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Indigenous Knowledge in Agriculture: A case study of the challenges in sharing knowledge of past generations in a globalized context in Uganda.

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Abstract

For centuries, farmers have planned agricultural production and conserved natural resources by adopting indigenous knowledge. The development of indigenous knowledge systems, including management of natural environment, has been a matter of survival to the people who generated these systems. A study was conducted in western Uganda to investigate indigenous agricultural practices using local knowledge by researchers. The challenges from the study include; integration of conventional research with indigenous knowledge, storage and selective sharing of knowledge by farmers. The study determined a positive correlation between improved technologies and assets and access to extension services. It revealed that indigenous knowledge are used by all farmer categories, its dominant, easily accessible, safe for man, animals and promotes social cohesion due to the mechanism of dissemination. It showed inefficiency of some indigenous knowledge methods. The study concludes by recommending that indigenous knowledge and practices are useful, must be integrated with contemporary research agenda to enable farmers compete and respond to global opportunities and challenges respectively.

Introduction

For centuries, farmers have planned agricultural production and conserved natural resources with the instruments of indigenous knowledge (IK). The development of IK systems, including management of natural environment, has been a matter of survival to the people who generated these systems. Such systems are cumulative, representing generations of experience, careful observations and trial and error experiments (Louise, 1998). IK is stored in people's memories and activities. It is expressed in stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local languages and taxonomy, agricultural practices, equipment, materials, plant species and animal breeds. Indigenous forms of communication are important to local level decision making processes and for the preservation and spread of IK (Louise, 1998). This body of knowledge has developed over generations through the process of man-environmental interaction and its continuity depends on its transmission and the ability of the young generation to acquire and practice it (Atteh, 1980). Indigenous knowledge systems in traditional Africa have been used by communities to protect natural resources from unsustainable exploitation thereby averting disasters that may have occurred from such exploitation.

Agriculture in Uganda

The agricultural sector accounts for about 90 percent of exports and 80 percent of the employed household population. The sector provides most of the raw materials to the mainly agro-based industrial sector comprising coffee hulling, cotton ginning, tea processing, sugar production, textile mills, soap industries, edible oil industries, cigarette manufacturing, grain milling, meat processing, beverages and breweries industries, dairy and leather products manufacturing (MFPED, 2002). There are about 3 million smallholder farm households of which 80 percent have less than 4 ha of farmland and the hand-hoe is the predominant technology for cultivation. The main traditional cash crops grown are coffee, cotton, tobacco, tea and sugar cane, while the traditional food crops are mainly maize, beans, cassava, solanium potatoes, sweet potatoes, groundnuts, bananas and finger millet. Food crop production dominates the agricultural sector, contributing 63.8 percent of agricultural GDP (MFPED, 2003).The agricultural sector in Uganda is characterized as semi subsistence with low input and low productivity and the challenge facing Uganda is to provide the necessary support services to turn Uganda's widely dispersed small-scale subsistence agriculture into an engine of economic development. The sector has high potential if improved agricultural technologies are adopted by farmers besides their traditional methods of agriculture. The government of Uganda has embarked on a Plan for Modernization of Agriculture (PMA), in order to move the predominantly rural economy out of poverty and to improve the welfare of the majority of the population. Under this policy, the focus is on increased and sustainable food production by improving agricultural techniques and practices, optimal use of land and water resources, increasing production of high-value commodities and products and gradually moving towards commercial agriculture in collaboration with the private sector. The key issue targeted by PMA and implemented by national agricultural research system (NARs) is increasing agricultural activities. The departure point is envisaged as generating appropriate agricultural technology options for transfer to the small scale and resource poor farmers.

Recent developments

The National Agricultural Research Organization (NARO) Uganda is mandated and conducts agricultural research on behalf public. It has developed and disseminated improved agricultural technologies to increase agricultural productivity while simultaneously preserving the natural resource base. Surprisingly however, farmers have taken up few of these while the rest remain on-

shelf (un-used). This can be attributed to limited integration of agricultural practices and natural resource management practices of farmers into formal research. Many questions have been raised as to why the adoption rate of these technologies has been low. Whatever the reason, the major issue is that farmers have been previously left out in technology generation and development process. There have also been some discussions on indigenous technologies as away of getting to understand farmers' needs.

Indigenous knowledge

Indigenous knowledge (IK) is ideas, beliefs, values, norms, and rituals, which are native and embedded in the minds of people. It is local knowledge which is unique to a given culture or society (Warren, 1987). According to Rajasekaran 1993, IK is the systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments and intimate understanding of the environment in a given culture. Local people, including farmers, local artisans, and cattle keepers are the custodians of IK systems. They are knowledgeable about their own situations, their resources, what works and what doesn't work, and how one change impacts other parts of their system. IK is dynamic and it changes through creativity and innovativeness as well as through contact with other local and international knowledge systems (Warren, 1991). These knowledge systems represent mechanisms to ensure minimal livelihoods for local people. IK systems often are elaborate and adapted to local culture and environmental conditions tuned to the needs of local people and quality and quantity of available resources. In this study, the terms traditional knowledge, indigenous technical knowledge, rural knowledge have been used interchangeably.

The need for stakeholder ownership is now well established and involves ensuring widest possible participation of those who are supposed to be the beneficiaries of the projects so that they drive the process, which includes planning, design, implementation and monitoring. A farming systems and livelihood analysis survey for the Lake Albert Crescent zone (Masindi, Kibaale and Hoima districts) was undertaken and many issues emerged from the study concerning farmers' coping mechanisms based on indigenous knowledge use at the different stages of agricultural production processes. Most of these could be incorporated into research to enrich the agricultural technology development process and make it more relevant for the farmers. The promising indigenous farmer practices and knowledge need to be tested validated and where necessary improved.

Bulindi Zonal Agricultural Research Institute (ZARDI) therefore carried out a study in Hoima, Masindi and Kibale districts of Uganda to investigate skills, practices and methods of crop and livestock production using local knowledge. It was aimed at identifying appropriate and promising farmer practices and recommending them for integration into conventional research. Integrating indigenous knowledge into research was expected to enhance adoption of agricultural technologies generated by the research organization that has been relatively low. The study targeted the rural people as primary stakeholders to contribute to the programme of integrating farmers' knowledge into conventional research by sharing their knowledge and insights in indigenous practices.

Overall objective

To improve agricultural productivity of farming communities by integrating indigenous knowledge into research thereby enhancing adoption of agricultural technologies.

Specific objectives

1) To identify and document farmers' IK in agricultural production as a process from land preparation to marketing, stating constraints
2) To document farmers' coping mechanisms to constraints identified

Justification for the study

The National Agricultural Research Organization (NARO) has for many years been disseminating technologies for farm use. Surprisingly however, farmers have only adopted few of the technologies while the rest are "on-shelf". Many questions have been raised as to why the adoption rate of these technologies has been low. Some people think that these technologies may not be relevant to farmers' needs. Others think the technologies may be expensive for the farmers. Whatever the reason, the major issue is that farmers have been previously left out in technology generation and development process. The central issues in development have been overlooked in the past and many mistakes have emanated from it. The poor therefore, have not been the object, but the subject of development. The need for stakeholder ownership is now well established and involves ensuring widest possible participation of those who are supposed to be the beneficiaries of the projects so that they drive the process. It involves participation in planning, design, implementation and monitoring of any intervention project. A farming systems and livelihood analysis survey for the Lake Albert Crescent zone (Masindi, Kibaale and Hoima districts) has been completed and many issues have emerged concerning farmers' coping mechanisms and indigenous knowledge at the different stages of agricultural production activities. Most of these could be incorporated into research to enrich the research process and make it more relevant for the farmers. Moreover most of the farmer technologies are cheap and easy to obtain. Most export markets now prefer organic foods produced by this category of farmers and this offers an opportunity to improve their income. The promising indigenous farmer practices and knowledge need to be tested, validated and where necessary improved.

Methodology

The steps taken to accomplish the task included the use of a more qualitative approach. The research design employed was a cross-sectional survey and the method was deemed suitable because it enabled the required information to be collected on several pre-determined variables of a single point in time and from a cross- section of fairly uniform group. The study was conducted in Masindi, Hoima and Kibaale districts and representing the Lake Albert beans-maize farming system of Uganda. A total of eight parishes from eight sub-counties were selected. Generic review of literature was also carried out to follow the changing context of agricultural research in Uganda. While technological developments are pivotal in change in agenda, overall changes that have been taking place in the agricultural sector are described. To synthesize farmers' practices and experiences to draw the useful lessons required participating in, and following a number of iterative steps. Researchers, extension officers and district production officers jointly developed checklists with open ended questions and administered to through individual interviews with five key informants and farmers. Purposive sampling was used in selecting 20 key informants from each district basing on their knowledge of the subjects as well as their policy making and implementation roles. They included the elderly above 60 years, Local Council (LC) executives, and extension officials from forestry, agriculture, environment and livestock departments. The elderly were selected because they were thought to possess sufficient information about utilization of IK in agriculture production as they had lived long enough to witness the changes in utilization. The L.C. executives and the extension workers of agriculture, forestry, livestock and environment departments were selected because of their special roles in the community. Individual interviews

were conducted with 240 farmers from a randomly selected sample from the parishes where focus group discussions (FGD) were conducted. A total of 12 focus group discussions (FGD), 4 from each district were conducted. Each FGD comprised of between 15 and 25 participants selected from the farmer groups participating in on-farm trials. This in-community approach allowed in-depth observations of some of the practices mentioned by respondents during individual interviews and at the same time cross – checking the responses.

Conceptual framework

Indigenous knowledge in this study refers to the body of knowledge which is native to the farmers. This knowledge system is however not exclusive but can be modified with time. Whereas modern knowledge refers to concepts, ideas, values, beliefs which are imparted in the minds of the native by extension workers who are trained in scientific agriculture, it should be noted that in some cases the difference between indigenous knowledge and modern techniques is not distinct enough. To a large extent, improved agricultural research improves on already existing techniques. For instance mulching, fallowing and crop rotation fall under both indigenous and modern techniques of soil conservation and fertility improvement. In this study, crop rotation, mulching and fallowing have been categorized under indigenous practices. The study was conceived on the theoretical premise that as man tries to adapt to the environment which he lives and derives his livelihood, he improves his knowledge, skills and strategies to harness natural resources in a sustainable manner. The knowledge and skills are derived from man's daily interactions with the environment, observations and experiments. They greatly shape and model the decisions made by people regarding exploitation of resources. The knowledge, skills and practices relating to natural resources are passed down to generations through the cultural learning process. It is the outcome of all these among different groups and the environment that is termed indigenous, local, tradition or people's knowledge.

Results:

Crop and livestock production systems

There was little variation in the main crops grown across the study sites in Masindi, Hoima and Kibaale districts and the results presented is representative of study area. Almost all crops grown were for both food and earning income. The main cash crops are tobacco, tea, coffee, cocoa and cotton. Cocoa was grown on a very small scale as a cash crop. The main food crops were bananas, cassava, sweet potatoes, millet, maize, ground nuts and beans. Other crops include rice, yams, solanium potatoes, sorghum, cow and field peas, endagu, soya bean and simsim. Rice is a new crop which farmers thought had high potential of becoming a major cash and food crop.

The main vegetables grown in order of importance were obugoora, tomatoes, dodo (amaranthus sp.), egg plants and cabbage. Onions, African egg plant (enjagi), green pepper, sukuma wiiki, eyobyo (spider weed – gynandropsis gynandra), eteke and pumpkins were also grown. These vegetables are also for both cash and food. The vegetables were all local varieties except tomatoes and cabbage.

The main fruits grown are guavas, oranges and tangerines. Jack fruits, pawpaw and mangoes were mainly grown for domestic consumption while passion fruits, pineapples and avocados were for sale.

Crop production constraints

The four major constraints in crop production in order of importance were recorded as lack of knowledge on improved farming methods, inadequate extension services e.g. one agricultural officer could hardly suffice for the whole sub-county, lack of improved crop varieties and markets coupled with low producer prices and unscrupulous middle men who in most cases exploit farmers in many ways. Other constraints of importance were crop pests and diseases, lack of capital to purchase proper farm implements thus many farmers are condemned to using hand hoes. Another challenge was unpredictable or unreliable weather conditions characterized by too much or less rainfall and some times drought. Farmers lacked capital to buy inputs like spray pumps and chemicals. Many farmers are unable to access loans due to high interest rate charged by banks. Limited land to expand farming, declining soil fertility and high presence of vermins (baboons, monkeys and rats/rodents) were also some of the challenges to crop production.

Livestock keeping constraints

The livestock considered important were available in communities of the study area. Almost all households kept chicken and goats for both home consumption and income. Piggery is a relatively new enterprise that has become an important source of income to a number of households. Other types of livestock reared on small scale both for sale and home consumption were cattle, sheep, rabbits, ducks, and peacocks. The main constraints in livestock keeping in order of importance were diseases, the expensive feeds, thieves, wild animals, lack of improved breeds and lack of training in modern livestock keeping techniques.

Indigenous knowledge use in farming

Farmers employed various indigenous practices most of which were cross cutting among the crops grown. Early planting is one of the pillars for both indigenous and improved farming methods practiced. This is especially important in this agro-ecological zone where agriculture is rain-fed. Farmers take advantage of the early rains which also reduce the incidences of pest and disease leading to high yields.

When farmers burn grass or trash in their farms, they prefer to plant or sow green vegetables and millet in it. The ash is assumed to be a source of nutrients and also burning is believed to kill crop pests. Farmers plant lab-lab around their farms as they believe it prevents night dancers from intruding in their gardens and other related cases of witchcraft.

Farmers also practice selection of clean planting materials as in the case of formal research to control pests and diseases. For the case of cassava, they ensure that the cuttings are not damaged prior to planting and that nodes face downwards to encourage effective sprouting and root growth. Farmers relied on crop rotation to rejuvenate the soil. Many farmers in tobacco growing area prefer to plant root crops in plots that originally had tobacco to specifically control pests.

Farmers use rudimentary post harvest handling techniques. For instance many root crops are highly perishable crop when harvested. When farmers harvest cassava and not all of it is consumed or sold, the fresh tubers are buried in moist soil measuring 1ft deep. According to farmers, the tubers stay fresh for up to seven days. The common methods of processing cassava involve peeling, slicing, drying and storing in baskets. For bitter cassava varieties, it is peeled, sliced and left to ferment indoors for three days. It is later dried, chopped and finally ground or pounded into flour. Fermentation was reported to reduce the cyanide level in or the bitterness of the cassava, a process also recommended by conventional research.

For grain crops like beans, farmers ensure that beans are planted as the second crop in the rotation system. Broadcasting the seed before ploughing is still a popular method used when planting. Early plating is also preferred to allow crops receive enough rainfall and reduce pests and diseases incidences. Farmers also used concoctions of ash, goat droppings, dry and water as insecticide to control pests and diseases. Ash I also used as an important component for preserving specifically beans. Some farmers mix ash with water to form a light paste and add to the beans before storing in containers called ebikoodo/ ebitwaro made from dry banana leaves, fibers and sticks. Currently however, this method is no longer common because such storage facilities needed to be kept outside and there have been rampant cases of theft. Others use anthill soil as a preservative during long storage

Farmers also put elephant grass flowers locally known as etete and leaves of obukomera and neem tree in beans because the scent produced by the plants species repels storage pests. Caterpillars were reported as the most important sweet potato pests. They are controlled by picking the infested leaves and burying them. Ash is sometimes mixed with human urine and sprinkled on vines. Farmers sometimes apply cow dung on potato vines and also rogue potato leaves. Lastly, farmers also carryout some form of rudimentary biological control of pests. They catch black ants and release them in sweet potatoes fields to eat the caterpillars

From years of experience, farmers know which crops require fine seed beds and which ones do not and when they come in the rotation system.
Banana suckers with weevils are rouged and pseudo stems split and placed upside down on the stools to trap weevils. A mixture of human urine, leaves of omuhoko, some water and pepper is fermented for 14 days and applied around the banana stool to control weevils. This mixture is placed at least 2 feet away from the banana stool. Urine fermented for 14 days and mixed with ash and omuhoko controls banana weevils. Urine is applied directly on the banana stool to kill banana weevil. This partly explains resistance of banana stools to pests and diseases near kitchen since the kitchen is always a source of ash and its compound particles.

Farmers mix banana varieties when planting to control pests/diseases. This practice is different from current practice where each variety is planted in sole plot for commercial purposes. Banana for juice are placed in Embiso and itunguru (a structure constructed above the fireplace) to ripen. The Bokora/Kivuvu type of bananas is cooked and sun dried when they ripen. It can store for several weeks and mainly served with tea at break first.

Human urine is fermented for two weeks and it is mixed with water at a ratio of 1:2. If the mixture is being prepared to “spray” tomatoes, cabbage leaves are mashed and added to it. When the mixture is being prepared for “spraying” cabbages tomato leaves are mashed and added to it. To control tomato blight, the crop is sprayed with either milk or baking flour.

A mixture of fresh urine and water at a ratio of 1:1, and mukazi murofa (marigold leaves), pepper, and tobacco leaves are added to the mixture and kept fermented for 2 weeks. This concoction is mainly used to control pests in vegetables and bananas. Approximately three liters is applied per banana stool.

Farmers expressed reasonable knowledge on soil fertility indicators. This is mainly determined by soil characteristics, types of weeds growing in an area and crop characteristics such as yields, vigor and the general appearance of the plants. Soil types, degrees of soil fertility, and land use categories were also desegregated by farmers. Color, texture and even taste usually distinguish soil types while some classified their soils based on vegetative cover.

Farmers can determine that when the soil is exhausted. The water retention level reduces substantially (becomes too porous), the plants/crops or weeds are stunted and yellowish and the crop yields decline at an increasing rate. Decline in soil fertility is also determined by evident loss of crumb structure. It also becomes very light, dusty or sandy in texture. The soil color changes from dark or brown to reddish with increased number of stones. When soils are exhausted, it allows the growth of weeds like olaka, ebitezi (wandering jew), spear grass, amatojo and amaranga. Other hand weeds like bidens pilosa, embuura, milk weed (euphorbia species) also indicate soil infertility.

Farmers use various means at every stage of the plant growth to cope with the problems of soil fertility loss. This include making mounds by collecting and heaping trash in preparation for planting sweet potatoes, solanium potatoes, tobacco and vegetables which are preferably planted on raised seed beds.

Other common practices are fallowing and planting elephant grass at the beginning of fallow period, for one season for up to 4 years depending on land availability. Intercropping beans and maize, groundnuts and maize, millet and maize and agro forestry is practiced especially for fruit trees and coffee to improve soil fertility. Crop rotation where cassava is planted as last crop in rotation is also a popular practice as many farmers believe that cassava is not a heavy feeder and that when cassava leaves wither and drop, they decompose and add manure to the soil.

Farmers heap soil and trash around the plant while weeding and make bands. Water run off and/or soil erosion is reduced using soil bands (fanya chini and fanya juu). Farmers also add crop residues like kitchen waste/refuse and manure from goats, chicken, and cattle to their fields and fallow plots to enhance nutrient status. Farmers mostly use elephant grass and maize stalks to conserve soil moisture and add manure after decomposition when mulching. Mulching was practiced in at least 4 out of 10 households in every village. Many farmers had stopped the bush burning practice and were making and applying compost manure.

Indigenous knowledge was mainly applied to crop production than in livestock rearing. For livestock, farmers mainly used IK on chicken and goats than to the rest of the animals and birds. There was little information on piggery as far IK use is concerned probably due to the fact that piggery is a relatively new enterprise in most households.

There were interesting findings on use of IK in chicken production and some reported below;

- When a brooding hen abandons the eggs completely because of pest infestation like obuhoroko (mites), farmers put dry banana leaves in a mortar and position it near a fireplace to aid the eggs brooding process. The eggs are regularly turned and eventually the chicks hatch

- Farmers prepare and place a small bottomless basket to encourage hens to lay more eggs and hatch many chicks. The baskets are placed in a small round hole lined with dry banana leaves

- Farmers supplement feeds for hens with millet and maize to encourage the hens to lay more eggs. The eggs are removed regularly in order to increases the number of eggs laid

Chicken are fed on a mixture of millet and paraffin to prevent sotoka (coccidiosis). This however is believed to make the hens take longer to lay eggs. Chicken infected with coccidiosis are injected with or given mixture of ash, ground pepper and water to drink. Enjahi (cannabis) is mashed and added to water and used for treating coccidiosis. Farmers also make an incision under the chicken

wing to prompt bleeding from the vein of an infected (with coccidiosis) chicken. The vein is usually distinct i.e. dark/black in colour.

Farmers give chicken insects from empike (enkubebe) to peck in order to control New Castle Disease. The canabis leaves are also pounded and added to water, boiled and given to the chicken and other birds. The cannabis can also be given to chicken to peck for the same purpose.

Muziri fish specie (tiny fish) is fed to the chicken to treat the New Castle Disease. Ettekke (green leafy vegetable) is mashed, added to water and the mixture given to chicken to drink.

To destroy pests, farmers apply paraffin and vaseline on affected area especially around the chicken eyes. An old tyre (ekipira) is burnt in chicken coop to destroy obuhoroko (mites). Farmers also cut and place a moist tree branch in the chicken coop to attract and trap obuhorok which is removed and thrown far from the homestead when it is laden with the pests. In tobacco growing areas, farmers spread fire cured tobacco leaves on the chicken coop floor to kill obuhoroko (mites).

Farmers give petero leaves to chicken to peck as a de-worming agent. It was also reported that the same leaves are used for de-worming humans. Pawpaw seeds also are given to chicken as de-wormers.

Farmers use their hands to aid goats experiencing difficulties while delivering. Incase the placenta (ekyenyuma) fail to disengage, farmers give the goats cowpea leaves (omugobe). Others prefer to hit the bottom of the goats with brooms ease the release of the placenta. Another remedy is giving goats a mixture of enderema, water and salt to aid the disengagement of the placenta after the goat delivers. When a pregnant goat fails to deliver, it is tied near a fireplace to presumably burn fats believed to block delivery.

Worms in animals are treated using omugina (green vegetable) with a specific measure that farmers know. Diarrhea is treated using a mixture of cowpea leaves (omugoobe) and little salt. The mixture may either be boiled or not. Potato leaves are also used to treat diarrhea in goats. Omugina and ekisura is mashed and added to water to control running stomach in goats.

Fever in goats is treated using ekibirizi which is mashed and added to water. A quantity of 0.13mls is administered to each goat using a syringe. Farmers did not give an explanation of how they use soap or foam to prevent fever in goats although they said they use it. In addition, fresh enjahi (cannabis) leaves and little salt is mashed and added to water to treat goats suffering from fever, cough, poor appetite and/or diarrhea.

To increase milk production, farmers add salt to banana peels, bean soup and omubimba leaves squeezed with salt and little water and feed it to the their animals to increase milk production. Others use ekibirizi boiled with salt while some mix omubimba and orunya.

Farmers castrate their animals using a rudimentary method which is by cutting veins leading to testicles, using a sharp razor blade or small surgical blade (if available).

To make the kraals comfortable for livestock, farmers regularly make fire in the kraal to get rid of pests. They also "fallow" the kraals to reduce pests infestation especially enkwa and ebibarabara.

East Coast Fever (ECF) is a common livestock disease and farmers use a mixture of akaranda, and omurubaali to it. Farmers sometimes cut the infected part and burn with hot metal. Another common practice is the application of sap from the rukoni tree on the infected spot. Others

believe that tying ekinyege around the neck of the infected animal treats ECF. Mastitis on the other hand is treated by directly pressing a hot metal on the affected areas.

Farmers use a tedious approach of pricking fleas (embarabara) with a needle and leaving them to die on the animal to control the pest.

Some livestock experience constipation and in case of such a condition, farmers mash leaves of omukyora or ekibirizi with some salt and give it to a suffering animal.

Sources of indigenous knowledge

The study identified different sources of ITK. Main sources were reported as interactions with the elderly, parents, grand parents, relatives and friends. Other commons sources of IK are through visits where one finds a technology being applied and picks interest in it. Migration of people from other parts of the country with different ethnicity, radio programs and extension workers and own discoveries were noted as supplementary sources of IK.

Constraints of using indigenous technical knowledge

- Education and exposure especially of the young generation to modern training have biased people's attitudes towards using ITK
- Some farmers feel it is time consuming, exhausting and sometimes dangerous to hunt for herbs in the forests and bushes
- ITK was reported as not effective in large scale production
- Some religious beliefs do not encourage traditional beliefs and technologies regarding them as demonic and superstitious
- Regressive government laws prohibiting some practices like growing cannabis, un-authorized tree cutting and rudimentary castration of livestock
- Depletion of most trees and herbs that are sources of local medicine
- Lack of standardization and documentation of indigenous technologies and practices
- Variation in prescription such as quantity to administer at a time and for how long
- The educated people despise some indigenous methods referring to it as ineffective and dirty
- Selfishness that inhibits people from passing on knowledge to others

Advantages of using IK in agricultural production

- ITK products are cheap and in most cases cost free in monetary terms
- It creates social harmony and cohesion
- It is easy to grasp the concepts and practices because knowledge can be passed on orally using the local language
- They are available domestically e.g. urine, ash and hot pepper
- Not harmful to human health
- It does not have side effects
- ITK products are prepared and obtained on demand and problems associated with expired products are not of much concern
- Application of ITK products does not always demand specialist attention like veterinary doctors or extension workers

Changes in application of indigenous knowledge

A lot of IK has been lost through deaths of elderly people since there is no formal documentation of such knowledge. Some individuals also deliberately refuse to share the knowledge of IT they posses with others due to selfishness and desire power/control. But most importantly, market-oriented production requires large scale production for producers to enjoy economies of scale. IT use has been limited in such production systems. Rural urban migration has also significantly reduced agricultural labor force. In addition, increased modern scientific, effective and efficient methods have limited reliance on IT use. Some IK were completely abandoned while some are still in use and more discoveries being made through trial and error. Population increase and pressure has also led to intensification of agriculture in some areas and this requires use of modern techniques.

Generations come and go which implies different problems for different generations. For instance, new pests and diseases are emerging that did not exist in the past, while people's attitudes towards agriculture have changed from being a livelihood provider to a lucrative business entity. All these have singly or in combination prompted people to make thrift and prudent decisions in regard to enterprise selection and inputs use. While changes in economic status of a few farmers have improved, many resource poor farmers still rely completely on IT.

Sustained use of IK and adoption of modern techniques

Despite the increased influence of modernization and economic changes, a few traditional agricultural management and knowledge systems are still predominant. These systems exhibit important elements of sustainability. For example, they are well adapted to particular environments, rely on local resources, are small-scale and decentralized, and they tend to conserve the natural resource base. Many farmers felt that IK use must be promoted in all farming practices. This was expected to give an opportunity to those who know more about IK to share what they know with others especially for some diseases and pests where modern techniques are not known or readily available. Most farmers using locally available resources for their livelihood are poor and need support to improve on the existing IK. Many farmers were optimistic that they would continue using IK because they hope to continue growing the same crops and keeping the same livestock using the same practice.

From the study, it became clear that farmers appreciate the advantages of using modern technologies as both effective and efficient in terms of labor required during its application. However, the study acknowledges that modern technologies are expensive for the majority of farmers. Although modern technologies can effectively respond to contemporary demands and challenges, the adoption rate was slow due to lack of awareness and capital for acquisition and maintenance. Modern techniques in most cases were reported to be imported and thus unreliable due to lack of originality.

Integrating improved methods and indigenous knowledge

Extension workers and progressive farmers encourage farmers to use modern agricultural production techniques such as planting in rows, using improved seeds, practicing soil conservation techniques like contour ploughing, mulching etc. diversifying their production by growing cash crops including but not limited to cocoa, coffee, cotton and spraying animals and treating with recommended veterinary drugs. Some farmers explained that modern technologies are mainly earmarked for cash crops like tobacco for better yields and increased incomes.

This study found that farmers want all aspects modern technologies and IK that solve farmers' problems, to be integrated. This is because some new pests and diseases have emerged. Agricultural production has also become more diverse thus the need to use both modern and indigenous techniques.

Limitations to sustained use of indigenous knowledge

The biggest limitations to sustained use of IT include minimal sharing of "intellectual property rights" i.e. selfishness and sometimes limited co-operation amongst farmers, lack of farm records and increased interest in new technologies. In schools students are taught modern techniques which are easier to manage. In the past, farmers produced for subsistence unlike today where production is commercial-oriented. While commercial production have led to more application of modern and convenient technologies, lack of knowledge, co-operation and sometimes attaching monetary value to provision of IK has reduced its continued use.

There are no standardized measures for applying IK which discourages its use in today's modern farming. Indigenous knowledge bearers do not take aggressive steps to discover more indigenous knowledge tools. Farmers who earn reasonable off-farm incomes prefer to use. While off-farm incomes have enabled some farmers acquire improved technologies, indigenous practices are continually shunned because it is associated with ignorance, illiteracy or poverty.

Conclusion and Recommendations

We conclude that IK is used in agriculture, engineering, medicine, soil conservation and in many other fields. For instance, wooden hand hoes out of wood were used for cultivation, farmers knew which trees to get herbs from, fresh foods were obtained from the wilderness and people observed changes in climate by watching the entire environment. Intercropping is believed to increase on the crop yield per unit area and also to replenish the soil. Long periods of fallowing land were observed, mulching was practiced and crop rotation was equally important. Management strategies employed by the local people to exploit the environment show that there is a store of indigenous knowledge which people have developed over generations through daily observations and practice. The study determined that in many cases, indigenous knowledge systems have sophisticated technical components, which enabled people to survive in the natural, as well as the cultural environment. However, more attention has been paid to economic, political and social factors and less attention to cultural factors in the development process. Over the decades, indigenous knowledge basing on existing flora and fauna has been used to detect changes in seasonality patterns, predict the start of drought or define soil fertility and generally monitor the state of the ecosystem. These indicators have always been used to make decisions and to develop appropriate measure/steps related to production and appropriate natural resources management strategies. This always ensured continued human survival and sustainable resource management.

From the study, we also showed increased use and availability of modern technologies. Indigenous practices are dominant but the use not necessarily increasing. Besides, the introduction of modern technologies through formal education and informal training have exposed farmers to very many and much easier farming methods subsequently reducing the application of indigenous knowledge. Other factors like pressure on land, changes in climate, labor requirements, the commercial market economy, increased research and extension work were also mentioned as factors influencing use of IK.

Legislation and by-laws have made it increasingly difficult for farmers to practice indigenous techniques like they used to in the past. Farmers who use indigenous techniques that harm livestock and the environment face legal action. These factors have in one way or another influenced the utilization of indigenous knowledge in agricultural production.

Today, indigenous knowledge can hardly cope with the new challenges. Many diseases and pests have emerged and affecting both local and improved crop varieties and livestock breeds. However, modern technologies require proper training to apply and maintain it. Therefore, many disadvantaged farmers will continue to use indigenous knowledge and practices. Current development trends have so far demonstrated that improved technologies are un-affordable for many poor farmers and they continually fall back on indigenous knowledge and practices. It is therefore paramount that research finds ways of identifying, collecting and validating indigenous knowledge practices. Such information must be stored in a form that is retrievable for use and/or reference by future generations.

Farmers showed interest in promoting all aspects of indigenous knowledge application and utilization especially for treating livestock using local herbs, proper animal feeding, mechanisms of preventing pests and diseases both when growing crops and in storage, improving yields through crop rotation and fallowing.

Promising indigenous knowledge use in the areas mentioned above can be promoted through training, sensitization on the benefits through exchange visits, field day exhibitions, radio programmes, and production of books on ITK and study tours to other parts of the country. Research scientists and extension workers can promote IK in poor communities because some are effective. Use of ash, dry soil from anthills, cow dung and pepper as storage mechanisms and castrating calves are widely practiced. Their promotion can be successful because they are cheap and available and sometimes can be effective like modern technologies. It does not also involve costs associated with imports as the case with introduced technologies.

Few NGOs were involved in promoting IK in the study area. For instance, Africa Network 2000 is promoting sustainable agriculture using locally available materials in Businsi Sub County and Hoima Diocese Farmers Association a programme for Hoima Catholic Diocese is promoting sustainable agriculture by encouraging use of urine, ash and dung to increase soil fertility. Researchers from NARO, especially those based at Bulindi ZARDI can either work in collaboration with these organizations or introduce a similar programme in other areas.

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Acronyms used

ARDC	Agricultural Research and Development Centre
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GOU	Government of Uganda
IK	Indigenous knowledge
ITK	Indigenous Technical Knowledge
LC	Local Council
MAAIF	Ministry of Agriculture Animal Industries and Fisheries
MFPED	Ministry of Finance Planning and Economic Development
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organization
NARS	National Agricultural Research System
NGO	Non Governmental Organization
PMA	Plan for Modernization of Agriculture