment and give back-up to the qualitative data. Examples where this has given back-up include the cross-tabulation to find the relationship between why the farmers engaged in farming and the seed variety planted; where the farmers got the seeds they planted and the respective numbers, the relationship between area of crop land and the seed variety planted which indicated whether one was farming purely for subsistence or for both subsistence and commercial, since it was clear that there was no full scale commercial agriculture practiced in the village. Through cross-tabulation of the quantitative data, it has been possible to give explanations to qualitative information about the different benefits of the farming activities practiced in the indigenous setting and in the modern setting.

INDIGENOUS KNOWLEDGE – CONCEPTS AND STRATEGIES

This section is an attempt to achieve the first objective of the study which was *"To identify the specific indigenous knowledge strategies used by the people of Bar-Sauri"*. It starts by defining the key concepts such as Indigenous Knowledge, and Scientific Knowledge and attempting a distinction between the two. It goes ahead to address the issue of Indigenous Knowledge and Food Security and what range of indigenous agricultural practices farmers adopt.

It goes ahead to dwell on some of the application of indigenous agricultural farming including indigenous soil preparation and planting materials, indigenous methods of controlling pests and diseases, indigenous methods of maintaining soil fertility, indigenous methods of controlling weeds and indigenous methods of harvesting and storage. The section also deals in detail about the concept of Sustainable Agriculture and Food Security, organic agriculture as a holistic production system based on active agro-ecosystem management rather than on external inputs, the challenges of agriculture and food security and the critical role played by agriculture in enhancing food security. It sums up the role of indigenous knowledge in rural development acknowledging the need for integrating both the knowledge of the local indigenous people with new development

approaches to ensure local ownership and eventual sustainability. Ultimately, it details the indigenous farming methods used to enhance food security in the MVP.

Brokensha *et al*., (1980) have observed that to incorporate in development planning indigenous knowledge, is a courtesy to the people concerned; is an essential first step to successful development; emphasizes human needs and resources, rather than material ones alone; makes possible the adaptation of technology to local needs (Brokensha *et al*, 1980:7 – 8). This position cannot be more apt than in the context of the Millennium Village Project at Bar-Sauri, where there is already an efficient way of using modern scientific research in development. Warren, one of the foremost writers on indigenous knowledge, notes that Indigenous Knowledge is an important natural resource that can facilitate the development process in cost-effective, participatory, and sustainable ways… it has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities (Warren, 1991: 1).

In this study, sustainable food security is measured by the ability to attain sustainable yield over a long period of time, ability to attain inter-generational equality and attaining equity through provision of equal opportunities and access to all. This study aimed to look at ways of improving farm production and farming systems thereby enhancing sustainable food production and food security for sustainable rural development.

There is need to create the conditions for sustainable agriculture and rural development (SARD) especially in the MVP. The major objective of SARD is to increase food production in a sustainable way and enhance food security. To achieve this grand objective will involve among other strategies, the development of appropriate and new technologies for improved production and income generation to alleviate poverty in line with the provisions of MDG 1. According to the Agenda 21, governments need to improve farm productivity in a sustainable manner, as well as to increase diversification, efficiency, food security and rural incomes, while ensuring that risks to the ecosystem are minimized.

There are indigenous practices that have practically disappeared as they become inappropriate for new challenges or because they adapt too slowly. Moreover, many local practices may also disappear because of the intrusion of foreign technologies or development ***concepts that promise short-term gains or solutions to problems without being capable of sustaining them.*** Accordingly, care must be taken not to undermine effective indigenous practices. This study sought to tap the advantages of the available IK and seeing how they can be adapted to the modern techniques to ensure food security in the Millennium Village.

Indigenous Knowledge Defined

According to Scoones and Thompson (1994), Knowledge is viewed as a social process and 'knowledge systems' in terms of multiplicity of actors and networks through which certain kinds of technical and social information are communicated and negotiated, and not as a single, cohesive structures, stocks or stores. Knowledge emerges as a product of the interaction and dialogue between different actors and network of actors. Long and Villareal (1994) arguing along the same line note that knowledge is essentially a social construction that results from and is constantly being reshaped by the encounters and discontinuities that emerge at the points of intersection between actors' life worlds (Ibid. p.50).

A commonly asserted dichotomy distinguishes between the written and the oral tradition. 'Indigenous' knowledge is associated with 'oral' – information is not written down and thus remains outside recorded history. It is important to consider knowledge in three broad views namely how it is generated, transmitted and applied in a particular context for it to be relevant.

The terms 'traditional' and 'indigenous' are often generically used rendering their meanings interchangeable. However, in conventional usage, indigenous knowledge or local knowledge is a particularistic knowledge of place and the things in it. It is a knowledge born from rooted experience and is precisely the kind of intimacy that may be unavailable to an outsider. Richards (1994) observes that indigenous knowledge is the single largest knowledge resource not yet mobilised in the development enterprise.

In the literature, indigenous knowledge has also been conceived in terms of Rural People's Knowledge. It is a valuable and underutilised resource that needs to be intensively and exhaustively studied, and 'incorporated' into formal research and extension practice in order to make agriculture and rural development strategies more 'sustainable' (Thompson & Scoones, 1994). Odera Oruka (1991) conceives of indigenous knowledge in terms of the knowledge held by the sages or the wise persons. He sees this as the selection of common basic values of a people on a given subject and using the understanding of such values to interact with the people and this he sees as the anthropological-philosophical use of sagacity in development. Accordingly, indigenous knowledge rests with the sages but it is a knowledge that is adaptive and accommodative.

Indigenous people have continually taught the world small but powerful lessons; how to live in harmony with nature. Indigenous people are believed to have invented science, biodiversity, sustainable management of resources, and all other good things we all want to be associated with today. The evidence is their historically minimal greenhouse gas emissions. The rest of us only systematized (or grave structure) to the science practiced by indigenous people for years (Abukutsa-Onyango, 2009).

Indigenous Knowledge and Scientific Knowledge

Indigenous Knowledge initially defined as the knowledge held by indigenous communities (people) has been expanded to include:

> *The sum total of the knowledge and skills which people in a particular geographic area possess, and which enable them to get the most out of their environment. Most of this knowledge and these skills have been passed from earlier generations but individual men and women in each new generation adapt and add to this body of knowledge in a constant adjustment to changing circumstances and environmental conditions. They in turn pass on the body of knowledge intact to the next generation, in an effort to provide them with survival strategies.* (IKDM, 1998).

There has been an attempt to romanticise and idealise local knowledge in a new reverence, and imply thereby a functional separation between two sorts of knowledge validated by different sets of criteria. When we conceptualise IK systems, we often think of 'other culture'. However, the danger of this has been noted in that we perceive cultures as discrete bounded systems that are undynamic and unchanging, which is not always the case.Indigenous knowledge is also seen as pivotal in discussions on sustainable resource use and balanced development (Brokensha et *al.*, 1980; Compton, 1989; Gupta, 1992; Niamir, 1990; Warren, 1990). Chambers (1983) affirms the complimentary role of the two knowledge systems when he assets that rural people's knowledge and scientific knowledge are complimentary in their strengths and weaknesses and that combined, they may achieve what neither would alone (Chambers, 1983:75).

Indigenous knowledge is often seen to exist in a local context, anchored to a particular social group in a particular setting at a particular time. Significant contributions to global knowledge have originated from indigenous people. Indigenous knowledge is developed and adapted continuously to gradually changing environments and passed down from generation to generation and closely interwoven with people's cultural values.

Indigenous Knowledge and Food Security

Indigenous knowledge has come to occupy a privileged position in discussions about how development can best be brought about so that finally, it really is in the interests of the poor and the marginalised (Agrawal, 2002). To ignore people's knowledge is almost to ensure failure in development (Brokensha *et al*., 1980). Since indigenous knowledge is essential to development, it is often suggested that it must be gathered and documented in a coherent and systematic fashion (Brokensha *et al*., 1980; Warren *et al*., 1989). As more studies of indigenous knowledge become available, its relevance to development will become self-evident.

Shepherd (1998) postulates that food security does not depend on crop production alone whether at household, region or country level. It depends to a greater extent on people's ability to command the resources to acquire the food they need – whether this is through production, farm production of cash crops, other income-earning activities, employment or remittances. The major problem, however for crop production lie in the farmers' use of high level chemicals, reduced diversity of the cropping systems, taking livestock out of the system and controlling nature to a high degree. It appears that Shepherd (1998) is faulting the over-reliance on the modern scientific knowledge only to the exclusion of the indigenous knowledge.

In an analysis of peasant crop production currently in the sustainable agriculture movement, Shepherd (1998) maintains that sustainable agriculture should focus on developing crop production firstly for consumption by the peasant family, secondly for the local market and preferably not for export, because export agriculture is naively understood to be against the interests of the rural peoples' food security. This position however, seems to contradict the very purpose for which the MVP was set, which was to make the village of Sauri move from simple subsistence to self-sustaining commercial activity (UN Millennium Promise, 2008).

Some of the positive traditional management practices in rural Africa which have been adapted and passed down over countless generations have been found to be in harmony with the short and long-term carrying capacities of the local ecosystem (Lalonde, 2005). Since the 1960s scientists have recognized the validity of the traditional bush-fallow system associated with shifting cultivation or slash-and-burn agriculture. Agricultural experts and extension workers have since developed a low-cost and labour intensive farming system called alley cropping, an adapted technique which capitalizes on the beneficial attributes of bush fallow, yet overcomes some of its limitations (Lai, 1990).

Farmers adopt a wide range of indigenous agricultural practices based on generations of experience, informal experiments and intimate understanding of their environments. The application of indigenous agricultural farming for example has reflected in the following:

- Indigenous soil preparation and planting materials
- Indigenous methods of controlling pests and diseases
- Indigenous methods of maintaining soil fertility
- Indigenous methods of controlling weeds
- Indigenous methods of harvesting and storage. (Abioye *et al.,* 2011: 3).

Sustainable Agriculture and Food Security

The World Commission on Environment and Development commonly known as the Brundtland Report, offered seven major proposals for a strategy to sustainable development including: reviving growth, changing the quality of growth, meeting essential needs for jobs, food, energy, water and sanitation, ensuring a sustainable level of production, conserving and enhancing the resource base, re-orienting technology and managing risks and finally, merging environment and economics in decision making (UNCED, 1987).

Gray (1991) defines 'Sustainable Agriculture' as the maintenance of the net benefits agriculture provides to society for present and future generations. Since agricultural production provides an important source of income for many individuals, families and communities, sustainable agriculture is, at least in part, maintenance of the flow of income from agricultural production. Thompson and Scoones (2009) in addressing issues of sustainability in agri-food systems say that there is need for "policies and actions that not only contribute to social objectives like poverty reduction, but also achieve continually modified and enriched understanding of the evolving ecological, economic, social and political conditions and provide flexibility for adapting to surprises." (2009:388).

According to Pretty and Hine (2001), Sustainable agriculture seeks to make the best use of nature's goods and services as functional inputs. It integrates natural and regenerative processes such as nutrient recycling, nitrogen fixation, soil regeneration and natural enemies of pests into food production processes. It reduces the use of non-renewable inputs (pesticides and fertilizers) that damage the environment. It makes better use of the knowledge and skills of farmers, so improving their self-reliance. It also makes use of social capital, that is the people's capacities to work together to solve common management problems such as pest, watershed, irrigation, forest and credit management. Sustainable agriculture technologies and practices must be locally-adapted. Sustainable agriculture jointly produces food and other goods for farm families and markets. It also contributes to other non-food functions that cannot be produced by other sectors like on-farm biodiversity, groundwater recharge, urban to rural migration and social cohesion (Pretty and Hine, 2001).

Pretty (1995) notes that sustainable agriculture is characterised by greater use of local resources and knowledge. However, some would argue that the only form of sustainable agriculture is organic and would that any agriculture using external inputs is fundamentally unsustainable. According to Pretty, the main challenge for sustainable agriculture is to make better use of internal resources and that this can better be done by minimising the external inputs used, by regenerating internal resources more effectively or by a combination of both.

Agriculture can only be persistent and sustainable when resource-conserving technologies are developed and used by local institutions and groups, who are supported by external research, extension and development institutions acting in an enabling way. For sustainable agriculture to spread, the wider policy environment must too be enabling.

Organic Agriculture and Food Security

Organic agriculture is a holistic production system based on active agro-ecosystem management rather than on external inputs. It builds on traditional agriculture and utilizes both traditional and scientific knowledge. It is a form of sustainable or ecological agriculture that involves production according to precise standards. Organic agriculture offers a wide range of food security, economic, environmental and social benefits. (UNCTAD, 2009). Organic agriculture builds on and keeps alive farmers' rich heritage of traditional knowledge and traditional agricultural varieties.

The UNCTAD study further shows that organic agriculture is a good option for food security in Africa – equal or better than most conventional systems and more likely to be sustainable in the longer term. It relies on local renewable resources instead of external inputs and this makes the resource-poor farmers experience more yields and incomes, enhancing food security, even as it reduces their vulnerability to external price volatility. (UNCTAD, 2009). Among the benefits of organic agriculture is that it leads to increased productivity and improved food security. Organic agriculture builds soil fertility and structure by restoring carbon and nutrients to the soil through sustainable land and water management techniques such as composting, cover crops,

mulching and crop rotation; it conserves biodiversity and natural resources on the farm and in the surrounding areas; it improves soil fertility and structure, thus improving water retention and resilience to climatic stress, contributing to climate change adaptation. UNCTAD (2009) finally notes that organic agriculture mitigates climate change by utilizing less energy than conventional agriculture and also by sequestering carbon. For all these reasons, organic agriculture can be a powerful tool for achieving the Millennium Development Goals, particularly those related to poverty reduction and the environment.

Among the challenges of organic agriculture however, are the fact that organic and other forms of sustainable agriculture receive little support from African Governments; agrochemical subsidies, tilt the playing field away from organic producers; organic agriculture is virtually absent in agricultural education, extension services, and Research and Development, and finally, there is lack of information regarding organic agriculture.

The Challenges of Agriculture and Food Security

Agriculture plays a critical role in food security. It is also the basis for economic growth and employment creation as most industries and manufacturing firms are agro-based. According to Thompson (2006) the developing world will remain predominantly rural until around 2020 and millions of poor people in these countries will continue to rely on agriculture for their livelihood. This ultimately means that chronic hunger and food security will continue to be a problem to address for quiet some time. The World Bank (2007) also notes on the same breath that agriculture is an important source of livelihoods in developing countries, providing ways of life for billions of people, many of them poor. Kenya is a developing country with a population of around 40.5 million[3] of whom 80% live in the rural areas and depend directly or indirectly on agriculture for their livelihoods.

The farming communities that have developed and sustained a rich diversity of seeds over millennia urgently need incentives to continue sustaining them. They need the same rights over their traditional seed varieties and associated knowledge as corporations have over modern varieties they develop and patent. Abukutsa-Onyango (2009) observed that any long term solution to global warming, drought and crop failure must be addressed by reducing dependence on western-style agriculture in favour of indigenous crops. This non-sustainable form of agriculture (western-style), while producing revenues in the form of exportable food, is no longer a viable means of insuring Kenya's food security, given the fact that 80% of Kenya's crops are grown in the arid lowlands, where rain is becoming increasingly unreliable.

According to Gorjestani (2000), IK is a significant resource, which could contribute to the increased efficiency, effectiveness and sustainability of the development process. Recognition of IK is increasingly becoming part of the development agenda. IK is the basis for community-level decision making in areas pertaining to food security, human and animal health, education, natural resource management and other vital economic and social activities. IK adds value to development in the productive as well as social sectors.

Indigenous Knowledge and Rural Development

Chambers (1983, 1994) points to the need for integrating both the knowledge of the local indigenous people with new development approaches to ensure local ownership and eventual sustainability. Incorporating indigenous knowledge into development may be achieved through

[3] According to the World Health Organisation figures, Kenya's population stands at 40,513,000 according to data from the Global Health Observatory for 2009. This information is available online at: http://www.who.int/countries/ken/en/ <Accessed on 21 January 2013>

farmer participation in research planning and implementation, external survey of local needs as a basis for planning research or the active synthesis of indigenous and scientific knowledge (in addition to collaboration between the scientist and the farmer) in order to capitalise on their potential complementarity. Sachs (2005) particularly talks about the participation of the villagers in identifying what he calls the Sauri's Big Five development interventions namely agricultural inputs, investment in basic health, investment in education, power, transport and communication services and finally safe drinking water and sanitation.

According to the World Bank (2009), indigenous knowledge is important for the local community in which the bearers of such knowledge live and produce. It is also important for the development agents who need to recognize it, value it and appreciate it in their interaction with the local communities. Lastly, it forms part of the global knowledge since it can be preserved, transferred, or adopted and adapted elsewhere. The development process interacts with indigenous knowledge especially when designing or implementing development programs or projects (World Bank, 2009). From the foregoing, it is certain that since this development is people-driven and involves the actual participation of the local community from the grassroots, it leads to the development of the rural areas and this eventuality leads to the sustainability of the development interventions especially targeting the rural areas.

Indigenous farming methods and food security

Among the indigenous farming methods practiced by the people included burning of grass, hoe digging, broadcasting of seeds and the use of animal manure. However, some farmers maintained that the soils were still very rich in nutrients and there was no need to use manure before the introduction of the MVP. This assertion however, was found not to be in tandem with the scientific findings from the ICRAF soil scientists' on the soils of Bar-Sauri since there was evidence that the soils were phosphorous deficient.

The farmers were using the indigenous LSV which did well even with little rainfall. There was also the practice of mixed farming by the farmers where they were engaged in both crop production and animal rearing. In crop production, there was mixed cropping where the farmers could grow more than one variety of crop on the piece of land. Usually, Maize was the main crop and this could be intercropped with beans and even cassava for one season and then after the harvest of maize and beans, cassava could be left in the garden for another season or two before maize could be brought again.

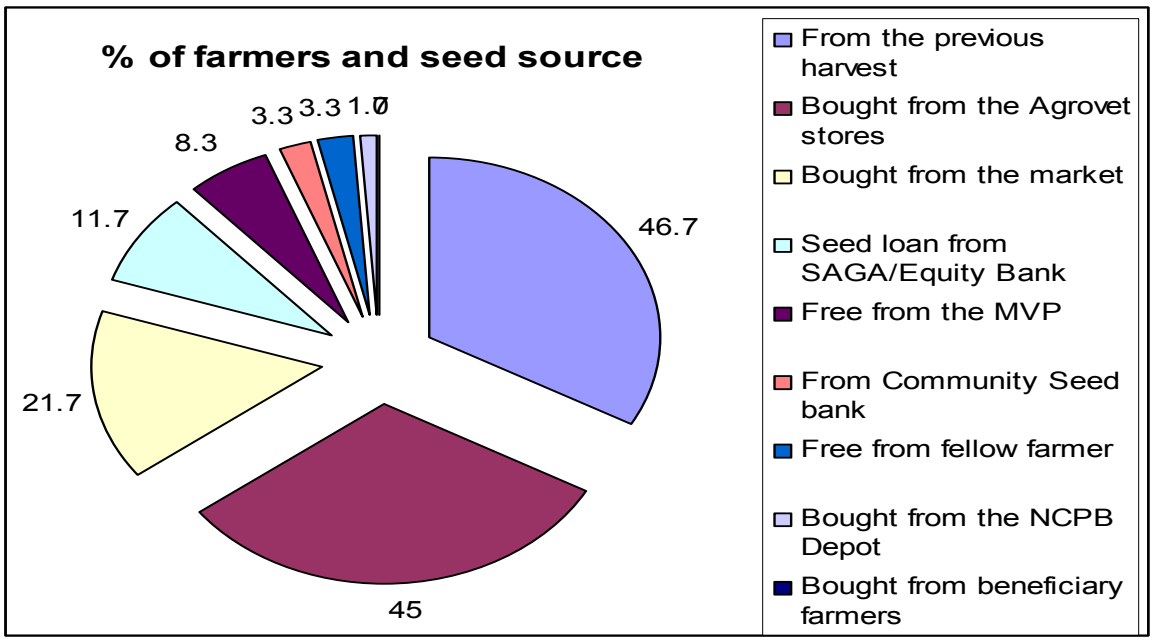
The farmers admitted that they were following the traditional farming practices that they had inherited from their parents and grandparents. They however, attributed this to lack of knowledge and the fact that there was nobody then to teach them of the new farming techniques. The farmers also maintained that in the olden days, crop production was good using the indigenous methods because the farms were not exhausted as they are today and there was no population pressure to warrant small sub-divisions of cropland.

The commonest soil fertility management strategies used by the people included farmyard manure and animal manure especially collecting cow-dung and chicken wastes for use as manure. There are also farmers who use compost manure. Fallowing and crop rotation were strategies used in the past when there was no pressure on the land. The farmers chose seeds from the best grain crops from the previous harvest. The seeds were usually dusted with ashes from burnt animal wastes for consumption, although some farmers dried the chosen seed cobs by hanging over the fire place.

There was a definite farming pattern and this followed a regular calendar where the farmers knew that January was the digging period, February the planting period, April to May the weeding period and July to August as the harvesting period for the long season. The planting season was

identified by the nature of the clouds and winds and also by the movement of the birds. However, the fall of the first rains was the confirmation of the onset of the planting season.

Figure 1 Pie chart showing the percentages of farmers and their seeds sources



Source: *Field Data.*

The harvested grains were usually stored in the traditional granaries and in sacks. However, a section of the farmers maintained that the produce was so small and was basically stored in the traditional storage baskets. Some farmers also admitted to using metal drums for the storage of their produce. Most of the farmers didn't market their produce as they used this basically for subsistence. However, when need arose, those who marketed their produce would take them to the local market or exchange for other commodities. They also did some barter trade by exchanging grains with fish or even meat in the market. They also exchanged grains with the neighbouring Luhya community who provided them with traditional storage baskets.

The indigenous methods used for controlling weeds were basically two namely hand pulling and continuous weeding. The post-harvest pest management was mainly through dusting with ashes from burnt cow dung and also regular drying in between intervals of three months to remove any likely moisture or weevil attacks. Some farmers were also able to use pesticides to control the pests.

Table 1 Farm engagement – Seed variety planted by farmers Cross tabulation

		Seed variety planted by farmers			Total
		High Yielding Variety	**Local Seed Variety**	**Both HYV and LSV**	
Why one is engaged in farming	**Subsistence**	10	19	16	45
	Both subsistence and cash	7	2	6	15
Total		17	21	22	60

Source: *Field Data*

INTEGRATION OF INDIGENOUS KNOWLEDGE FOR FOOD SECURITY

This section in an attempt to achieve the second objectives of the study which was *"To assess the extent to which indigenous knowledge is integrated in the current farming methods for food security"*, outlines the areas of integration and the pertinent activities which include *inter alia* identification of the planting seasons, seed variety choices, soil fertility management, food processing, grain preservation and storage; integrated pest management and weed control; and ultimately, social capital and the management of production shocks.

The call for Integration of Indigenous Knowledge

Knowledge is an embodied practice and should be addressed as an interface between the practices and discourses of the local communities and the external agents of change, which in our particular case will refer to the modern scientific methods (Long and Long, 1992). There is a growing acceptance of the need to involve the local people as active partners in all aspects of the research and development process. Scientific and technical knowledge can validate and upgrade indigenous knowledge and it drives modernisation. IK should be discovered, cultivated, harvested and promoted more vigorously for socio-economic transformation. The thesis of Farmer First was that the solutions to the problems posed by Transfer of Technology lay in the farmers' own capabilities and priorities.

Incorporating indigenous knowledge into planning allows culture and belief systems to direct the way in which information is collected and used. As much as farmers are encouraged to grow hybrid crop varieties due to environmental challenges, they should also be encouraged to complement these with indigenous varieties which have high nutrition value, long storage period and can easily be managed by low income farmers. Communities should share knowledge, lessons and experiences in the farming of indigenous crops, manure production and seed multiplication and storage.

Local people in general identify themselves more with new technologies, if their knowledge has been integrated into the whole knowledge generating process and, their ideas, experiences and creativity have been assimilated in the process. Resultant outcomes are generally adapted to local conditions; technologies are cheap, simple and based on locally available materials. Alcorn (1995) recognises that resources derived from ethnobotanical knowledge (indigenous knowledge) can contribute to the attainment of rural development goals which include: improving rural livelihoods, sustainable use of the natural resource base, improved well-being, health and nutrition, strengthened institutional capacity to meet the needs of rural people and the generation of capital surplus for financing industrialisation.

The ILEIA – Information Centre for Low External Input and Sustainable Agriculture advocates for an agriculture which makes optimal use of locally-available natural and human resources, such as climate, landscape, soil, water, vegetation, local crops and animals, labour, local skills, and indigenous knowledge. For this to be sustainable, it needs to satisfy the four criteria of sustainability namely economically feasible, ecologically sound, culturally adapted and socially just. The use of external inputs is not excluded but is seen as complementary to the use of local resources (Haverkort, 1995). The main sources of knowledge for Low External Inputs Agriculture are traditional agricultural practices, indigenous knowledge and scientific insights as developed in agro-ecology.

The critics to the integration model point out that 'Rural people's knowledge, like western scientific knowledge, is always fragmentary, partial and provisional in nature. It is therefore not easy to 'blend' or 'incorporate' local knowledge into existing western scientific procedures since it is not ready for extraction and incorporation (Thompson and Scoones, 1994). They maintain that

knowledge whether 'indigenous' or 'scientific', is inclusive in the sense that it is the result of a great many decisions and selective assimilations of previous beliefs, values, ideas, and images, but at the same time exclusive of other possible frames of conceptualisation and understanding. There are also critics who maintain that indigenous knowledge could be reduced to trivia if it is forced into the framework of western epistemology (Juma, 1987) and even devalued (Thrupp, 1987) if we simply collect the technically useful items of local knowledge in 'scientized packages'.

Integrated farming methods and crop production

The farming methods practiced by the people of Sauri have been learnt from different sources. Whereas the farmers admit to having learnt some of their present practices from their parents and grandparents and also from the cultural practices, modern farming learning methods have also contributed to the knowledge that the farmers currently use for crop production. The two go hand-in-hand and compliment one another rather than one replacing the other.

Some of the indigenous practices used by the people of Bar-Sauri MVP in food crop production include mulching using elephant grass, spear grass, small tree/shrub branches, banana leaves and fibres; use of organic manure such as animal wastes and crop residues and use of locally made pesticides (mixture of red pepper, human and animal urine, *neem* tree, tobacco and *Tephrosia vogelii* leaves).

Table 2 Integration of the farming methods.

		Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Valid	Yes	41	68.3	68.3	68.3
	No	17	28.3	28.3	96.7
	N/A	2	3.3	3.3	100.0
	Total	60	100.0	100.0	

Source: *Field Data*

The majority of the people of Bar-Sauri, 68.3% integrate the two farming methods while only 28.3% do not integrate. Of those who do not integrate, the majority use only the indigenous farming method as they are unable to afford the expensive farm inputs that come with the modern farming methods. The farmers have been able to incorporate the knowledge they get from the Agricultural Extension Officers and from the MVP staff into their indigenous practices.

It is clear that the highest percentage of farmers regarded the benefits of both the modern and integrated farming methods as the increase of crop production which in effect translated to an increase in food production at 85% in both cases. 6.7% of the farmers feel that integrating the two farming methods lead to intensified agricultural knowledge and preservation of genetic resources. This may look minimal, but this is likely to have significant impact in the future when all the farmers shall have learnt of the need for integration for sustainability of crop production. It is disheartening to learn that only 41.7% of the respondents feel that modern farming methods lead to increased income levels compared to 33.3% who feel the same for integrated systems. This does not augur well for the project given that it was aimed at moving the local community from simple subsistence to the level where they engage in farming as a full time commercial venture. The level of savings is 11.7% for integrated methods as compared to 0% for the modern farming method. However, this does not indicate that those who engage in the modern farming method only do not have savings.

Among the methods identified by the farmers where there are elements of integration of the farming methods include the use of both the indigenous LSV and the modern HYV seeds, the identification of the planting seasons, soil management techniques, pest-control mechanisms, weed

control, crop choices and the grain storage techniques. A small number of respondents agreed to integrate the methods but were uncomfortable with integration when it comes to seed choice and soil fertility management. They were of the opinion that it was in their own interest that they continue using the indigenous LSV and also the indigenous soil fertility managements as they are aware of the repercussions of continued use of chemical fertilizers. The farmers however, were of the opinion that integrating the two systems also led to a reduction in weed infestation. But on closer scrutiny, it emerged that the factor that was responsible for this reduction in weed infestation was the improved fallow for one season or more before planting the maize crops.

It should be clear that integration of farming systems or of knowledge systems in agriculture is not always a smooth process. There are always conflicts between the systems and this is what Long and Long (1992) calls the battlefields of knowledges creating an interface between the knowledge systems. It would be appropriate to outline the fundamental assumptions that have been made in this study for us to be able to appreciate the effects of the farming systems on crop production. First and foremost, there is an assumption that it is not the MVP only that has brought the modern elements of farming to this village. The people had been interacting with the Agricultural Extension Officers and personnel from the ICRAF and KEFRI and a lot of the modern farming methods were learnt from them. So, the MVP only emphasised on this and developed it further. Another assumption is that there is always a conflict in the systems interacting that lead to either a struggle or accommodation, or conflict versus harmony. There is need to understand what factors affect the integration of the systems, whether be they exogenous or endogenous.

It should be realised that integration of the farming systems depend on a number of factors which include *inter alia* the people involved (the actors), the time of the season, the activity and supporting environment like issues of access to, and ownership of land as the principal resource for any agricultural activity to flourish. The knowledge levels of the farmers also help explain their ability or inability to adapt the modern scientific methods easily. From the field data, 26.7% of the farmers do not have any form of education. This factor though not specifically mentioned can explain the trend of adoption or non-adoption of the modern farming methods. It can therefore be seen why the majority of those who did not adopt the modern farming methods were those without any form of education and they continued to practice purely, the indigenous farming methods. Those with at least primary level of education constitute the remaining 73.3% with 25% having at least secondary education. For this category of farmers, it was easier for them to have a blend of both the indigenous and the modern scientific farming methods as compared to the illiterates who generally tended to stick to the indigenous purely.

The time of the season also indicates whether one uses the indigenous method or the modern method or whether to integrate or not. In identification of the planting season, the same methods that were used in the indigenous system are used. Whereas 11.7% of the farmers indicated that they still use the movement of the birds to indicate the start of the planting season, there is abundant agreement that there are definite planting seasons as 96.7% for the indigenous system used that method as compared to 93.3% presently. Other methods that are relied on include the nature of the clouds, advice from village elders and advice from the MVP staff which accounts for 10%. Generally, the MVP staff advice the farmers to practice dry planting in anticipation of the rains, but still, this is guided by the definite planting patterns which show that planting was done around February and March. So even when the rains have not started around that time, the MVP staff would advice the farmers to do dry planting.

Another area where we find elements of integration is the grain preservation and storage. In preservation, the farmers use both the indigenous 'ash-method' while at the same time they use the modern pesticides. However, a great number of farmers still maintain that the indigenous 'ash-method' is very effective and also that the modern pesticides are not only expensive but also not effective in completely killing the stock-borers. The general perception of the farmers is that when

they use the two methods combined, then the effectiveness of both is enhanced, put forward again a strong argument for integration. It is also good to know that in as much as the farmers are using the modern grain storage facilities like the plastic sacks, plastic drums, metal drums and warehouses; they have also not forgotten about the indigenous storage facilities like the traditional granaries, the *Abundu*[4] and the earthen pots. This also confirms that the farmers are using their tacit knowledge of grain preservation to supplement the modern scientific methods. They have not completely given up the traditional methods, but they also have to make use of the modern methods.

In the management of soil fertility, the use of animal manure only has greatly reduced from 63.3% to the present 31.7% while the use of chemical fertilizer has increased from 23.3% to 93.3%. This is a great improvement which can be attributed to the MVP, but the extent of integration is affected by among other factors the high prices of the chemical fertilizers and the relative levels of wealth pitting those who are well-off and those who are poor. This has ensured that only the well-off farmers are able to integrate highly and achieve greater production, while the poor who are not able to afford the chemical fertilizers are getting very low production. This also has effects on the level of sustainability because we'll be asking ourselves, if the poor farmers are not able to effectively integrate, is their crop production likely to be sustainable? The problem with access to and affordability of the HYV seeds and chemical fertilizers has been the greatest issue that has greatly affected a majority of the farmers.

The initial assumption of the farmers was that the MVP was to continue providing them with free inputs until such a time that they would be stable financially before they pull out. However, the systematic reduction in subsidies (Sanchez, Denning and Nzigubeha, 2009) caught the farmers off-guard as most had sold their surplus produce cheaply and misused the funds. They were therefore, unable to buy the farm inputs in the second season and this impacted negatively on the level of crop production, a trend that has continued since then and continues to deteriorate. To make matters worse, this category of farmers are systematically reverting to their indigenous farming methods, a trend which will greatly affect the levels of sustainability of their crop production.

Other activities in the indigenous system that persist include the use of hoe digging. Generally, in the whole Millennium Village at Sauri, agricultural mechanisation has not taken root and this can largely be attributed to the land fragmentation that is so prevalent in Sauri area and the farmers having very small parcels of land that it would neither be cost-effective nor physically feasible to use heavy farming machinery like tractors. Even the use of ox-drawn ploughs is very limited to the few rich farmers who have relatively large parcels of land and who are consequently able to cultivate both for individual consumption and also for the market.

Table 3 Engagement in farming and integration of the farming methods cross-tabulation.

Why one is engaged in farming			**Do you combine both IK and Modern farming**			
			Yes	No	N/A	**Total**
Subsistence	Sex of Respondent	Male	10	3	0	13
		Female	16	5	2	23
	Total		**26**	**8**	**2**	**36**
Both subsistence and cash	Sex of Respondent	Male	6	3		9
		Female	3	2		5
	Total		**9**	**5**		**14**

Source: *Field Data.*

[4] A traditional granary which is small in size and usually put inside the house unlike the large one which is erected in the middle of the homestead. As a result of the increase in theft cases of grains from the traditional granaries, the people came up with this innovation of the small one to be kept inside the house.

The respondents were all in agreement that the LSV was of higher quality in terms of food value and was also easy to manage in terms of storage. However, managing the HYV grains is extremely difficult as they are easily susceptible to the weevil attacks which destroy them greatly. The HYV seeds are also known to require so much rains that if the rainfall is inadequate, then the crops do too badly. The farmers agreed that for those who had money to purchase the expensive inputs, then their output is extremely great whereas those who have little, their production is also little. The respondents were also in agreement that the HYV crops are not good for roasting and therefore they planted the LSV for quality food and the HYV only for commercial purposes.

Table 4 Benefits of different farming methods

Benefit	Benefits of Integrated farming methods		Benefits of Modern farming methods	
	Frequency	% Respondents	Frequency	% Respondents
Increases crop yields	51	85	51	85
Low weed infestation	22	36.7	14	23.3
Increases food production	51	85	51	85
Low attacks by pests	5	8.3	0	0
Increase in income levels	20	33.3	25	41.7
Increased savings	7	11.7	0	0
Increase in business investment	5	8.3	0	0
Ability to access input credits	0	0	0	0
Indigenous methods are not productive	1	1.7	0	0
Intensified agricultural knowledge/ Preservation of genetic resources	4	6.7	5	8.3
Don't know	3	5	7	11.7

Source: *Field Data*

Broadcasting versus line-cropping

It is clear from the villagers that they did not start line-cropping with the initiation of the MVP. They had learnt this from the extension officers, however, in their indigenous farming systems, those who still broadcasted seeds accounted for about 36.7% of all the farmers. The reasons for broadcasting were varied but the main one was that when the plants compete, one would be able to get good harvest when one plants more crops than few. They did not care about the quality of the produce. The driving force was quantity. But this is a practice that has steadily died out and with the initiation of the MVP, it is clear that none of the farmers is any longer using broadcasting as a planting method. The dying out of this practice has serious consequences on the sustainability of crop production because in the event that the indigenous seeds will not be doing well as a result of the line-cropping in future, then the farmers may get very low production and this may lead to food insecurity.

Broadcasting of seeds is contrasted with Line cropping where we find that in the indigenous farming method, this accounted for 68.3% compared with the present 96.7% after the initiation of the MVP. This shows clearly that the farmers have seen the benefits of line cropping which outweigh those of broadcasting and as such they have shifted to line-cropping. The benefits of line cropping include less competition for crop food which leads to high quality produce, the production also generally increases as compared to the crowded crops in broadcasting which lead to very thin maize crops. In the method of planting, as such there is no element of integration as the farmers have gone fully modern, but with likely serious consequences on the sustainability of the practice.

Mono-cropping versus Mixed-cropping

Shifting cultivation involves clearing and burning natural vegetation, cultivating the cleared area for a season or two, and then moving to a new plot while the old one regains its fertility under natural vegetation regrowth. Mixed cropping is an agricultural system in which several different crops are grown in close proximity, in a rotation system, or both. It also refers to the planting of different crops in the same field during the same season. Sole-cropping on the other hand is the planting of one crop per field per season while mono-cropping or monoculture, is the planting of a single crop in the same field for a succession of seasons or indefinitely.

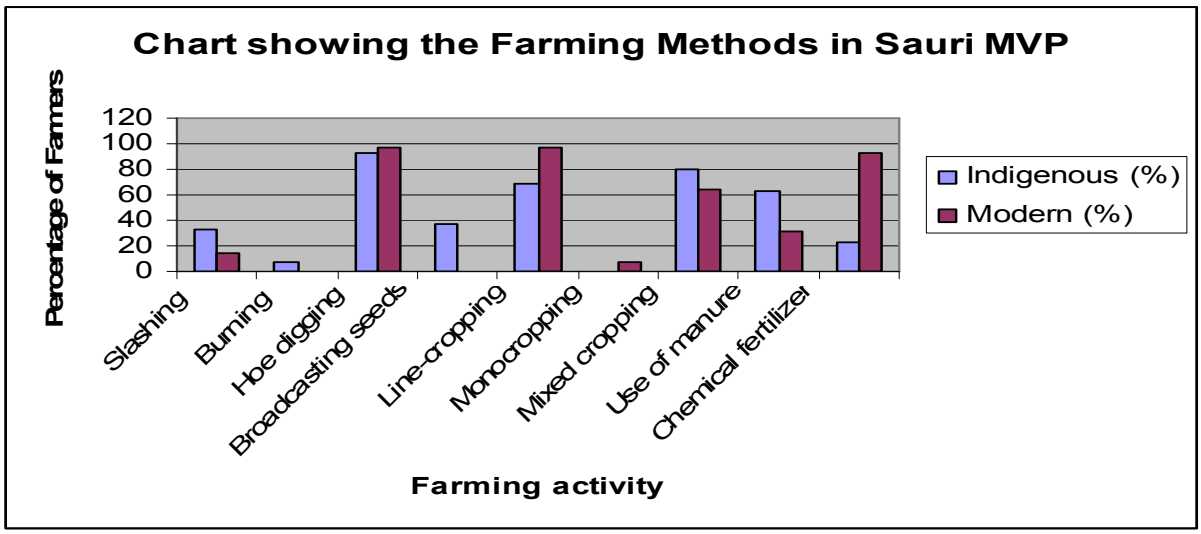
Mono-cropping is an agricultural practice in which the same crop is planted year after year, without practicing crop rotation or resting the soil. It severely depletes the soil, as the plant will strip the soil of the nutrients it needs. Mono-cropping generally reduces crop diversity, which is perceived as a bad thing both because the loss of biodiversity is unfortunate, and because if a crop does become subject to a particular pest or disease, a lack of biodiversity makes it especially vulnerable. Mono-cropping is very dangerous when natural disasters or shifting weather devastate a crop. A farmer with diverse crops could afford to take a small loss if one crop failed to yield, but in a region where only one crop is grown, the results can be catastrophic.

The most common mixed cropping system in Bar-Sauri is one in which the farmers manipulate three variables namely planting date, maturity period and harvest date. The benefits of mixed cropping include better and more reliable yields, a smoother labour input profile, better control of pests, weeds and diseases and mixed cropping also supplies a diversity of subsistence materials for example foodstuffs like staples and long duration and drought resistant crops such as cassava and vegetables. Mixed cropping can be regarded as a route to an indigenous agricultural revolution because the gains from mixed cropping are greater on soils of lower rather than higher fertility. The optimum densities also tend to be higher for intercropping systems. The explanation given by the farmers is that a degree of ‘crowding’ seems to stimulate intercropped plants to perform better – thus intercropping is a viable route to better yields. This is the same argument that had initially been advanced by the indigenous farmers regarding the rationale for broadcasting the seeds.

From the data collected, it is noted that in the indigenous farming systems, there was completely no mono cropping, while in the modern farming system, this figure has risen to 6.7%. Another notable occurrence is that the level of mixed cropping has drastically dropped from 80% in the indigenous systems to 65% in the present farming system. The resultant scenario is that a minority of the farmers are integrating the two systems while the majority are still practicing mixed farming. This is a case where the indigenous method advantages outweigh the modern advantages and the farmers are rational enough in their choices and options for integration.

According to Altieri (1999), mixed species cropping has been seen as a promising technique to develop sustainable farming systems because it often has multifunctional roles and can potentially provide a number of eco-services within the farm system. Examples may include the addition and recycling of organic material, water management, protection of soil from erosion and pest or disease suppression. This functional diversity contributes to ecological processes to promote the sustainability of the whole farm system. However, it is also important to note that these two cropping systems are a dichotomy such that it is not easy to integrate them. The farmers have no option but to adopt either. It is generally held in principle that intercropping offers the farmers the opportunity to exploit nature’s principle of diversity on their farms and that it also gives higher cash returns and total production per hectare, relative to those of monocultures.

Figure 2 Chart showing the farming methods in Sauri MVP.



Source: *Field Data.*

Identification of the planting season

It is clear that the people of Bar-Sauri have two planting seasons. The long season is referred to as the '*Chwiri*' with the planting done between February and March and the harvesting in June and July. The short season is referred to as the '*Opon*' with the planting in August and the harvesting in December. Before the initiation of the MVP, the farmers used to plant maize and beans during the long season while during the short season, they planted some yellow maize called '*Nyamula*' which matured relatively fast and could do well even with very little rainfall. Some farmers could leave their lands to lie naturally fallow during the short season. Thanks to the MVP, the farmers can now grow improved fallow crops on their fallow lands which not only enrich soil fertility but also control weed infestation.

The farmers are aware that continuous cultivation is detrimental to soil fertility. They are therefore grateful that they are also being encouraged by the MVP to cultivate for only one season – the long season and avoid the short season cultivation. The movement of '*ogungo*' birds heralded the start or the approaching of the rainy season. So once the farmers had prepared their lands, they were ready to plant after three or four days of rainfall. Generally, according to the definite weather pattern that the farmers used, they usually planted before the fifteenth day of March each year.

There were crucial beliefs that the first rains usually brought glad tidings and that is why everyone wanted to plant with the first rains. Crops planted with the first rains also did very well in terms of produce. This cultural belief was given scientific backing when the MVP also encouraged the farmers to adopt the practice of early farm preparation and dry planting in anticipation of the first rains which they say are full of essential nutrients for the crops.

Seed Variety Choices

(i) High Yield Variety versus Low Seed Variety

There are various reasons why people are engaged in farming activities at the MVP. From the study, it emerged that 75% of the farmers are still engaged in subsistence farming while only 25% are engaged in both subsistence and cash. However, it was clear from the study that there is no farmer who is engaged purely in commercial agriculture. Of the farmers engaged in Subsistence farming, only 22.2% planted the HYV seeds, 42.2% planted the LSV while 35.6% planted both the

HYV and the LSV. This shows that in terms of subsistence farming, there is high integration in the choice of seeds planted. On the other hand, for those who engage in farming for both subsistence and commercial purposes, the highest number accounting for 46.7% plant the HYV, this is followed closely by those who plant both HYV and LSV at 40% while only 13.3% grow the LSV. This is a clear manifestation that the growing of LSV alone cannot lead to sustainable commercial agriculture and that is why the farmers have resorted to growing the HYV for high crop output while the LSV is for family subsistence and also for the preservation of genetic resources. In general, the figures indicate that of the farmers taken in general, only 28.3% plant the HYV only, 35% plant the LSV only and 36.7% planting both HYV and the LSV. This latter case puts up a strong argument for the element of integration at least in so far as seed variety choice is concerned.

(ii) Locally adapted crops and preservation of genetic resources

Locally adapted crops that are part of local knowledge systems include varieties of major and minor crops, multipurpose trees and pasture. Such crops are often ignored by outsiders who introduce new crops and exotic multi-purpose trees without considering the value of the resources being replaced. These crops usually have a lot of value to the local people. Improving the yield of locally adapted, traditional varieties or integrating the management of local and high-yielding varieties are seldom taken as goals by outsiders (Alcorn, 1995). Local minor crops fulfil local food needs and offer critically important nutritional variety to diets and should therefore not be discarded. It would be interesting to see research done on the application of fertilizer to the local seed varieties to see how they perform instead of the farmers having to experiment on their own with fertilizer that is ideally suited for the high yield variety.

The Insect Resistant Maize for Africa Project (IRMA) combines conventional and transgenic approaches to produce maize varieties resistant to stem borers. The IRMA project aims to contribute to food security in Kenya and through replication, to the rest of Africa. It has been suggested by Ayele, Chataway and Wield (2006) that the Genetic Modification (GM) route also offers benefits in terms of environmental and human health impacts from reduced use of pesticides.

Farmers' ability to acquire and maintain seeds is important for continued agricultural production. Orindi and Ochieng' (2005) takes the particular issue of seed acquisition and management as a strategy to recover from drought-related effects. They show how seed fairs have been used in drought recovery. They shed light on how assistance given to communities during disasters can be used, not only to help them recover from a particular event, but also to strengthen their own coping strategies, institutions and economies that may prove valuable in the long run. The use of seed fairs as opposed to formal method of seed relief distribution strengthens local economies through sale of seeds by local suppliers (farmers and grain/seed stockists). It also exposes farmers to new crop germplasm from research organisations which they would plant in the following season. The community-based seed intervention strengthens the community seed systems.

Despite having three successive crop failures, seed supply through the seed fairs was adequate in 2001 indicating that local seed systems are resilient and that local farmers and markets can supply the required seeds. Omanga (2002) observes that since local sources could provide enough seeds after such a long and continuous drought season meant that seed aid in response to increased climate-related disasters should focus first on local resources. The availability of local seeds during fairs enables the farmers to purchase local varieties and improved seeds that have passed through generations and cycles of planting, contributing to the overall conservation of genetic resources or diversity

Table 5 Cross Tabulation – Seed Planted and Agricultural engagement

		Seed Variety Planted by farmers						
		HYV	%	LSV	%	BOTH HYV and LSV	%	TOTAL
Why one is engaged in farming	Subsistence	10	22.2	19	42.2	16	35.6	45
	Both Subsistence and Cash	7	46.7	2	13.3	6	40.0	15
Total		17	68.9	21	55.6	22	75.6	60

Source: *Field Data*

Table 6 Seed variety planted by farmers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High Yielding Variety	17	28.3	28.3	28.3
	Local Seed Variety	21	35.0	35.0	63.3
	Both HYV and LSV	22	36.7	36.7	100.0
	Total	60	100.0	100.0	

Source: *Field Data*

In terms of indigenous seed choice, the majority of the farmers opted for the '*oking*' which they regarded as the best grain type for the seed because it was shinny and hard for the weevil to penetrate. They also chose the '*radier*' seed because of good production output and very fast maturity.

Most of the farmers who planted both the HYV and the LSV admitted that the larger portion was for the HYV due to the huge production associated with this while only a small portion was reserved for the LSV for purposes of preservation of genetic resources. The farmers cannot take chances with their genetic resources because it is already clear on their mind that the HYV crops cannot be re-planted and their prices continue to sky-rocket. So it would mean that in case of any eventuality they would resort to their indigenous genetic resources. The farmers usually planted the best grain seeds, but in the eventuality that these did not germinate as was sometimes the case, then any seed could be planted. Other respondents also grow the LSV because they feel that it is easier to store in that it is hardy and is not easily attacked by the pests. They are also discouraged by the HYV seeds because these keep changing.

It has been realized that LSV does not do well even with chemical fertilizer. However, HYV seeds need proper drying and dusting with ashes for proper storage. Most of the respondents who opted for the HYV seeds mainly gave the reason for the bulk harvest. It is also important to note that even those who have opted for the modern scientific methods of farming still they have not forgotten about the indigenous LSV which despite its low production, is reputed for being 'heavy' in terms of food quality and does not require so much rainfall for it to do well unlike the HYV. Most of the farmers who are expecting bulk harvest during this harvest season are either those who had practiced dry planting or those who had planted during the fall of the first rains. This therefore underscores the importance of early preparation of land and waiting for the rains. Since LSV did not require too much rainfall to mature, whenever there was excess rainfall even if it did not flood, the crops usually turned yellow in colour and performed very poorly.

There is no specific cash crop grown by the people of Sauri. What they use as food crop is what they would also sell in cases of emergency, although there are a few farmers who have turned fully commercial and the crops they grow include the staple maize, bananas, vegetables, onions, tomatoes and chillies. Sweet potatoes and cassavas were generally grown as strategic foods which

usually assisted the farmers in case of production shocks. The farmers have decided to continue with the growing of the LSV to preserve the indigenous genetic resources and also to ensure that in future when they may be unable to buy the HYV seeds, then they may have something to plant.

Soil Fertility Management

(i) Manure versus Chemical Fertilizer Usage

Another area where we find elements of integration is in the use of manure and that of chemical fertilizers. From the study, it emerged that 63.3% of the farmers were using animal manure prior to the initiation of the MVP and this has dropped to 31.7%. The farmers indicated that using manure alone cannot yield sustainable production, so they have to use it as a supplement. To the farmers, the soils have grown used to manure alone that the production level seems to be the same without any external inputs. To improve on the production, therefore, they use the two together. Prior to the initiation of the MVP, only 23.3% of the farmers were using chemical fertilizers. This has drastically shot up to 93.3%. This shows that the farmers have known the value of chemical fertilizer as an input for its increased production and they have therefore almost wholly embraced it. However, the remaining 6.7% who have not embraced the use of chemical fertilizers are wary of the likelihood of severe side-effects of the use of these inputs. They are well aware that the toxic chemicals found in fertilisers can be absorbed into the plants and enter the food chain via vegetables and cereals, although the biggest health risk is when the chemicals seep into the ground water which is then extracted directly for drinking water. However, it is important to indicate that in terms of soil fertility management, manure and chemical fertilizer can be integrated and can be used together at the same time, unlike the dichotomy which exists between the mono-cropping versus the mixed cropping.

Prior to the initiation of the MVP, the farmers did not know how to ration the use of fertilizer. This was therefore one of the benefits of the new farming methods. Initially, the farmers used to put the seeds and fertilizer together and in most cases, the seeds didn't germinate because they were 'chocked' by the fertilizers. However, with the MVP teachings, they are supposed to mix the '*boma*' manure with the DAP manure, cover these with some little soil and then put the seeds on top before covering the seeds with soil. This has proved to work very well.

It has emerged from the study that the fertilizer brought about by the modern scientific farming is actually not a method of managing soil fertility. Some farmers maintain (and rightly so) that the fertilizer and the urea for top dressing are only food for the crop but does not enhance soil fertility. To them, in fact fertilizer depletes soil fertility and should be avoided if possible and we resort to the use of the improved fallow crops for those who have big land and *boma* manure and farmyard manure for those who have small farms.

As a way of managing soil fertility, the people after harvesting usually grazed animals on the farm and the animal waste added fertility to the soils. In the farming calendar, it was clear that December was the month for digging, January for the second digging commonly known as *buso*. The planting period was usually from February although this could be delayed to either March or April depending on the availability of rainfall.

(ii) Integrated Soil Fertility Management

Integrated use of inorganic fertilizers and organic manure such as compost, green and farmyard is in many ways advantageous as soil organic matter is replenished and builds the nutrient reserve in the soil. Organic manure releases nutrients slowly, reducing the risk of leaching and improves soil water retention. The application of organic manure such as compost to soil is the quickest and most effective way of raising the organic matter levels for the soil fertility improvement. Organic

manure imposes rainwater infiltration, water holding capacity, raises soil pH in acid soils and increases fertilizer use efficiency. Pretty *et al* (1995) argue that low-external input technologies improve pest management, conserve soil, water and nutrients, recycle wastes and utilise local sources of water efficiently. The selection of elements appropriate to local livelihoods will best be made by rural people, who know most about local conditions. This participation in planning, implementation and maintenance has been shown to produce highly effective, efficient and sustainable solutions, but generally only on a small scale.

Pretty *et al* (1995) assert that farming households do not always see the modern varieties and associated packages of external inputs in the same way as researchers and extension workers. Their criteria for evaluating and making choices are frequently so different that the best products of research services are sometimes rejected, while others judged as inappropriate are chosen by farmers as favourable (Pretty *et al*., 1995:128). The people of Bar-Sauri have not wholly embraced the HEI because of the problems with storage of the grains and also their perception of it is that it is not of good meal quality. The grain is highly subject to insect damage during storage and is of very low starch content. Foe high productivity of grains, farmers need access to the whole package which includes the HYV seeds, enough rainfall, labour, capital or credit facilities, fertilizers and pesticides, yet this is not always possible. Other integrated methods of soil fertility management include the growing of the '*osinde*' grass in the less fertile regions to induce fertility, growing of Napier grass (*Pennisetum purpureum*) which raises the soil level and quality and using terraces and gulley to control or prevent the top soil from being washed away.

It is virtually impossible to maintain crop production without adding nutrients. When crops are harvested, nutrients are invariably removed and so have to be replaced. Livestock manures have been the traditional key to maintaining agricultural productivity in LEI systems, replenishing nutrients and improving solid structures. Composting is also a technique used and combines the use of animal manures, green material and household wastes. Legumes are also grown together with or before a cereal crop. This improves both total yields and stability of production. Agricultural development emphasising both HEI and LEI strategies are littered with spectacular failures where local perceptions and needs have not been understood. Where these local factors are not involved, projects are less effective as fewer people adopt the new technologies, and these are often not sustained (Pretty *et al*, 1995:138). Along this same argument, Rhoades (1989) also observed that farmers select from technology complexes only elements that suit their constantly changing circumstances. However, be it as it may, they just incorporate the new technology alongside their existing practices and do not discard their old practices at all. They only use the elements of the new technology that interest them.

Food Processing, Grain Preservation and Storage

According to a study conducted by Agea *et al.,* (2008) in Uganda, indigenous practices used in food processing include: Sun-drying, winnowing, pounding using locally-made mortars, roasting and frying foods and grinding using stones. These appear to be the same practices that are used by the people of Bar-Sauri given that the MVP has not as yet introduced in the village modern food processing technologies. However, it should be realised that there are posho mills where the local people take their maize for milling. The use of locally made pounding mortars and pestles and grinding curved stones to process foods such as groundnuts and sorghum was also found to be a common practice in Bar-Sauri village.

As an indigenous grain storage strategy, sneeze wood is used for storing maize. 'Sneeze wood' (*Ptaeroxylon obliguum*) leaves and bark are used for storing maize. Branches of sneeze wood are used to store unshelled maize. The bark of the tree is burnt and the ash is also mixed with grains while storing. The bark is grey when young and turns brown on ageing. The powdered bark is also an effective pest repellent. The smoke out of burning sneeze wood also helps in warding off insects

during storage of maize. According to Kitange, one kilogram ash or sneeze wood powder is mixed with 20 kilograms of grains (Kitange, 1999). The use of ash for grain preservation has a long history in the Bar-Sauri and continues to be popular with the farmers. Apart from the use of sneeze wood, the farmers also use leaves from some trees which have been known to have medicinal values. The leaves are then burnt and the powder used to preserve the grains.

Another indigenous seed storage mechanism is the use of new earthen pots. These are usually brushed with cow urine and left to dry in the shade for a day and in the sun for another day. Grains can be stored in such pots where they will be safe for one or two years. Seeds meant for future sowing are mixed with an equal quantity of sand and filled in new earthen pots. The mouth is covered with a lid and sealed with dung. When it is time to use the seeds, they can easily be separated from the sand with a sieve. The vessels are covered with lids and sealed with cow dung.

It emerged that the reason why the people were using ashes to dust their grains for preservation was because the ashes make the grains not get moist easily and the taste is so sweet to the weevil more than the grain. The weevil like the powdery things and since the ashes are from burnt cow-dung and this being a staple food for the weevil, they will concentrate on eating the ashes and forget about the grains. The maize seeds were also hung over the fireplace to make them hard from the soot, hence impenetrable for the weevils which would otherwise have attacked the seeds.

For grain storage, it was the Luhyas who are neighbouring the village who used to make the *Abundu* for storage in the house after the people became wary of the grain thieves from the traditional granaries which were usually in the compound of the homesteads. Some farmers admitted that they did have some surplus grains to market before the MVP and these they could sell to the Asian general merchants who were at the Yala shopping centre. The main units of measurement were the *ondong* equivalent in measure to the modern 250-gram tin, the *adita* which is equivalent to the modern 2-kg. *goro-goro* tin and finally, the *hamiero* which is equivalent to the 20-kg. debe.

The farmers shifted from the use of the traditional granaries outside the houses but in the homestead, to the use of *Abundu* which is similar to the traditional granary but is smaller in size and is put inside the house. The reason for this shift was that thieves had started stealing grains from the granaries at night and the reaction was to protect the grains from the thieves. It was not possible to get a traditional granary in any of the homesteads sampled.

Integrated Pest Management and Weed Control

The most common weeds that have been identified in Bar-Sauri are *Ombugu* (Couch grass / *Digitaria scalarum*) and *Hayongo* (Witch-weed / *Striga hermontheca*). Before the initiation of the MVP the most common methods of weed control were consistent weeding and hand-pulling or uprooting of the weeds. However, some older farmers indicated that the use of cow-dung manure also stifled weed growth and throwing of wet cow-dung in the farm either wet or dry also reduced the growth of weeds. They could not however, give an appropriate explanation for the adoption of this method only indicating that it had been done that way by their parents and grandparents and that they had learnt from them as an aspect of indigenous knowledge.

It emerged that before the MVP, the farmers were using *boma* manure to eradicate the *hayongo* weed. They could also plant sweet potatoes on a parcel of land for about a year to raise the soil levels or increase the soil depth and hence improve the fertility of the soils as it also eliminates the weeds in the process. It has been known that the *hayongo* weed only grows in poor soils and is one of the indicators of soil infertility. So the improved fallow trees like *Calliandra calothyrsus*, *Sesbania sesban, Tephrosia vogelii* and *Tephrosia candida* that improve the soil fertility usually eliminate the weed.

Integrated Pest Management involves the conjunctive use of a number of pest control strategies in a way that not only reduces pest populations to acceptable levels, but can also be sustainable and non-polluting (Pretty, 1995:20). This is another method that the farmers in Bar-Sauri are adapting with time. They are steadily using leaves from trees which have been known to have medicinal value, to protect the crops against pest attacks.

Agea *et al.,* (2008) indicated in their study in Uganda that majority of the households reported to be using locally-made pesticides red pepper, banana juice, wood ash, citrus lemon leaves, neem tree, tobacco and tephrosia leaves to control array of pests such as maize stem borers and cabbage diamondback moths that food crops while in the gardens and those such as rodents and bean weevils (*bruchids*) in storage. The study also reports that the use of locally made concoctions as pesticides to control pests that attack crops while in the field and while in storage was common in Mukungwe Sub County, Masaka District. Most farmers tended to use mixtures of red pepper, tobacco and *Tephrosia vogelli* to manage insects and animal pests that attack crops or stored produce. (Agea *et al.,* 2008: 6). It is interesting to note the similarity between the study findings in Uganda and Bar-Sauri village.

Table 7 Soil Fertility Indicators plant species

Soil Fertility		**Soil Infertility**	
Local name	**English name / Botanical name**	**Local name**	**English name / Botanical name**
Odagwa	Cator oil / *Ricinus communis*	*Hayongo*	Witch-weed / *Striga hermontheca*
Onyiego	Black jack / *Bidens pilosa*	*Mapera*	Guavas / *Psidium quavaja*
Siala	Markhamia lutea / *Platicalyx*	*Osinde**	Thatching grass / *Pennisetum purpreum*
Ombugu	Couch grass / *Digitaria scalarum*	*Ombugu*	Couch grass / *Digitaria scalarum*

Source: *Adapted from Otwoma, 2004.*

** Note that **osinde** or thatching grass (**Pennisetum purpreum**) is an indicator of soil infertility; however some farmers indicated that a way of managing their soil fertility was to plant the grass so that as it does well in the infertile soils, it raises the depth of soil levels and at the same time provides material for thatching.*

There was a shocking revelation from some farmers that they did not want to completely finish *ombugu* weed because where there is no *ombugu*, soils are shallow and crops do not do well there. They had observed that where there is *ombugu* weed, it showed that the place was very fertile. The only problem is that it denies the plants food. The planting of beans was also seen by the farmers as a way of reducing chances of growth of weeds because the leaves cover the weeds underneath and does not allow them access to light.

With regard to post-harvest pest control, the people still prefer preservations using ashes because they believe the chemical powder used for modern preservations can have side effects. The chemicals also have pungent smell which discourages the farmers from using it. It has also been realised that the reddish-brown '*osama*' weevil is too tough for the chemicals and only the ashes can control them effectively. The new powder pesticide introduced by the MVP kills the weevil instantly while the ashes only ensured that even if the weevil was there, it did not attack the crops. Integrating the two will now guarantee the safety of the crops against weevil attacks. The farmers use the chemical powders like Actellic Super, Skana Super and the Spinto dusting powders.

Management of production shocks

There were indigenous strategies that were in place to cushion those who were food insecure. During periods of plenty in one village, the farmers freely donated to their relatives and friends who were in scarcity. In case of misfortune, such as the vagaries of weather or other natural or even man-made calamities the burden of misfortune was shared across the community.

During times of floods, the people depended on cassavas, bananas and sweet potatoes. Millet was also used as a food reserve for emergency purposes. Flooding is one of the great production shocks that the village has witnessed. In most cases, the strategies to deal with this kind of shock were limited to either leaving everything to fate or to rely on relief donations. There are also farmers who addressed these shocks through crop diversification and inter-cropping. Growing crops like cassava, sweet potatoes and bananas helped when other crops failed. It also emerged that the growing of root tubers enhanced soil fertility.

Given that crop production is affected by the vagaries of weather, it means that if the production is thus affected, then the farmers will have to loose their household goods as collateral to the bank. This will just enhance the levels of poverty and will not go along helping to achieve the objective of the MVP of transforming the village from subsistence to self-sustaining commercial activity and ultimately help in achieving the MDG 1 on Eradication of Extreme Poverty and Hunger.

There are also instances when the people were forced to look for wild fruits like *ochuoga*, *mapera* (guavas), *jamna*, *mzabibu* (grapes) and *olemo* (wild fruit). There was what was known as the male *dero* also known as *mondo*. This was used to store grains from the man's garden and was not to be used until times of emergencies or during production shocks. This was like the modern day strategic grain reserves. During the shocks, the man could call his wife (and usually wives, given the polygamous nature of the Luos) and distribute to her (them) grains from the *mondo* (special storage) depending on the number of children the wife had.

EFFECTS OF INTEGRATION ON CROP PRODUCTION AND FOOD SECURITY

This section attempts to address the third objective *"To find out the effects of integration on crop production and food security"*. To this end, it outlines some of the effects which include the area under cultivation, crop diversification and food security, adoption of modern farming methods, negative effects of culture, farm acreage, the loaning scheme, the school feeding programme, provision of farm inputs and finally, the limitations of indigenous knowledge utilization, the establishment of the Community Cereal Bank and finally how crop production and food security is enhanced through this integration. It also addresses the issues of sustainability of crop production for food security from both the perspectives of the farmers and also from the perspective of the implementing staff from the MVP.

There should be a greater productive use of local knowledge and practices, including innovative approaches not yet fully understood by scientists but widely adopted by farmers. There should be an increase in self-reliance among farmers and the rural people. In general, it is appropriate to appreciate that sustainable food security strives for the integrated use of a wide range of pest, nutrient, soil and water management technologies. As natural processes increasingly substitute for external inputs, so the impact on the environment is reduced.

The pertinent objective of the Millennium Village Project is eradicating extreme poverty and hunger. To achieve this, agriculture is given prominence and it is anticipated that the transition from simple subsistence to self-sustaining commercial activity would go along way in ensuring that poverty is eradicated and food security ensured. In as much as the activities of the MVP are

spreading to the adjacent villages and eventually to cover the whole of Siaya District, it would be a study in futility if we replicate failures. It would therefore be appropriate that the pilot project is a success before this can be replicated elsewhere.

Three elements have been singled out to guide in the measurement of sustainability of crop production. These are: the persistence and the capacity of the crop production to continue for a long time – which has been indicated to be at least a decade; resilience and the ability of the production to bounce back after unexpected difficulties like the current drought, and the environmental factors where the activities are not damaging or degrading the environment or natural resources. We should be asking ourselves the questions, are we able to access land for farming? Are we able to get seeds and other inputs at the right time? In the event of crop failures, do we have a fallback position?

What is the farmers' perspective on Sustainability?

The perspectives of the farmers on sustainability are addressed at the two levels that had been identified by Gray (1991) namely the level of production and also the level of consumption. It is the farmers who are the producers and at the same time, we have farmers who are consumers. At the level of production, the question that the farmers are asking is whether it is possible for them to continue getting bountiful harvest in the present conditions and to continue with this kind of production in the future? At the level of food consumption, they are asking themselves, if they are capable of getting enough food now and even surplus for sales, will they be capable of continuing with this trend or is the production likely to fall? These two are very crucial questions that will determine the level of sustainability from the farmers' perspective.

It is also important that effectiveness is improved as the people should feel an ownership of the development intervention and are willing to contribute to its maintenance and improvement. How do the people feel a sense of ownership? The local community feel that they should be involved at all the levels of decision-making and ensuring that their voices are heard. Since this has not been the case, the locals have already started referring to the project as 'that one of the MVP' and not 'our project'. This leads to a sense of recklessness especially when it comes to the management of any input got form the MVP as they regard these are freebies which should be perpetual.

What is the MVP perspective on Sustainability?

From the perspective of the MVP, the sustainability of the project is to be based on the ability of the farmers to continue with the activities that have already been initiated by the MVP. These include activities in the agricultural sector, health, water and sanitation, education, environment and energy among others. Particularly in the agricultural sector, it will be measured by the ability of the farmers to access the necessary farm inputs like the improved HYV seeds, chemical fertilizers, improved fallow seeds, herbicides and pesticides. It will also be measured in terms of capacity building and by assessing how many locals shall have had the requisite trainings in the modern farming methods to disseminate the same to the villagers. To this end, the project has organised workshops and seminars to the farmers with a view to building their capacity. The project has also been able to benefit from the government in terms of the Agricultural Extension Officers (AEOs) who were seconded to it working directly from the project office. The crucial question that needs to be asked is whether after the withdrawal of the MVP Staff, will the government continue with the attachment of the AEOs to the village?

Crop diversification and food security

It has emerged that the same food crop namely maize is the one also that serves as a cash crop, although there are some farmers who grow bananas as a cash crop. The MVP has been able to

introduce the planting of fruit trees as a long term mechanism to ensure the sustainability of crop production beyond the growing of the cereals and in particular maize production. The farmers have also diversified their production by growing vegetables. Some of the vegetables grown by the farmers in Bar-Sauri include kales (*sukuma wiki*), cabbages, tomatoes, onions, chillis and a modern germplasm of *osuga*. With improvements in horticultural activities, the farmers are able to guard against production shocks that may affect the production of maize and beans. The farmers have also been introduced to the practice of grafting mangoes and oranges and also growing new varieties of fruits such as pawpaw and avocadoes for high quality fruit production and income generation. They are able to sell the seedlings to the MVP which does the marketing.

Adoption of modern farming methods

In order to enhance the performance of crop production in the MVP, the villagers are of the view that appropriate measures should be put in place for the full adoption of the modern farming methods, the need to make easy access to farm inputs, the need to consider the status of the poor in the society especially those who have little or no land to farm and the widows. However, the farmers feel that in as much as they should adopt the modern farming methods, there are some indigenous methods that they cannot do away with. These include the use of '*boma*' manure and also the indigenous grain storage mechanism of dusting with burnt cow dung ashes. These strategies should therefore, be integrated with the modern for enhanced performance.

Negative Effects of Culture

Cultural traditions like the family having to wait for the first wife to plant seeds before the other younger wives could do also affect crop production. This usually happens when the first wife is a lazy one and does not prepare her land early enough. This means that she'll not be able to plant early and this will affect the production of all the other wives who will have to wait for her. Jealousy and enmity among the wives could also lead to waste in crop production because during harvest time, the first wife could intentionally decide to delay harvesting so that the younger ones who usually have smaller children to feed could also not harvest at the right time.

Farm Acreage

It is worth noting that the MVP initially gave seeds and fertilizer according to one's size of the *shamba* or garden. It therefore followed that those without land were disadvantaged from the word go. It is a pity that this initiative was aimed at and targeted the poor in the community, but from the initiation, it is evident that they have been greatly sidelined. This therefore, raises crucial issues of sustainability and the ability of the initiative to lift the community out of abject poverty.

The Loaning Scheme

It has also emerged that the MVP just gave the initial seeds and fertilizers and then left it for the people to buy thereafter. SAGA started giving people loans in terms of farm inputs, but since they did not have appropriate follow-up mechanisms and security precautions, the people defaulted in repayment and they had to leave. Equity Bank has since taken over from SAGA to give loans with strict commitment to repay in the forms. This however, has only attracted those with the means to repay and it effectively locks out the poor without any form of getting security.

The School Feeding Programme

As a result of the improved crop production due to the initiation of the MVP, parents with pupils in the local schools are expected to make contributions to the school feeding programme by donating four tins of maize and two tins of beans per child per term. This translates to twelve tins of maize

and six tins of beans per child per year. However, with the production output reducing by the years, there are fears that it may be just a matter of time before the whole programme goes crumbling.

Provision of Farm Inputs

The effect of climate change has led to the non-predictability of planting seasons. Some farmers start planting after the fourth day of rains only to be disappointed when the rains fail again for a very long period. The pricing of farm inputs is way above what the majority of the farmers can afford. It therefore means that those who cannot afford to buy the inputs will have to resort to the indigenous methods of farming using the indigenous seeds and no chemical fertilizers.

Limitations of Indigenous Knowledge utilization

One of the major limiting factors is its lack of documentation. When IK is not documented, useful information that could be exploited to enhance food security are lost from one generation to another. Other limitations include the inability of the locals to attribute a scientific explanation to their procedures, despite the fact that they do work. Some local practices and technologies are also time demanding and may not be replicated on large scales. Examples of these include the use of ash for grain preservation, where it was admitted that it would be impractical to use this indigenous technology for storage of large amount of grain for example the ones that were being stored for the people at the Yala Cereals and Produce Board.

CONCLUSIONS AND POLICY IMPLICATIONS

To understand the importance of indigenous knowledge in the context of the agricultural practices at the village and to assess whether there are elements of integration, a lot of questions come to mind. It is the analysis of these questions that will help us understand the different levels of eclectic mixes in which the farmers are engaged in their farming activities. What are the mixes at the level of gender? Are there more men adopting the modern farming method than women? What factors affect the adoption of the new farming methods? Are the farmers actually depending on the produce from the farm only for their livelihood or are they able to get some supplementary support from husbands working in the towns? These and other questions are important to understand whether the people actually depend on agriculture as their sole source of livelihood or not.

There are some families who are engaged in basic gardening and not actual farming where they only depend on the produce from the farms for food. Such kind of families will not be able to feel the hardship in the event of unfavourable weather conditions leading to poor crop production or in the event of any other unforeseen crop production shocks.

Another issue which has not come out clear in the study and which should generate further study is that of the distinction between subsistence and commercial farming. It is clear that from the data obtained, no farmer was purely engaged in farming for purely commercial purposes. There were farmers however, who were engaged in subsistence farming but because of reasons beyond their control, they could still sell some of their little produce to take care of emerging urgent issues to be addressed such as medication, buying household basics such as cooking oil and paraffin and some even to get money to take care of funeral expenses. So the issue of clear-cut distinction between subsistence and commercial agriculture is still contentious and calls for further study.

The choices of the seed variety also need to be further investigated because there are so many different mixes that are available at that level. How do people choose to plant HYV or LSV? What are the factors that affect the choice of the seeds? What factors affect the use of manure and that of

chemical fertilizers? Are there farmers who use chemical fertilizers with LSV and vice versa, are there farmers who use HYV without chemical fertilizers? What factors affect these choices?

Recent development in the field of agriculture and rural development has seen a steady rejuvenated recognition of indigenous knowledge for sustainable development. However, this recognition has not downplayed the role that modern scientific knowledge has played. It is therefore justifiable to advocate for a marriage-of-convenience between the two knowledge systems for effective output and eventual sustainability. In this development, the Executive Board of the International Fund for Agricultural Development (IFAD) approved the IFAD (2009) Policy on Engagement with Indigenous Peoples. Among the principles of engagement, it is noted that:

> *In enabling poor rural people, in particular indigenous peoples and ethnic minorities, to overcome poverty, IFAD will acknowledge and build upon the asset of their cultural distinctiveness. It will assist communities in taking full advantage of their traditional knowledge, culture, governance systems and natural resources, all of which form part of their tangible and intangible heritage. IFAD will value indigenous peoples' knowledge and practices in investment projects, and will build on these assets by supporting pro-poor research that blends traditional knowledge and practices with modern scientific approaches. Particular reference is made to indigenous women, also as bearers of rich varied traditional knowledge systems.*[5]

In line with the overall study objective of examining the effect of integrated indigenous knowledge on food security, this study concludes that there are elements of integration of the two farming methods in the context of the Millennium Village Project at Bar-Sauri. However, it is evident that this integration was not anticipated at the initiation of the project and that it is either done unconsciously or as a last resort because it is the only fallback position available to the people. However, the general agreement is that without consciously integrating the two farming methods, it is unlikely that the interventions of the MVP will lead to food security on their own without taking cognizance of the role of indigenous knowledge. It is also clear that indigenous knowledge on its own cannot be a panacea to the crop production shocks. However, in agreement with Robert Chambers' earlier assertion, the two are complimentary in their strengths and weaknesses and combined, they may achieve what neither would alone.

In conclusion, therefore, this study notes that in as much as outright integration may not be possible at the systems level for the two knowledge systems, there has been a lot of this at the activities level and in particular seasons. What now needs to be done for the future of indigenous knowledge and scientific knowledge is that of combining the different eclectic mixes that are available for the farmers and assess what factors affect the eclectic mixes. It will be possible then from a study of the different eclectic mixes that we are able to ascertain the choices made and the effect of each choice on the sustainability of crop production for food security.

POLICY RECOMMENDATIONS

1. National Policy on Indigenous Knowledge

Conspicuously missing in Kenya is a National Policy guiding indigenous knowledge research, including guiding principles on the integration of indigenous knowledge. Such a policy should clearly state that before any development intervention can be approved by the government, it should clearly outline how indigenous knowledge is to be integrated in the particular intervention

[5] IFAD Executive Board meeting in Rome, Italy on 14 – 15 September 2009 during it 97th Session approved the **'Policy on Engagement with Indigenous Peoples'**, which had been prepared after a consultation with indigenous peoples' leaders and other experts on a discussion paper on IFAD's engagement with indigenous peoples, held on 18 March 2008 at IFAD Headquarters.

in much the same way as Environmental Impact Assessment is a pre-condition for the initiation of any development project.

2. Organise Community Agricultural Shows

The community should be able to organize agricultural shows along the lines of the Agricultural Society of Kenya shows. These would make it possible for farmers to display their products and compare with products from other farmers and learn the areas of successes and weaknesses and adjust appropriately. By giving prizes and certificates to winning farmers, this would give an incentive to the other farmers to work even harder so that the following year, their efforts can also be recognised.

3. Empowering Community Based Organisations

The CBOs should be empowered to enable them manage the affairs of the village. A good example would be to facilitate the Community Cereal Bank with adequate finances for a start to be able to buys bulk inputs at subsidized rates and distribute to the farmers at equally subsidized rates. Farmers should be able to pay the cereal bank through their harvest.

4. Participatory Community Development

There is need to ensure that the village participates in the development process – it should be community-driven. What has been happening in the past is that the MVP advocates for participatory decision-making while the reality on the ground is that the opinions of the villagers are not taken into account when decisions are made. There should be no provision of loans without securities and group loans should be encouraged as compared to individual loans which have proved ineffective. Group activities will ensure a sense of community belonging and ownership of the development projects and reduce the element of jealousy arising from some farmers envying the successes of individual farmers.

5. Targeting Poor and Vulnerable

There is need to target the poorest farmers for provision of free farm inputs. These include the widows, the orphans and the vulnerable. Although it may not have an immediate tangible result, in the long run, it will be able to alleviate poverty. There should be specific guidelines on who should fall in the category of the poor and vulnerable, for example there should be a list of all the orphans in the village, the widows and widowers, the poor and other vulnerable members of the community. This information should be with the provincial administration and also at the MVP site office to guide the MVP staff whenever there are provisions to be made to such kind of people.

6. Cushioning the Poor and the Vulnerable

Measures should be put in place to ensure that the poor and vulnerable are not exposed to the negative effects of the external forces like the market forces of supply and demand and the volatile international markets for food produce. Social capital should be enhanced, and in cases where there are production shocks, the government should move in to cushion the poor and the most vulnerable in the community. The Government should establish a cushioning scheme for the farmers as a form of insurance in case of crop failure as a result of the vagaries of weather or any unforeseen calamities like the post-election violence which led to the destruction of crops and also rendering farmers unable to cultivate land.

7. Appropriate Government Early-Warning Mechanisms

To enhance crop production, there should be policy directives to encourage the farmers to plant only during the long season and plant fallow crops during the short season for the farm to regain fertility. The government through the Meteorological Department should be able to inform the farmers of the weather patterns so that they prepare their land early in anticipation of the rainy season. Through the early-warning systems, the farmers should be able to anticipate bad weather and prepare appropriately. The government should also subsidize the costs of farm inputs like the high-yield variety maize seeds and the fertilizers. There is also need for government intervention to ensure that farmers diversify crop production by growing vegetables, cassava and sweet potatoes alongside the staple food crops maize and beans.

8. Re-introduction of Orphan Crops

It has been established that there were crops that were used to cushion the community during the extremes of the vagaries of weather, such as drought or floods. During such times, the people depended on cassavas, bananas and sweet potatoes. Millet was also used as a food reserve for emergency purposes. It is disheartening to note that these crops have not been given prominence in the Millennium Village project and may be on their way to being classified as 'orphan crops'. Emphasis should be made at re-introducing these 'orphan crops' such as cassava, sweet potatoes, sorghum and millet.

9. Harnessing the Potential of Organic Agriculture

Food and Agriculture Organization of the United Nations and other international organisations has over the years been working on harnessing the potential of organic agriculture for development. This has however, not been given due recognition in the Millennium Village Project at Bar-Sauri. It is important that this is given prominence as studies have indicated that it leads to increased productivity and improved food security, and it is also particularly well-suited for smallholder farmers, who comprise the majority of Africa's poor, and Bar-Sauri is a perfect example of this. There is need for the Government to give support to organic and other forms of sustainable agriculture and to include organic agriculture in agricultural education, extension services, and Research and Development.

10. Capacity-building on Indigenous Coping Strategies

The Government should build the capacity of the local community on indigenous coping strategies and stress on the need for integrating the two knowledge systems rather than completely relying on the modern coping strategies. The old women who are perceived as the custodians of indigenous knowledge should be facilitated to offer training and instruction to the younger generations through both formal and informal training sessions, so that the indigenous knowledge of the community continues to be passed from one generation to the next.

References

Abioye, Abiola., Zaid, Yetunde & Egberongbe, Halima S. (2011) 'Documenting and Disseminating Agricultural Indigenous Knowledge For Sustainable Food Security: The Efforts of Agricultural Research Libraries in Nigeria.' IFLA Conference, San Juan, Puerto Rico. Accessed on 27 November 2011 from < http://conference.ifla.org/ifla77>

Abukutsa-Onyango, Mary. (2009) 'Solving Kenya's Food Crisis, One Indigenous Crop at a Time'. Retrieved on 16 September 2009. Downloaded from http://solveclimate.com/topic/Africa

Agea, J. G., Lugangwa, E., Obua, J & Kambugu, R. K. (2008) 'Role of Indigenous Knowledge in Enhancing Household Food Security: A Case Study of Mukungwe, Masaka District, Central Uganda.' *Indilinga – African Journal of Indigenous Knowledge Systems.* 7 (1): 64 – 71.

Agrawal, Arun. (2002) 'Indigenous Knowledge and the Politics of Classification'. *International Social Science Journal* 173: 287 – 298.

Alcorn, Janis B. (1995) 'Ethnobotanical Knowledge Systems – A Resource for Meeting Rural Development Goals.' In Warren, D. Michael, L. Jan Slikkerveer, and David Brokensha, eds. 1995. *The Cultural Dimension of Development: Indigenous Knowledge Systems.* London: Intermediate Technology. 1 – 12.

Altieri M. A. (1999) The Ecological Role of Biodiversity in Agroecosystems. *Agriculture Ecosystems and Environment* 74: 19 – 31.

Ayele, S., Chataway, J. & Wield, D. (2006) 'Partnership in African Crop Biotechnology and the Millennium Development Goals'. *Nature Biotechnology* 24 (6): 619 – 621.

Briggs, J. (2005) 'The Use of Indigenous Knowledge in Development: Problems and Challenges.' *Progress in Development Studies.* 5: 99-114.

Brokensha, D., Warren, D. & Werner, O. (eds.) (1980) *Indigenous Knowledge Systems and Development.* Lanham, MD: University Press of America.

Chambers, R. (1983) *Rural Development: Putting the Last First.* London: Longman.

Chambers, R. (1994) "Participatory Rural Appraisal (PRA): Challenges, Potentials and Paradigm." *World Development.* 22 (10).

Compton, J. (1989) 'The Integration of Research and Extension'. In J.L. Compton. (Ed.) *The Transformation of International Agricultural Research and Development.* Boulder: Lynne Rienner. pp. 113-136.

Gorjestani, N. (2000) "Indigenous Knowledge for Development: Opportunities and Challenges." UNCTAD Conference on Traditional Knowledge in Geneva, November 1, 2000.

Gray, R. (1991) 'Economic Measures of Sustainability'. *Canadian Journal of Agricultural Economics,* 39 (4): 627 – 635.

Gupta, A. (1992) *Building upon people's ecological knowledge: Framework for studying culturally embedded CPR institutions.* Ahmedabad: Indian Institute of Management, Center for Management in Agriculture.

Haverkort, Bertus. (1995) 'Agricultural Development with a Focus on Local Resources: ILEIA's view on Indigenous Knowledge.' In Warren, D. Michael, L. Jan Slikkerveer, and David Brokensha, (eds.) (1995) *The Cultural Dimension of Development: Indigenous Knowledge Systems.* London: Intermediate Technology. pp. 454 – 457.

IFAD. (2009) IFAD Policy on Engagement with Indigenous Peoples. Available online from http://www.ifad.org/english/indigenous/documents/ip_policy_e.pdf <Accessed on 22 January 2013>

IKDM. (1998) *Indigenous Knowledge and Development Monitor*. 6 (2).

Juma, Calestus. (1987) 'Ecological Complexity and Agricultural Innovation: The Use of Indigenous Genetic Resources in Bungoma, Kenya.' IDS Workshop on Farmers and Agricultural Research: Complementary Methods, held at the Institute of Developmnet Studies, University of Sussex, UK. 26 – 31 July 1987, cited in Chambers, Pacey and Thrupp (eds.). Farmer First: Farmer Innovation and Agricultural Research. pp. 31 – 38.

Kenya, Republic of. (2008) *Millennium Development Goals: Status Report for Kenya – 2007.* Nairobi: Government Printer.

Kitange, Jane. (1999) 'Sneeze Wood for Storing Grains: Indigenous knowledge from Tanzania'. *Honey Bee* 10(3):2. Retrieved on 14 September 2009. <http://knownetgrin.honeybee.org/InnovationDetail.asp?innId=1090>

Lal, R. (1990) "Low-Resource Agricultural Alternatives in Sub-Saharan Africa". *Journal of Soil and Water Conservation*. 45 (4): 437 – 445.

Lalonde, A. N. (2005) 'African Indigenous Knowledge and its Relevance to Sustainable Development.' Retrieved on 28 November 2008. <http://www.idrc.ca/en/ev-84408-201-1-DO_TOPIC.html >

Long, Norman & Long, Ann. (ed.). (1992) Battlefields of Knowledge: The Interlocking of Theory and Practice in Social Research and Development. London: Routledge.

Long, N. & M. Villareal. (1994) 'The Interweaving of Knowledge and Power in Development Interfaces'. In Scoones, Ian and John Thompson (ed). 1994. *Beyond Farmer First: Rural People's Knowledge, Agricultural Research and Extension Practice.* London: Intermediate Technology. (pp. 41 – 52).

Niamir, M. (1990) 'Herder' Decision-making in Natural Resource Management in Arid and Semi-arid Africa.' *Community Forestry Note 4.* Rome: Food and Agriculture Organization.

Olatokun, W. M & Ayanbode, O.F. (2008) 'Agriculture and Food Production – Use of Indigenous Knowledge by Rural Women in the Development of Ogun State.' *Indilinga – African Journal of Indigenous Knowledge Systems.* 7 (1): 47 – 63.

Omanga, Paul. (2002) 'Seed Fairs in Kenya: Experiences from CRS – Kenya'. In Mugah, J.O. (ed). 2002. Strengthening Emergency Seed Support in Kenya. Workshop Proceedings,

Garden Hotel – Machakos, Kenya. 12 – 14 June 2002. Catholic Relief Services and Food and Agriculture Organisation.

Orindi, V. A., & A. Ochieng'. (2005) 'Case Study 5: Kenya. Seed Fairs as a Drought Recovery Strategy in Kenya'. *IDS Bulletin*. 36 (4): 87 – 102.

Oruka, Odera Henry. (1991) *Sage Philosophy: Indigenous Thinkers and Modern Debate on African Philosophy.* Nairobi: ACTS Press.

Otwoma, Nelson Juma. (2004) 'The Role of Indigenous Knowledge in the Management of Soil Fertility among the Smallholder Farmers of Emuhaya Division, Vihiga District.' *(Unpublished M.A. Thesis, University of Nairobi.)*

Pretty, Jules N. (1995) *Regenerating Agriculture: Policies and Practice for Sustainability and Self-reliance.* London: Earthscan.

Pretty, Jules N., Irene Guijt, Ian Scoones & John Thompson. (1995) 'Regenerating Agriculture: The Agroecology of Low-External Input and Community-Based Development'. In Kirkby, J., Phil O'Keefe and Lloyd Timberlake (ed). (1995) *The Earthscan Reader in Sustainable Development.* London: Earthscan.

Pretty, Jules & Hine, Rachel. (2001) 'Reducing Food Poverty with Sustainable Agriculture: A Summary of New Evidence'. Final Report from the SAFE-World. The Potential of Sustainable Agriculture to Feed the World Research Project, University of Essex. London: DfID.

Rhoades, Robert. (1989) 'The Role of Farmers in the Creation of Agricultural Technology.' In Chambers Robert, Arnold Pacey & Lori Ann Thrupp (ed). 1989. *Farmer First: Farmer Innovation and Agricultural Research.* London: Intermediate Technology Publications.

Richards, Paul. (1994) 'Local Knowledge Formation and Validation: The Case of Rice Production in Central Sierra Leone'. In Scoones, Ian & John Thompson (ed). 1994. *Beyond Farmer First: Rural People's Knowledge, Agricultural Research and Extension Practice.* London: Intermediate Technology. 165 – 170.

Sachs, Jeffrey. (2005) *The End of Poverty. How We Can Make It Happen In Our Lifetime.* London: Penguin Books.

Sanchez, Pedro A., Glenn L. Denning & Generose Nziguheba. (2009) "The African Green Revolution moves forward". *Springer Science*. International Society for Plant Pathology.

Scoones, Ian & John Thompson (ed). (1994) *Beyond Farmer First: Rural People's Knowledge, Agricultural Research and Extension Practice.* London: Intermediate Technology.

Shepherd, Andrew. (1998) *Sustainable Rural Development.* Houndmills, Basingstoke: Macmillan, 1998.

Thompson, John. (2006) 'The Dynamics of Changing Rural Worlds: Balancing Income Generation and Household and Community Food Security in an Era of Growing Risk and Uncertainty'. Paper presented at the Global Forum on Agricultural Research 3rd Triennial Conference, Reorienting Agricultural Research to Achieve the Millennium Development Goals, 8 – 11 November 2004, New Delhi, India.

Thompson, John & Ian Scoones. (1994) 'Challenging the Populist Perspective: Rural People's Knowledge, Agricultural Research, and Extension Practice'. *Agriculture and Human Values*. 11 (2/3): 58 – 76.

Thompson, John & Ian Scoones. (2009) 'Addressing the dynamics of agri-food systems: An emerging agenda for social science research'. *ScienceDirect: Environmental Science and Policy* 12 (2009): 386 – 397.

Thrupp, L. A. (1987) 'Building Legitimacy of Indigenous Knowledge: Empowerment for Third World People, or 'Scientized Packages' to be sold by Development Agencies?' IDS Workshop on Farmers and Agricultural Research: Complementary Methods, held at the Institute of Developmnet Studies, University of Sussex, UK. 26 – 31 July 1987.

UNCED. (1987) *Our Common Future*. New York: Oxford University Press.

UNCTAD. (2009) 'Sustaining African Agriculture Organic Production.' *UNCTAD Policy Briefs* No. 6, February 2009. Accessed on 21 January 2013 from http://unctad.org/en/docs/presspb20086_en.pdf

United Nations. (n.d) *United Nations Declaration on the rights of Indigenous Peoples, Article 29.*

United Nations. (1992) 'Extract from Agenda 21 of the 1992 Earth Summit.'

UN Millennium Promise. (2006) *The Millennium Villages Project – Annual Report for Sauri, Kenya.* Millennium Research Village – July 2005 to June 2006.

UN Millennium Promise. (2008) 'Millennium Promise – The Millennium Villages in Kenya'. Retrieved on 28 November 2008 from website <www.millenniumpromise.org>.

Warren, D *et al.*, (1989) 'Indigenous Knowledge Systems: Implications for Agriculture and International Development.' *Studies in Technology and Social Change* No. 11. Ames, Iowa: Technology and Social Change Program, Iowa State University.

Warren, D. Michael, L. Jan Slikkerveer, & David Brokensha, (eds.) (1995) *The Cultural Dimension of Development: Indigenous Knowledge Systems.* London: Intermediate Technology.

Warren, D. M. (1990) 'Indigenous Knowledge Systems and Development.' Background paper for Seminar Series on Sociology and Natural Resource Management. The World Bank, Washington, D.C. December 3, 1990.

Warren, D. 1991. *Using Indigenous Knowledge in Agricultural Development.* World Bank Discussion Paper 127. Washington, DC: The World Bank.

Warren, D.M. (1992) Keynote Address at the Conference on "Conservation of Biodiversity in Africa: Local Initiatives and Institutional Roles" at the National Museums of Kenya, Nairobi, Kenya. 30 August – 3 September 1992.

World Bank. (2007) *World Development Report 2008: Agriculture for Development.* Washington DC: The World Bank.

World Bank. (2009) *What is Indigenous Knowledge?* Available online from: www.worldbank.org/afr/ik/basic.htm < Accessed on 21 January 2013>