

INDIGENOUS KNOWLEDGE PRACTICES EMPLOYED BY SMALL HOLDER FARMERS IN KAGADI DISTRICT, KIBAALE SUB-REGION, UGANDA



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ABSTRACT

This paper identifies the use of indigenous knowledge by small holder farmers in Kagadi district of Kibaale sub-region in South Western Uganda. The farmers here practice diverse farming systems and 51% practice either mixed farming and / or intercropping.

The results clearly show that 67% of the small holder farmers still use indigenous knowledge in farming. 62% of the technical persons believe that food production and sustainability is due to use of indigenous agricultural knowledge by the local people of the rural communities carrying out mixed farming 71.8% grow crops and also look after domestic animals simultaneously. But all of them (100%) use indigenous knowledge in managing diseases and selection of seeds for planting the following season.

They use indigenous knowledge in food security by growing “hard” crops like maize, cassava and beans. These crops have been turned into commercial crops which was not the primary intention originally.

They still practice indigenous knowledge in produce quantity and quality, in disease control, in agro-ecosystems and soil fertility management among others. This paper concludes that despite many changes in the agricultural practices, most smallholder farmers use indigenous knowledge in farming mainly because this knowledge has been tested over generations.

Keywords: indigenous knowledge, smallholder farmers, diverse farming system, mixed farming.

I. INTRODUCTION AND BACKGROUND

Indigenous knowledge (IK) is an important part of lives of local rural communities in Africa and in Uganda. This is especially so for the poor who depend directly on natural resources for their livelihoods. This knowledge is a key element of their social capital and an asset to their survival. They use it to produce food, to provide shelter, and to achieve control of their own lives. The specific areas and activities that illustrate IK are diverse and include hunting, farming, gathering, food, herbal, medicine and health, commercial and even architecture. Local indigenous farmers’ knowledge systems offer an alternative approach to interpreting environment and development change. This often helps to instruct or inform and improve development policies and actions at the local and national planning levels. Local rural people have over time made decisions using their local tools or knowledge for monitoring and measuring challenges such as land degradation during cultivation and therefore they interpret and act on their own understanding of sustainable development (UNCST, 1999).

In Africa there are traditional healers, traditional birth attendants and traditional surgeons who treat fractures including compound fractures. African Traditional medicine is holistic and attempts to go beyond the boundaries of the physical body into the spiritual. This can be categorised as mind-body medicine. Some common medical principles have emerged over time in various African regions. These include several scientifically proven techniques and strategies, some of which are culturally specific and of psychological importance. Among the common ones are hydrotherapy, heat therapy, spinal manipulation, quarantine, bone-setting and surgery - male and female circumcision, brain surgery and the excision of tumours (Carlson, 2002). Western based pharmaceutical companies often send agents to tap the knowledge of traditional African pharmacologists. Carlson (2002) acknowledged that Shaman Pharmaceuticals collaborated with 58 traditional doctors from 7 provinces and 42 communities in Guinea, West Africa, between 1994 and 1998. As a result of this collaboration, 145 plant species were identified as useful for the treatment of type 2 diabetes mellitus.

Among the rural African communities, the local people know when and where to plant certain types of crops; why certain crops do not grow in certain areas, when to take their animals for grazing, why at certain periods there is a low milk supply and what to give the animals to increase the milk supply, how to treat animal diseases using indigenous herbs and shrubs (Aluma, 2004). Tabuti *et al* (2004 and 2012) further reported that local people know the whole process of food processing and preservation for example derivatives from cassava tubers, cereals, legumes, oil seeds, palm tree sap and milk.

Fenta (2010) and Polthanee (2010) have reported how IK is used to maintain and even improve soil fertility in Dejen District, Amhara Region of Ethiopia and in Northeast Thailand. Some farmers have maintained soil fertility by using IK methods for example crop and weed residues available on the farm to produce compost fertilizer for application to the soil.

Agea *et al* (2008) reported the use of IK in Mukungwe sub-county, Masaka District in Central Uganda, in sustaining subsistence farming and enhancing household food security. The majority of farmers in this sub county, mulch their crops using local materials like coffee husks while others use locally concocted pesticides to control pests such as maize stem borers and cabbage diamondback moths. Fresh cassava and potato tubers are buried into the soil to increase their shelf-life.

In Northeast Thailand, farmers use multiple cropping which is a form of intercropping where for example maize and cucumber are intercropped usually after rice harvest under irrigated conditions (Polthanee, 2010). Similarly in KwaZulu-Natal, farmers with a few exceptions, own livestock and practice mixed cropping and rotation systems for fertility management (Buthelezi *et al.* 2012 also reported that local farmers also use traditional plant protection methods to reduce pests and burn the common lake-growing plant, Jariamun (*Potamogeton malaianus miq*) in the middle of the rice

field like a torch, thus driving this pest from the farm (Widianingsih, Kasim and Ploeger, 2012).

While there is much evidence on the use of IK in many areas across the world very little is fully documented about the use of the various IK among small holder farmers in rural areas of Uganda.

II. OBJECTIVES

The main objective of this study was to document some of the indigenous knowledge practices employed by small holder farmers in Kibaale sub region with special attention to Kagadi District (Figure 1).

The specific objectives of this study were to:

1. Identify the on farm and off farm activities undertaken by small holder farmers;
2. Document activities undertaken by farmers in which they applied IK;
3. Identify the application of IK on Various Agricultural Activities;
4. Identify the various IK methods used in disease and pest control;
5. Document the benefits and challenges of using IK.

Figure 1: Districts of Kagadi, Kibaale and Kakumiro



III. METHODS

Study Areas and Selection Criteria

The study was carried out in Kagadi District (Figure 1) and focused on three sub-counties namely: Burora which is dominated by Bafumbira/Rwandese and Bakiga (immigrants); KyanaISOke predominantly occupied by Banyoro; and Muhorro which has a multiplicity of ethnic groups.

The three sub-counties are densely populated due to immigrants and refugees (as a result of incessant wars in the neighboring Democratic Republic of the Congo), hence the possibility of generating a wide range of IK practices. These sub-counties (Figure 2 below) have high population densities, a factor that influences IK and agricultural practices.

Figure 2: Map of Kibaale Sub Region showing the sub-counties where the study was carried out



(Source: Ministry of Water Lands and Environment (MWLE), 2010 (<http://www.citypopulation.de/php/uganda-dmin.php?adm2id=016>))

Data collection methods

A questionnaire administered by the researchers was developed and used on randomly selected local small scale farmers in purposively selected representative sub counties in the districts mentioned above (Appendix 1).

Data was also collected by direct field observations by the researcher when the farmers took the researcher on tour of the IK methods being used on their farms.

To improve quality of information collected, triangulation was done between the data from different individual farmers and also the field observations by the researcher.

In a few instances in situ experiments were conducted and are reported here as case studies to illustrate the short time efficacy of some IK applications.

Data collected from all the above methods was analyzed using the Social Science Statistical Program 2010.

IV. RESULTS AND DISCUSSION

General Background Information About The Farmers

Farming Systems practiced by the farmers

In Kagadi district, farmers practice diverse farming systems. The types of farming systems determine the use of IK in farming. The farming systems used depend on a number of factors such as limited cultivable land for some people, ample cultivable land for others and land fragmentation. Mixed farming and intercropping were reported by 26.6% and 25% respectively of the respondents. Those who practice intercropping reported that it is done for various crops such as coffee with bananas, coffee with cocoa, beans with maize, beans with cassava and cow peas, cassava with beans, groundnuts with cassava, rice with cow peas, rice with maize, rice with beans, Irish potatoes with beans and maize and cassava. In mono cropping, farmers (22.6%) cited examples of such crops as alcohol bananas (*Musa spp*), beans, groundnuts, sweet potatoes, cassava, rice, pineapples, maize, and eucalyptus trees. Farmers reasoned that mono cropping is practiced in order to avoid crop competition for soil nutrients, sunlight and other requirements for proper growth. Other farmers reasoned that with mono cropping, the use of selective herbicides like 24D, Weed End, Weed All and Weed Master in rice fields is achieved.

18.6% reported to be practicing crop rotation and mono cropping. Only 7.2% of the farmers practiced other farming systems concurrently, and these included intercropping, mono cropping, and crop rotation (Table 1).

Table 1: Farming Systems Practiced by the Farmers of Kibaale District

Farming System	No.	%
Mixed Farming	33	26.6
Mono cropping	28	22.6
Intercropping	31	25
Crop rotation,(including bush fallowing), and mono cropping	23	18.6
Intercropping, mono cropping, and crop rotation	9	7.2
Total	124	100

The technocrats’ responses on the different farming systems practiced by the farmers in Kibaale district were diverse. They included a mix of farming systems such as mixed farming, plantation agriculture, protected farming, intensive and semi-intensive farming, agro forestry, intercropping, fallowing, intercropping and mono cropping.

Reasons for farmers’ choice of a particular farming system

The farming systems farmers use largely depends on the resources they have in terms of land, capital, and access to mechanization, education and extension services. On why the various farming systems are the choice of farmers, various responses from farmers and technocrats were registered as listed below:

- With intercropping a variety of crops can be grown in the same garden at the same time and no specific sophisticated techniques required
- Government programmes and policy encourages growing of coffee and bananas.
- Intercropping of coffee and bananas and mono cropping of especially beans, groundnuts and maize are recommended by various technical advisory services for example Enterprise Mix. More than one enterprise ensures potential for increased productivity and income generation.
- Scarcity of land and land fragmentation hence intercropping
- Desire for sustainable income, hence diversification in crop growing and livestock
- Mixed farming helps farmers to harvest a variety of agricultural produce and mitigate risks
- Farmers who engage in tree planting say they are planning for the future while technocrats and politicians are planting trees in preparation income during retirement period.
- Subsistence farming is practiced because it is affordable, involves use of cheap raw materials (local seeds, family labor) and land is small due to land fragmentation. Generally however, there is lack of information on the importance of agricultural mechanization despite being promoted by Government Policies and demand from cross border markets
- Commercial farming is not practiced due to low mechanization.
- Protected farming for example green-houses following promotion by various development partners.
- Free range grazing and chicken rearing is practiced because it does not need heavy investment like infrastructure and maintenance.
- Lack of exposure and effective role models in farming heavily hinders agricultural mechanization.

When asked about the farming systems’ sustainability and environmental friendliness, 62.5% of the technocrats reported that these farming systems are sustainable because they use IK.

Farming systems practiced in the past but stopped and why?

54% of the farmers reported that no farming systems had been stopped, however, 46% reported three systems which had been stopped (Table 2).

Table 2: Farming Systems used and stopped

Farming system used in the past but stopped	No.	%
Line planting with a big hoe and making mounds	11	8.8
Slash and burn (Burning grass in the garden)	42	33.9
Seed broadcasting	4	3.2
No farming system stopped	67	54.0
Total	124	100

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The major reasons given for stopping some of the farming systems was awareness and sensitization from various sources (37.9%) and the limited or no increase in production when using those systems (18.5%) (Table 3).

Table 3: Reasons given by farmers for stopping some farming systems

Reason for stopping farming systems	No.	%
No increase in production	23	18.5
Labor intensive	15	12.1
Training/sensitization on SFM and SWC especially by URDT	47	37.9
Time consuming, no increase in production, difficult to space and weed	17	13.7
Bush burning is bad& Burning the grass kills fertilizer making insects – earthworms, grass generates fertilizer	5	4.0
Tractor not suitable on land where trees are inter cropped with plants	1	0.8
Broadcasting seeds- maize and beans would not give high yields	1	0.8
N/A	15	12.1
Total	124	100

13.7% of the farmers reported that they stopped line planting of beans for example because it was time wasting and they preferred using hoes but in a haphazard fashion. However they noted the challenges of weeding when seed broadcasting is applied (Table 3 above).

During a focused group discussion with Kibaale - Kagadi Community Radio (KKCR) Cultural Leaders Group one elder noted that:

“In the past millet was intercropped with maize. A few people plant millet today and many have resorted to planting maize and rice. This has been brought about by agriculturalist that are promoting other kinds of crops like orange fresh sweet potatoes, quality protein maize that are fast growing and have attracted many people’s attention. Even traders in villages just look for maize and cassava, not millet. Farmers grow millet on very small scale for home consumption. The demand for millet is low though the price is high especially due to demand by the local alcohol brewers. Millet bread has been substituted by cassava bread”.

The promotion of certain crops has also inadvertently led to the abandonment of certain farming practices such as broadcasting which was mainly used in planting of millet and sorghum.

How farmers obtain seeds for planting in their gardens

The majority (35.4%) of farmers retain seed from the previous harvest or old stock. In case the previous harvest was not good and farmers were not able to reserve seed for planting in the next season, farmers either buy seed from the market (25.8%) or get it from their neighbors (22.6%) and pay back after harvesting. 13.7% of the farmers reported using seeds from both old stock and buying from the market (Table 4 below).

Other farmers reported that they get seeds from the Government National Agricultural Advisory and Delivery Services (NAADS) program and from various NGOs working in their areas. The banana suckers, sweet potato vines and cassava cuttings, are obtained from neighbors free of cost.

Decision making on types of seeds to plant in a particular garden

Decision-making on the types of crops to plant in a particular garden is determined by such factors as crop-rotation calendar, vegetation type, compatibility for intercropping, type of soil, land and seeds available among others (Table 4).

Farmers also reported that they follow a crop rotation calendar by growing for example sorghum, groundnuts, maize and beans in that order. This practice is common among the Bafumbira / Bakiga communities in Burora Sub County. Fallowing is practiced for two seasons for farmers who have ample cultivable land. They further reported that as the land is left to fallow, they can hire more land for agriculture. However they reported that the fallow periods for most of them has reduced due to increased population density.

The level of soil fertility and hence types of crops to be planted on a given land was determined by the type of vegetation or weed growing on that piece of land. For example the existence of the big-sized Wondering Jew and McDonald’s eye was reported to be a sign of fertile land suitable for bananas, groundnuts, beans and maize. While exhausted soil was characterized by weeds such as black jack and *Oxalis Latifolia* and was reported to be good for sweet potatoes and coffee. Loam soil with some sand and stones was reported to be good for all crops, while rice does well in reddish soils.

Table 4: How farmers obtain seeds and decision making on seeds to plant

Method of getting seeds	No.	%	Decision-making on seeds to plant	No.	%
Seeds kept or old stock	44	35.4	Intercropping	23	18.5
Market	32	25.8	Crop rotation calendar	39	31.5
Borrow from neighbors	28	22.6	Type of vegetation	34	27.4
Old stock and market (Seeds from previous harvest + buy from colleagues)	17	13.7	Soil type/ Texture	16	12.9
NGOs/CBOs and NAADS	1	0.8	The size of the Land	3	2.4
Previous harvest	2	1.6	How often the land is used	2	1.6
			Type of land - virgin and non- virgin	2	1.6
			Type of seed	2	1.6
			Soil type, crop rotation	3	2.4
Total	124	100	Total	124	100

Farm Tools and Techniques Used in Farming

A number of different IK tools and techniques are used in farming (Table 5). The different methods where these tools and techniques are used include:

- (a) Land Preparation: Farmers reported that they used pangas (machete) for cutting trees, hoes for digging, making terraces and trenches in the garden.
- (b) Planting: Farmers reported that they use small old hoes to plant beans, groundnuts and maize, while broadcasting was used for planting millet and sorghum.
- (c) Weeding: Whereas some farmers reported that they weed with hands and hoes, and mulch the weeds in the same garden, others reported that they use herbicides to spray weeds.
- (d) Harvesting: Farmers reported that they use hands, pangas, sickles, knives and hoes for harvesting different crops.
- (e) Wwinnowing: Farmers reported that for winnowing, they use local trays made from rattan canes, bamboo, papyrus reeds and palm trees. Others use plastic basins while others use baskets (Figure 3).
- (f) Threshing: All farmers reported that they use sticks to thresh. This happens for all crops especially maize, millet, sorghum, wheat, rice, beans, cow peas and groundnuts.
- (g) Storage: Majority of the farmers (50.8%) reported that they dry the produce on plastic materials then pack it in sacks and keep it inside their houses due to increased burglary cases and hence could not store produce in outside granaries (Figures 4 and 5). However, a small number of farmers (8.9%) reported that they sell their produce immediately after harvesting.
- (h) Marketing: 56.4% of the farmers reported that they sell their farm produce to middlemen who are within the communities and usually agents of other middlemen from various major towns of Uganda. These in turn sell the produce in Kampala and neighboring countries like Rwanda, Kenya and South Sudan. The rest of the farmers (44.6%) reported that they sell as individuals.

Figure 3: A groundnuts Sheller and traditional winnowing trays - Burora Sub-county



Figure 4: Maize crib in Kyanaisoke Sub-county! Proper drying not on bare ground is done to void dust contamination



Figure 5: Maize, clothes and motorcycle in the same room in Kyanaisoke Sub-county. Middle: maize and other produce on the floor of the mud and wattle house. The produce in the middle picture were found in the house depicted in the picture on the extreme right



Table 5: Farm Tools, Techniques and Methods in Agricultural Production

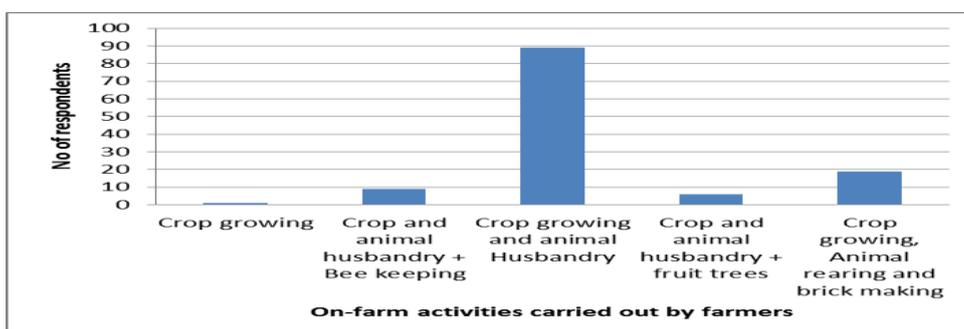
(A) land preparations	No.	%	(E) Winnowing	No.	%
Panga and hoes	44	35.5	Traditional trays	31	25.0
Hoes	23	18.5	Basins	41	33.1
Slashers	27	21.8	Baskets	24	19.4
Axes	18	14.5	No answer	12	9.7
All above	7	5.6	Local tray + Basin	16	12.9
Panga, axe and hoe	5	4.0	Total	124	100
Total	124	100	(F) Threshing		
(B) Planting			Threshing sticks	118	95.2
Small hoes	79	63.7	None	2	1.6
Seed broadcasting	45	36.3	Machine (groundnuts, Maize)	4	3.2
Total	124	100	Total	124	100
(C) Weeding			(F) Storage		
Hands	59	47.6	Crib	4	3.2
Mulching	26	21.0	House(mode of storage not specified)	31	25.0
Hoes	32	25.8	Put in bags and store in houses	70	56.5
Use of chemicals	6	4.8	Immediately sells	11	8.9
Hand, spraying with 24D	1	.8	Pour on floor inside house	1	.8
Total	124	100	Put in bag , placed on timber	7	5.6
(D)Harvesting			Total	124	100
Hands	5	4.0	(G) Marketing		
Pangas	46	37.1	Sale from home to business people within sub-county	27	21.8
Knives	42	33.9	Group	18	14.5
Hoes	17	13.7	Middlemen	70	56.4
Sickle	2	1.6	Group marketing	2	1.6
Panga, Knives, hand Hoe	12	9.7	When crops are still in the gardens	2	1.6
			Individual	4	3.2
			Taking produce to the market	1	.8
Total	124	100	Total	124	100

ON AND OFF FARM ACTIVITIES

On-farm activities carried out by the farmers

Farmers mentioned crop growing, animal husbandry, brick making, renting, beekeeping and fish farming as on-farm activities they are involved in. A large number of farmers (71.8%) carry out both crop and animal husbandry (Figure 6 below).

Figure 6: On-farm activities carried out by farmers



The crops mentioned by the farmers included maize, cassava, beans, groundnuts, rice, millet, sorghum, yams, pumpkins, coffee, cocoa, tobacco and different types of vegetables. The animals farmed included pigs, local chickens, goats and sheep. Cattle and rabbits were also reported. A few farmers (15% and below) reported being involved in bee keeping, fruit tree growing and brick making. This kind of farming is typical of smallholder farmers in Uganda and most of developing countries (Development Research & Training, 2012; Anderson J., Leach C.E. and Gardner S. T. (2016).

Off-farm activities done by the farmers

A number of activities are carried out by the small holder farmer off-farm (Table 6).

Table 6: Off-farm activities engaged in by farmers

Activity	No.	(%)
Carpentry	1	0.8
Handicraft	45	36.3
Hunting	21	16.9
No response	22	17.7
Mason (building)	6	4.8
Trade (retail shop, agricultural crop produce)	13	10.5
Saloon	3	2.4
Brewing and Mason	1	0.8
Repairing shoes	1	0.8
Restaurant , lodges + rentals	3	2.4
Trade + weave mats	1	0.8
Trade in fish and farm produce	2	1.6
Trade in fish, pigs, and brewing waragi	1	0.8
Casual Labour and Community Health Worker (VHT)	1	0.8
Selling Mandazi (doughnuts)	1	0.8
Business and distilling waragi	2	1.6
Total	124	100

The most common off farm activity was handcraft (36.3%) followed by hunting (16.9%). The results further show that women were engaged in handicrafts, petty trade and saloon, and this included making mats, table clothes, baskets, baby shawls and caps. The results also show that men were involved in hunting (for wild game meat), trading, brewing, mason, and carpentry. However 17.7% of the respondents were not involved in any off farm activities.

ACTIVITIES UNDERTAKEN BY FARMERS USING IK

Activities farmers carried out in the past using IK

Farmers reported a number of activities they undertook in the past using IK (Table 7). These included mushroom collection (23.4%), rice growing (16.1%) and wild honey collection (16.1%).

Table 7: Activities farmers carried out in the past using IK

Activity	No.	Percent (%)
Rice Growing	20	16.1
Wild Honey collection	20	16.1
Mushroom gathering	29	23.4
Making table clothes and selling doughnuts & porridge at Lake Albert	18	14.5
Trading	7	5.6
Hunting and trapping mud fish	2	1.6
No response	20	16.1
Honey from stingless bees + collecting wild mushrooms	3	2.4
Weaving baskets	3	2.4
Catching grasshoppers and white ants	2	1.6
Total	124	100

Activities done in the past using IK but stopped, when and why?

Results show that farmers stopped using IK at different intervals. Whereas some farmers stopped 15 years ago, others stopped just 2 years ago while others could not remember. Various reasons including advancement in age, lack of interest 32.3%), low production (12.9%), influence of modern farming methods (16.9%), unproductive casual activities and influence of NGOs (11.3%), were cited as some of the reasons for stopping using IK practices (Table 8 and Figure 7).

Hunting was one of the activities undertaken using IK methods. Wild animals hunted included bushbuck, wild pigs, antelopes, edible rats, baboons, and monkeys. Most of the communities involved in this activity included mainly the migrants from Kigezi sub-region. They argued that they discovered these activities were labor intensive and did not generate high incomes. Secondly due to forest destruction by human settlement, crop and domestic animal husbandry, wildlife habitats disappeared hence wild animal number dramatically decreased.

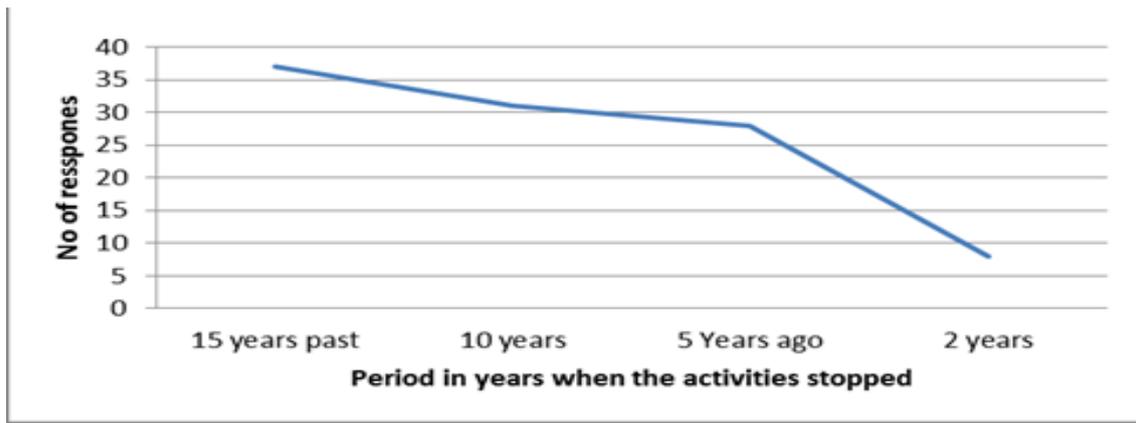
The major reasons given for abandoning most of different activities using IK included aging and labor intensive nature of the activities and loss of interest (32.3%). Modern methods of farming (16.9%), Low production (12.9%) and influence of other people or NGOs (11.3%) were reported among other reasons for stopping using IK in some activities (Table 8 and Figure 7)

A number of IK related activities which were stopped included making a local high alcohol content brew (1.6%) attributed it to banana bacterial wilt disease which destroyed the banana crop they use in making the brew. The mudfish trappers were on the other hand hindered by reduced catches as a result of reclamation of wetlands.

Table 8: Activities done in the past using IK but stopped, when and why

Past Activity with IK	No.	%	When stopped	No.	%	Reason for stopping	No	%
Hunting and gathering (Wild honey (from stinging and stingless bees, Mud fish Trapping)) Trapping moles for meat , Collecting white ants	56	45.1	15 years past	37	29.8	Aged + labour intensive Lost interest, aged	40	32.3
Others	14	11.3	10 years	31	25	Low production	16	12.9
Building grass thatched houses (for money)	6	4.8	5 Years ago	28	22.6	Modern Methods of farming	21	16.9
Rice growing	10	8.1	2 years	8	6.5	Influence of other people or NGOs	14	11.3
Making table clothes and porridge for sale	10	8.1	No response	20	16.1	Not developmental	1	0.8
Making baskets	4	3.2				No response	13	10.5
Brick making	1	0.8				No time, got married	6	4.8
Cultivation of cabbages and Irish potatoes	2	1.6				Finished my house, stopped brick making	2	1.6
Apiary (beekeeping)	2	1.6				Animals reduced	4	3.2
Brewing/distilling waragi & fishing on Lake Albert	2	1.6				Migrated to Kibaale	1	0.8
No response	17	13.7				Forest cut down	2	1.6
						No bananas (BBW), strong winds killed people on L. Albert	1	0.8
						Anthills dismantled to kill white ants that destroyed houses	2	1.6
						Have domestic animals	1	0.8
Total	124	100	Total	124	100	Total	124	100

Figure 7: Trend of IK usage in the past 15 years



Application of IK on Various Agricultural Activities

A number of activities related to agricultural production were investigated with the view to identifying the IK methods applied. These activities included timing of seasons, ensuring household food security, improving household income, improving the quality and quantity of agricultural produce, soil fertility management and agro-ecosystem management.

Application of IK in timing of seasons

The respondents reported that they apply IK through observing certain signs and hence were able to predict change of seasons. 31.5% reported following the traditional agricultural calendar and radio weather forecasts; 20.2% reported counting days from when it last rained; 21.8% reported observing the direction of wind; while 20.2% reported observing weather changes. The dimness of the moon was reported by a few farmers (0.8%) as an indicator of rains coming shortly (Table 9)

Table 9: IK Application in Timing Seasons

IK and Timing Seasons	No.	%
Agricultural calendar & radio weather forecasts	39	31.5
Counting days	25	20.2
The blowing (direction) of wind	27	21.8
Weather changes	25	20.2
I don't Know	1	0.8
Deem moon shows rain is about to start	1	0.8
Working in groups, early land prep and early planting	1	0.8
Trees shading off leaves-dry season	2	1.6
Earthquake and sunshine indicate change of season	1	0.8
Earthworms indicate rain	1	0.8
Movement of insects: butterflies for dry season, small millipedes for rains	1	0.8
Total	124	100

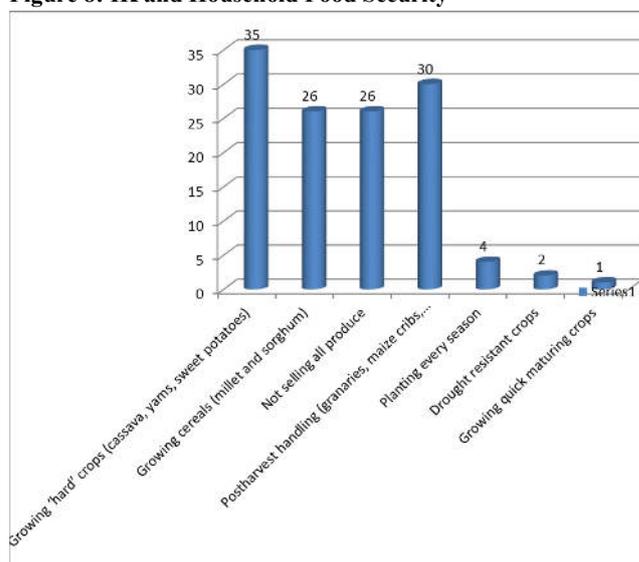
Application of IK in Household Food Security and Income

A large percentage (28.2%) of the farmer apply IK in ensuring household food security through growing easy to dry and store crops such as cassava, yams and sweet potatoes. 24.2% apply IK in post-harvest handling, 21% in growing cereals and 21% in keeping some of their produce. Only a small percentage (1.6%) reported growing drought resistant crops and 0.8% reported growing quick maturing crops (Table 10 and Figure 8).

Table 10: IK Application in Household Food Security and Income

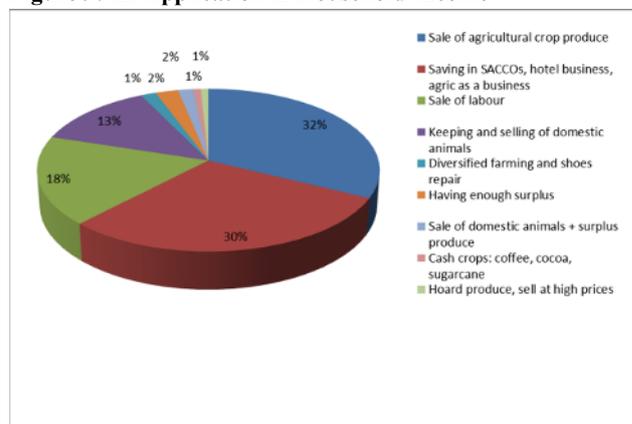
IK and Household Food Security	No.	%	IK and Household Income	No.	%
Growing food crops (cassava, yams, sweet potatoes)	35	28.2	Sale of agricultural crop produce	40	32.3
Growing cereals (millet and sorghum)	26	21.0	Saving in SACCOs, hotel business, agriculture as a business	37	29.8
Not selling all produce	26	21.0	Sale of labor	22	17.7
Postharvest handling (granaries, maize cribs, preserving food like beans and drying on tarpaulin)	30	24.2	Keeping and selling of domestic animals	16	12.9
Planting every season	4	3.2	Diversified farming and shoes repair	2	1.6
Drought resistant crops	2	1.6	Having enough surplus	3	2.4
Growing quick maturing crops	1	0.8	Sale of domestic animals + surplus produce	2	1.6
			Cash crops: coffee, cocoa, sugarcane	1	0.8
			Hoard produce, sell at high prices	1	0.8
Total	124	100	Total	124	100

Figure 8: IK and Household Food Security



Regarding household income, 32.3% of respondents reported use of IK in sale of crops, 29.8% in saving the produce, 17.7% in sale of labor and 12.9% in keeping and selling of domestic animals. Only 0.8% mentioned use of IK in cash crop growing such as coffee, cocoa and sugar cane and another 0.8% mentioned hoarding of produce as they wait for high prices (see Table 10 and Figure 9 below).

Figure 9: IK Application in Household Income



Application of IK in Produce Quantity and Quality

Regarding application of IK in improving produce quantity, 32.3% of respondents mentioned application of IK through cultivating larger pieces of land, while 30% mentioned use of extra external labor and 29% group work (Table 11 below).

Table 11: IK Application in Produce Quantity

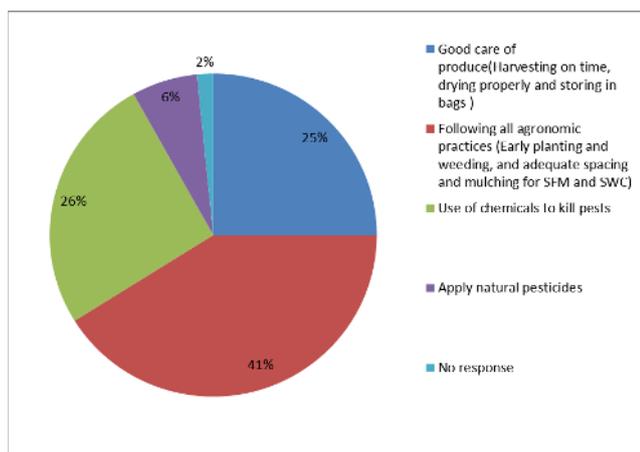
IK and produce quantity	No.	%
Cultivating a big piece of land	40	32.3
External labor	38	30.6
No response	10	8.1
Group work	36	29
Total	124	100

On the quality of the produce, 25% of respondents mentioned taking care of farm produce which is a post-harvest practice and 51% mentioned following all agronomic chain practices which include early planting and weeding, and adequate spacing and mulching among others. However, 25.8% of respondents mentioned use of chemicals to kill pests, and only 6.5% mentioned use of natural pesticides (Table 12 and Figure 10 below).

Table 12: IK Application in Produce Quality

IK and Produce quality	No.	%
Good care of produce(Harvesting on time, drying properly and storing in bags)	31	25.0
Following all agronomic practices (Early planting and weeding, and adequate spacing and mulching)	51	41.1
Use of chemicals to kill pests	32	25.8
Apply natural pesticides	8	6.5
No response	2	1.6
Total	124	100

Figure 10: IK and Produce Quality



Application of IK in Agro-ecosystem and Soil Fertility Management

Most of the famers (58%) mentioned applying IK in tree planting, 28.2% in preserving indigenous tree species, and 8.1% in use of organic pesticides, cultural and mechanical means in pest and weed control. A few (4.8%) mentioned living in harmony with animals. Examples mentioned included use of scarecrows to chase birds from rice gardens, a bell on a string to scare monkeys and baboons and smearing cow dung on young maize cobs to keep away wild animals. Very few (0.8%) mentioned using grass bands, tree planting, planting yams in wetlands without draining them as a way of managing agro-ecosystems.

Regarding soil fertility management, IK is mainly used in making natural manure (leaving grass to decompose in garden, burying weeds to generate manure and using animal droppings), planting Nitrogen fixing plants (29%) and bush following (23.4%). However, a small number of respondents (1.6%) mentioned use of grass bands, ditches, crop rotation and organic farming as good IK agronomic practices (Figures 11 and 12).

Figure 11: IK and Agro-Ecosystem management

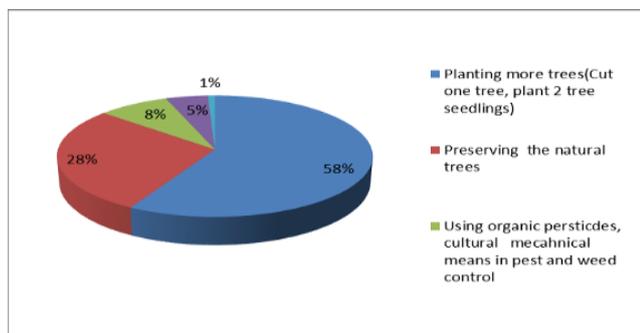
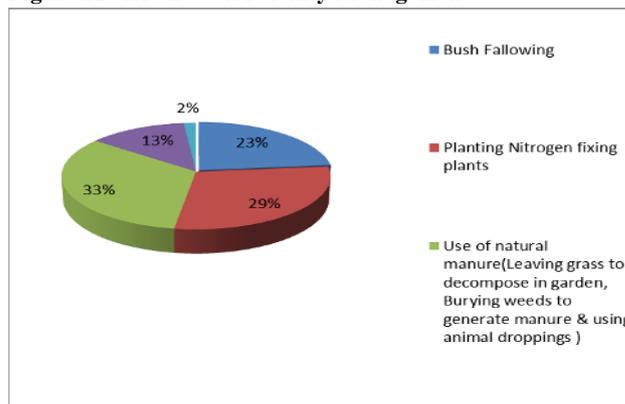


Figure 12: IK and Soil Fertility Management



Natural Methods in controlling pests and diseases in crops and domestic animals

Farmers reported various remedies in controlling pests and disease in crops and animals. The methods reported were a mix of actual and emerging knowledge resulting from farmers’ creativity and time-tested action. These included:

Natural Methods of pests and disease control – crops

- Spraying the affected plant with a mixture of ash and water or pouring dry ash around the infected crops.
- Soaking seeds overnight before planting.
- Smearing Red Pepper around beans to preserve them as seeds for the next season.
- Making natural pesticides: spraying concoctions of hot pepper, tobacco, marigold or urine in maize, beans and cabbages. Spraying sweet potatoes gardens with ash in dry season, mixing ash with *Lantana camara* to spray cocoa diseased plants, mix cyprus with *Lantana camara* to prevent bean weevils
- Removing male buds to fight Bacterial Banana Wilt, trapping weevils in bananas and pouring urine on banana stocks.
- Preservation of beans using red pepper or Cyprus leaves
- Using anthill soil or burnt bricks to prevent bean weevils
- Scarecrows to chase birds, bell on a string to scare monkeys and baboons, smearing cow dung on young maize cobs and sugarcane.

Natural Methods of pests and disease control – domestic animals

- Use herbs: For example *Oxalis corniculata* (omugobe) for treating diarrhea in goats, *Aloe vera* for treating cocodiosis and worms in chickens.
- Treating swine fever using: Pawpaw roots mashed in water; domestic animal urine mixed in soapy water; and or acacia leaves mixed with soap.
- Red pepper , ash , soot and water for coccidiosis in chickens.
- Deworming and cough in domestic animals: Hot pepper for chickens and marijuana to all domestic animals. Boiled candle bush leaves mixed with food and salt for de-worming pigs.
- Use of decomposed urine (kept for a week) to treat fever in poultry, pigs
- *Tephrozia* leaves used to kill lice in pigs
- Paraffin to kill lice around the eyes of chicken.
- Fractures in goats treated by bone setters

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Figure 13: Pawpaw tree – roots are used for treating swine fever. *Tephrosia*, an agroforestry tree whose leaves kill lice not only in pigs but also in homesteads



How farmers learned about pest and disease control using IK

Most farmers (46%) reported having got the IK information from parents and elders. Other sources included extension workers (19.4%), the local Kibaale Kagadi Community Radio (KKCR) (25.8%).

Applicability of pest and disease control methods (how often)

On how often the respondents applied the IK on pest and disease control, they reported as follows: 23.4% every season when there is an outbreak, 16.9% before sowing and 13.7% after harvesting. Other times mentioned included after germination and during flowering of the crops and when the crops or animals are diagnosed with a disease.

Effectiveness of IK Pest and Disease Control Methods

Managing pests and disease on crops, most farmers 25% reported that IK methods were very effective and 22.6% mentioned its effectiveness particularly in chasing birds and 19.4% in use of traps on wild animals. However, 4% mentioned that IK methods are effective and improve harvest. It was further noted that 21.1% of the farmers felt that IK effectiveness in crop disease control has not been proved beyond reasonable doubt (Table 13).

Responses regarding effectiveness of IK on animal parasite and disease control were reported to be more effective. 61.1 % of respondents mentioned that IK is effective in early treatment of animal related diseases especially if the disease and sickness is identified and treated early; while 1.6% mentioned that some diseases are difficult to treat using only IK.

However, a larger percentage (31.5%) indicated that IK was not effective in treating animal diseases compared to, only 21.1% mentioned in crop pest and disease control (Table 13).

Table 13: Effectiveness of IK Methods on Crops and Domestic Animals

Effectiveness in Crops	No.	%	Effectiveness in Domestic Animals	No.	%
Chasing birds works best	28	22.6	Treat at early stage of disease	77	61.1
Not yet proved it	27	21.8	Not effective	39	31.5
Use of Traps on wild animals and rats very effective	24	19.4	Some disease are difficult to treat	2	1.6
Very effective	31	25.0	No response	4	3.2
They are effective and improve harvest	5	4.0	N/A	2	1.6
In beans preservation, they are automatically effective	2	1.6			
No response	6	4.8			
N/A	1	0.8			
Total	124	100	Total	124	99.2

How the Natural Methods can be Boosted

Farmers cited various ways how the natural pest and disease control methods can be boosted so that they benefit many people. The majority of the respondents (33.8%) suggested training by specialists, while 32.3% recommended organizing radio programs, 20% suggested documentation of IK in illustrated books, and 9.7% reported need for government support to people practicing IK (Figure 14).

Figure 14: Suggested ways of boosting pests and Diseases control using natural methods



Weed Control and Utilization

Farmers control the weeds on their farms through utilization. Most respondents (60.6%) reported that they utilize weeds as animal feeds vegetables, medicine, mulch and organic manure when the weeds are uprooted and left to rot in the gardens. Of these 29.8% consume it as food and 18.5 use it as human medicine (Table 14).

Table 14: Weed Utilization by the Farming Communities

Weed Utilization	No.	%
Animal feeds, Medicine and Mulch for Organic Matter	33	26.6
Consumed by people	37	29.8
Medicine (black jack as first aid on simple cuts)	23	18.5
Fertilizers (organic manure)	9	7.3
No response	2	1.6
Mulching banana plantation and other gardens	1	0.8
N/A	4	3.2
Mulch , fertilizer, medicine, and vegetables	12	9.7
Animal feeds	1	0.8
Mulch	1	0.8
Leaves of black jack work like tea leaves	1	0.8
Total	124	100

How farmers learn from each other about IK and how information is passed on to the young generation

Farmers reported that they mainly learn from each other about IK in various fora which include working groups like digging groups (22.6%), visiting each other (31.5%) and from parents (31.5%) (Table 15).

Table 15: How farmers learn from each other on IK

Farmers Learning about IK	No.	%
Working in groups	28	22.6
Visiting each other	39	31.5
From parents	39	31.5
Sharing on the Radio	7	5.6
Learning from neighbors, Group work and sharing knowledge	5	4.0
Seminars by religious institutions especially FOU and church	2	1.6
No response	3	2.4
I don't learn anything from others	1	0.8
Total	124	100

IK is passed on to the young generation mainly from parents teaching their children (40.3%) through practical work (21.8%). Children get involved in agricultural activities with their parents during holidays, weekends and evenings when they are not engaged in school activities. Other respondents reported that some children learn about IK in agriculture and environmental conservation in schools (Table 16).

Table 16: How farmers learn from each other on IK and how knowledge is passed on to the young generation

Information to Young Generation	No.	%
Parents teach their children	50	40.3
Practical work	27	21.8
Involving the young children in Agriculture	24	19.4
Listening to KKCR programs	5	4.0
In schools, teachers teach agriculture and natural resource management	3	2.4
Discussing agriculture at fire place	3	2.4
Observation from parents	9	7.3
No response	3	2.4
Total	124	100

Benefits and challenges related to learning about IK

The major benefits reported by the farmer accruing from IK include changes in individual attitudes and practices (33.9%), achieving food security (20.2%) and easy access (12.9%). These benefits have enabled effective use of IK (Table 17).

Table 17: Benefits of learning about IK

Benefits of IK	No.	%
Easy to learn and pass on	15	12.1
Food security	25	20.2
Changes one's attitude and practice	42	33.9
Locally and easily available (Accessibility)	16	12.9
IK is easily applied in Agriculture and other businesses	8	6.5
Soil fertility maintained, no money spent, requires no skills	2	1.6
Enables one to be self-reliant	3	2.4
It's dependable and sustains families	3	2.4
Promotes teamwork	1	0.8
Freely sharing information on agric practices	2	1.6
Observable and practical knowledge, cheap	2	1.6
Farmers become researchers in their respective capacity	1	0.8
No response	4	3.2
Total	124	100

On food security, farmers reported that even when the weather is very bad, with IK, a farmer is able to harvest something, however small it may be.

The major challenges reported by farmers in learning about IK included its being disorganized (34.7%) unlike other courses or knowledge, less emphasized by extension staff (16.9%) and having relatively few trainers (12.9%) (Table 18).

Table 18: Challenges of learning about IK

Challenges of IK	No.	%
Few trainers of IK	16	12.9
IK not organized	43	34.7
IK less emphasized	21	16.9
Not effective	18	14.5
IK outdated	3	2.4
IK hampered by Illiteracy, trial and error	3	2.4
Negative attitude towards IK	1	0.8
No challenge	12	9.7
No classes organized to teach IK	1	0.8
No response	3	2.4
Lack of trust among some people	1	0.8
Learning hampered if a farmer does not belong in group	1	0.8
IK depends on nature	1	.8
Total	124	100

V. CONCLUSION AND RECOMMENDATIONS

While the small holder farmers in rural areas undertake many activities on and off farm, they do this as an insurance in the event that one crop or activity does not yield another will do. This is a very important practice of rural farmers

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The farmers apply IK on both their crops and their domestic animals and use it because it is accessible, cheap and easy and has been tested over time. This is opposed to modern / western knowledge which is not only inaccessible but expensive as well.

They also apply the IK in the whole food production chain from identifying the seeds to planting, weeding harvesting, drying and storage to transport and marketing

Farmers also use IK in managing disease and in pest control despite the many challenges including inadequate information and guidance; they find IK more reliable and affordable.

This paper wishes to make the following recommendations:

There is need for further research to specifically document these IK approaches in Agriculture across the whole country in order to have data beyond reasonable doubt about its efficacy.

There is need to identify the knowledge bearers of IK in the rural areas and use them as sources of information.

There is need to carry out education and awareness about IK targeting local rural communities in relationship to the various activities they do.

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