EISSN: 2707-0425

East African Journal of Science, Technology and Innovation, Vol. 3 (Special issue): February 2022

Effect of Agroforestry on community wellbeing in Kyannamukaaka Sub County, Masaka

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Abstract

Community wellbeing is dependent on agroforestry, which provides social, economic, health and ecological benefits for man, and has proved essential in the COVID-19 pandemic. The paper purposely examines the effect of agroforestry on community wellbeing with a focus on the benefits of tree-crop interactions on community's wellbeing, and limitations to adoption of tree-crop interactions in Kyanamukaaka Sub County. The paper employs a cross-sectional survey design using qualitative data collection approaches. The paper targets 35 farmers from which 32 practicing in tree-crop interactions were determined by Krejcie and Morgan sample size determination table. Respondents were purposely selected and participated in the study. Data was collected through interview, observation and documentary review. Later, it was organized, transcribed and triangulated to develop themes for interpretation, analysis and discussion. Results indicate that tree-crop interactions offer socioeconomic [food (96.9%), local herbs (100%), fodder (52.6%), raw material (62.5%), firewood and income (90.6%), employment (37.5%) and ecological (conserves soil fertility and moisture conservation (50%), controls soil erosion runoff (59.4%), protect soil health (28.1%) and act as habitats organisms (34.4%)] benefits. Furthermore, other themes included; climate change (84.4%), land size and ownership (90.6%), inadequate competences (50%) anthropocentrism (56.2%), poor quality and high costs of farm inputs (96.9%) and diseases (93.7%) as limitations to adoption of tree-crop interactions. The paper concludes that tree-crop interactions were of benefit to the community. However, observations show that some households had no trees while the others cut trees unsustainably on their farmlands. Therefore, to increase adoption of tree-crop interactions and diversity, Kyannamukaaka Sub County and Masaka District should create awareness and build farmers' capacity in climate change resilience, underground forestry management, tree growing and energy efficient technologies.

Keywords: *Adoption, agroforestry, climate change, health, tree-crop interaction, wellbeing*

Received: 28/10/21
Accepted: 13/12/21
Published: 16/02/22

Cite as: *Mbowa and Murongo (2022).* Effect of Agroforestry on community wellbeing in Kyannamukaaka Sub County, Masaka. *East African Journal of Science, Technology and Innovation 3 (Special Issue).*

Introduction

According to Jose (2009), agroforestry has recorded social, economic, political, and ecological benefits as vital to communities which boost communities' wellbeing across the globe. It involves the integration of trees with crops, and

animals on the same land, which eventually provides multipurpose benefits to the farmer (Jose, 2009; Ibrahim *et al.,* 2011; Prasad *et al.,* 2016). In Bangladesh, the reliance on agroforestry provided avenues for socioeconomic and ecological benefits (Ibrahim *et al.,* 2011). Similarly, in India, agroforestry enhanced food security, improved soil health, and mitigated climate change (Prasad *et al.,* 2016). Thus, such benefits were crucial to human life and wellbeing, as food prodcution was supported by fertile and health soil as well as favourable climatic conditions influenced by agroforestry trees grown.

In Sub Saharan Africa (SSA), agroforestry offered multiple roles for example; food provisions, and environmental stewardship, which were influential in mitigating climate change and its effects (Kuntashula, 2017). Amejo *et al.,* (2018) affirm that even though smallholder farmers integrated livestock and crops on their land units in SSA, the practice is on smallholdings which hinders their multiple productivity. However, in Zambia small scale farmers gained more from tree growing and animal rearing. As animals ate more and more fodder, more farm yard manure was produced to support soil health and fertility improvement hence increased agricultural production (Kuntashula, 2017). Morover, in Mali, grass and fodder plants grown provided more than enough feeds and the surplus was stocked for later seasons. Thus, in such areas, animals produced enough milk which was sold to households and earn substantial incomes (Amejo *et al.,* 2018). Additionally, the substantial farmyard manure generated was key to agricultural productivity as it was sold to other farmers. Literature reveals that in Ethiopia, the sequential rotations between animals and crops minimized synergies and tradeoffs in tree-crop-animal systems (Ibid).

Interestingly in the region, as earlier stated, integration of trees-crop and livestock at household level brought economic, social, and environment, potential influencing income, fuelwood, and food supply (Mugure and Oino, 2013). Notably, women play a fundamental role in support of agroforestry through growing trees to support their needs such as food, health and energy safety. This implies that agroforestry supports gender empowerment that is, income and health for women and children in local communities. Unfortunately, the male counterparts enjoy most of the benefits from timber, non-timber, and other tree services products. In Rwanda, agroforestry improved farmers' income and environmental wellbeing such as soil fertility, erosion control, microclimate and vegetation (Kiyani *et al.,* 2017). These are the fundamental elements of agroforestry specific for women and children as they utilize them to sustain their wellbeing. Additionally, farmers had maximized their incomes, increased tree diversity, managed energy crisis, and reduced the long distances women would move in search for wood fuel (Kiyani *et al.,* 2003). The researcher infers that, trees provide timber, shade and protect crops against strong winds.

In Burundi, women who planted *Markhamia lutea* together with crops reported that the trees treated diarrhea in children (Franzel *et al*, 1999) as cited in Mugure and Oino, 2013). It is worth noting that in Tanzania, farmers practiced improved fallows with different trees and shrubs. These were integrated and allowed to grow for a period of over five years to allow the soil to regain its fertility (Mugure and Oino, 2013). On the other hand, fallows housed organisms, controlled soil erosion and runoff, provided fuel wood and stakes which supported climbing vegetables like beans, and tomatoes.

In Uganda, farmers practice different forms of agroforestry including tree planting, crop growing and rear animals as sources of social, cultural, economic and ecological values. Literature reviewed indicates that people who integrate trees with crops and animals benefit most in different parts of the country. Socially, agroforestry provided fuelwood, raw materials, mulches, fodder for animals, food/fruits that enhance people's wellbeing (Ruhangariyo, 2018). Culturally, agroforestry is crucial to the community for example, birds, animals and crop products are used for cultural/traditional celebrations. On the other hand, agroforestry products are sold for households to earn income and are source of employment (Mbowa *et al.,* 2018). Revenues from tree-crop interactions help to improve infrastructural development within and outside the community. Agroforestry also

plays a fundamental ecological role in the society such as cleaning the atmosphere, control erosion, wind breaks, and improving soil fertility (Nabunya, 2017; Basamba *et al.,* 2016). These enhance sustainable agricultural productivity and better revenues. Regrettably, some communities have not embraced the values and benefits of agroforestry because they have not adopted agroforestry (Kyarikunda *et al.,* 2017)

Despite numerous studies carried out on benefits of agroforestry, less is done on tree-crop interactions and their benefits on community wellbeing in Kyannamukaaka Sub Country. Further, literature reviewed indicates that scholars focused more on agroforestry but not tree-crop and its significance to wellbeing, which this study addressed. More to that, there is limited studies carried out on the effect of tree-crop interactions on community wellbeing, of which the study added to the body of knowledge. Consequently, when the results from the study are disseminated to the respondents and entire community, it will enhance farmers' adoption and practice of tree-crop interaction. On that note, the study specifically established the effect of tree-crop interaction on community wellbeing and limitations to adoption of tree crop interactions by farmers in Kyannamukaaka Sub County.

Materials and Methods

Research design

The paper employed a cross-sectional survey design using qualitative data collection approaches, including observation, interviews and documentary review. Using the design, the researcher was able to collect reliable data in a short time from the respondents through qualitative methods and raw appropriate conclusions from the study.

Study population and sampling

The study targeted 35 farmers from which 32 farmers practicing tree-crop interaction were determined using Krejcie and Morgan sample size determination table. The respondents were randomly selected from the four (4) villages that is, eight (8) respondents from each village (Kaluuma, Ttala, Mannywa and Bulegeya) located in Kamuzinda parish to participate in the study. The participants selected were those actively practicing tree-crop interactions on their smallholder farms. Further, researcher also employed purposive sampling to select key informants of whom the interviews were conducted.

Data collection

Data was collected through interview, observation and documentary review. Firstly, the researcher designed an interview guide, which was administered through a semi-structured process. This allowed the researcher to interview the respondents a series of questions related to the problem under study. The researcher also used ace-to-face approach, wrote the responses in a notebook, and recorded audio using a phone to manage time and ease the process. This method was appropriate as it enabled those who were unable to read and write.

Secondly, the researcher used observation to collect firsthand information on the problem under study. During the study, the researcher employed a non-participant observation approach to collect data on trees, crops grown, and products from the tree-crop interactions as guided by observation schedule. The researcher recorded the observed data using both a notebook and video recorder.

Finally, the researcher collected data through documentary review, this involved reviewing literature from different journal articles and papers using key terms such as tree-crop, interaction, benefits, contribution; limitations, challenges, and problems. This helped to establish the gap in the literature, which helped to form a newness of the data the study area.

Data analysis

After collecting data from the respondents, data recorded was transcribed, into word codes and meaning attached. Further, data wrote in the notebook was edited, cleaned, coded to generate meaningful themes for analysis. Thereafter, the themes were entered into MS Excel to generate frequencies and percentages for interpretation and analysis. On the other hand, data from observation was organized, transcribed and triangulated to develop major themes for interpretation, analysis and discussion. Further,

data from documentary review was used to complement the primary data for thorough discussion and supported the arguments raised in the research.

Results

Benefits of tree-crop interactions to community wellbeing

Results collected from interviews were broadly categorized into two thematic areas that is socioeconomic and ecological/environment, of which each had its own subthemes as detailed in the Table 1 below:

Table 1. Benefits of Tree-Crop interactions

Benefits of crop tree interaction	Frequency (n=32)	Percent
Socioeconomic		
Food	31	96.9
Fodder	18	56.2
Local Herbs	32	100
Firewood	29	90.6
Raw materials	20	62.5
Income	29	90.6
Employment	12	37.5
Ecological/environment		
Soil fertility and moisture conservation	16	50
Soil erosion and runoff control	19	59.4
Protection of soil health	9	28.1
Habitat for organisms	11	34.4

According to Table 1 above, the study established two thematic areas that is socioeconomic and ecological/environment. On the socioeconomic, results reveal that local herbs accounted for (100%). This was followed by food (96.9%), fuel wood and income (90.6%), raw materials (62.5%), fodder (56.2%), and employment which accounted for the least benefit (37.5%). On the other hand, for ecological/environment benefits, results indicated that soil erosion and runoff control accounted for (59.4%), and soil fertility and moisture conservation (50%). Results also indicated that tree-crop interactions offered habitat for organisms (34.4%) and protected soil health (28.1%).

Limitation to adoption of tree-crop interactions by farmers

Results in Table 2 below summarized climate change, anthropocentrism, pests and diseases, land size and ownership, inadequate competences and poor quality and high costs of farm inputs as limitations to tree-crop interactions.

Table 2. Limitations to adoption of tree-crop interactions

Limitations	Frequency (n=32)	Percent
Climate change	27	84.4
Anthropocentrism	18	56.2
Pests and Diseases	30	93.7
Land size and ownership	29	90.6
Inadequate competences	16	50
Poor quality and high costs of farm inputs	31	96.9

Results in Table 2 above reveal that poor quality and high costs of farm input (96.9%) was the major limitations. This was followed by pest and diseases (93.7%), land size and ownership (90.6%), climate change (84.4%). Further, anthropocentrism and inadequate competences accounted for 56.2% and 50% respectively.

Discussion

Benefits of tree-crop interactions to community wellbeing

Accordingly, findings revealed that tree-crop interactions are source of food/fruits, which is vital household food security. For example, *Persea americana, Mangifera indica, Artocurpaus heterophyllus, Citrus spp,* and *Javanica* were observed as common trees providing food especially in form of fruits. During the survey, it was also observed that pine apples, sweet potatoes, bananas, beans, and irish potatoes were integrated with trees. A respondent in Kaluuma village reported that he grew vegetables such as cabbage, tomatoes, and onions together with cassava, and maize to supplement sauce and food respectively. This implies that, integrating trees with crops such as fruits, grains and vegetables with medical plants in Southern Western highlands of Uganda allowed increased food security throughout the year (Ruhangariyo, 2018).

Interestingly, findings indicated that local herbs from some trees and crops are source of medicine, for example, *Albizia spp,* Bottom brush, and *Mangifera indica*. A respondent from Ttala asserted that *Mangifera indica* helped in treating cough. In relation to the above view, Kalaba, Chirwa, Syampungani, and Ajayi (2010, p.465) urge that societies use fruits and herbal tree leaves to treat and cure constipation, toothache, cold and cough, fever, pains, measles and malaria. Kalaba *et al.* (2010) further infer that *Albizia antunesiana, Brachystegia spiciformis, Rhus chirindensis, Julbernadia paniculata, and Pseudolachnostylis maprouneifolia* were vital to such diseases in Zambia and other Sub Saharan African countries. Then again, Kofi *et al.* (2003) claim that *Morinda lucida* offers various medicinal uses to communities. For example, diabetes, hypertension, cerebral congestion, dysentery, stomach-ache, ulcers, leprosy and gonorrhea (Council for Science and industrial Research, n.d). Further, *Morinda lucida* is traditionally used for the fight against fever in Nigeria, and in Democratic Republic of Congo the plant is to treat against itches and ringworm (ibid).

Furthermore, tree-crop interactions are sources of fodder for animals, which help to increase milk production. It was reported that *Calliandra colothyrus, Gliricidia sepium Sesbania sesban, Luecena lucophala,* and Lab-lab provided good fodder for animals. The results are supported by Regmi (2003) who affirms that farmers who integrated trees with crops on their farmland experienced more benefits for example fodder for animals, income generation, and reduced pressure on natural resources/vegetation.

Conversely, tree-crop interactions help in providing fuel wood for cooking at home. When the trees are pruned, the branches are used as mulches in the garden and when dry the household use it as fuel wood. Not only tree-crop intercrop provides income, food and/or ecological benefits, it is a source of firewood which is a source of energy for cooking majorly in local and urban communities (Nabunya, 2017). This helps to address the energy crisis which is a serious consequence of deforestation and climate change.

Remarkably, income is earned as farmers' sale the tree-crop products, for example agricultural products such as fruits, beans, bananas, sweet potatoes, are produced for home consumption and the surplus is sold to earn a living. It is this income that a household uses to access the basic needs of life especially food, clothing, and other household property/items. Tree-crop interactions provide substantail cash incomes which are recycled into the food systems in cases of climate change variabilities (El-Lakany, 2004). Notably, (Arthur, 2018) agrees that trees contribute contributes to household income and such income earned is attributed to land size under agroforestry and tree intercrop.

Moreover, raw materials for example stakes, and wood/timber are harvested to make furniture,

and support crop growth such as tomatoes and climbing beans. More so, those with more trees harvest wood and stakes for sale to others specifically support bananas, fruits and vegetables (Sebukyu and Mosango, 2012)

Persuasively, tree-crop practice offers self-employment. Farmers who grew beans (Nabuddaama), pine apples, coffee and sugarcane asserted that they had permanent employment. This enabled them (farmers) to earn income to pay school fees for the children. Moreover, respondents reported that engaging in tree-crop production was a self-employment, coupled with emergence of COVID-19 pandemic, those engaged in tree crop interactions benefited more as other employment avenues were locked down. Similarly, Gideon and Verinumbe (2013) elaborate that men, women and youths are self-employed in the local industry and use leaves of *Borassus aethiopium* to make mats, and hand fans. Ndalama *et al.,* (2015) concur with the ongoing claim and state that households in Malawi were able to process juice from *Adansonia digitata* fruits and sold it to earn extra income. The incomes from sale of tree-crop products served as a safety net for rural societies and significant source of prosperity if intensively produced and managed.

Additionally, tree-crop interactions help to conserve soil fertility and moisture. This comes as a result of the cover provided by the crops on the soil and control soil erosion and runoff. Further, *Gliricidia sepium, Cajanus cajan, Sesbania sesban, Tephrosia vogelii* and *Faidherbia albida* tree species nourish soil fertility (Kuntashula, 2017). Markedly, since the soil is covered, the rate of soil erosion and runoff are minimized hence the ability for the soil to support crop production. Similarly in United States of America, smallholder farmers often planted trees with crops for soil erosion control, improve soil fertility and suplement socioeconomic benefits for example fruits for food, firewood, medicine and forage (El-Lakany, 2004).

Notably, tree-crop interactions protect soil health which includes moisture content, insects, animals and plants. For example, when tree leaves fall off onto the ground, they rot and provide organic content which favours insects and other microorganism into the soil. Further, the leaves act as cover to conserve soil moisture and air, when rot they improve humas potential of the soil's organic matter content vital for crop prodcutivity (Sebukyu and Mosango, 2012). Results concur with Kuntashula (2017) who asserts that in Zimbabwe where tree-crop intercrop offers carbon sequestration, biodiversity convservation and wastershade protection. Importantly, the dominance of trees in cropland and pasture is a safeguard for socioecological values including nitrogen fixation, soil fertility improvement, wind breaks, high content plant proteins (fodder) and drought resilience among households (Kofi *et al.,* 2003).

Lastly, tree-crop interactions are habitats for organisms including insects, animals, birds and microorganism. Respondents further reported that a number of lifeforms exist in the fallows and crop fields. For example, sweet potatoes provide a conducive environment for micro and macro organisms, and birds also build their nests on the trees and crops. Ruhangariyo (2018) expounds that when trees and crops grown adjacent to water course and forests, intensify species diversity and act as habitats for useful species that is, animals, birds, bees and butterflies which pollinate the crops. Regrettably, birds nest in the trees and feed on crops like peas, passion fruits, beans, bananas and maize. Though, they damage farmers' crops, they produce sweet music into farmers' ears, in early morning and late in the evening every day.

Limitation to adoption of tree-crop interaction by farmers

Regrettably, poor quality and high costs of farm inputs have seriously limited farmers and households to adopt to tree-crop component in Kyannamukaaka Sub County. Respondents reported that poor quality seeds, and seedlings coupled with expensive fertilizers affect their adoption. However, Sollen-Norrlin *et al.,* (2020) inform that lack of financial incentives limit smallholder farmers to relish tree-crop benefits. Thus, with lack of financial incentives, farmers spend their little money to purchase the poor quality farm inputs, which eventually lower productivity and sales revenue.

Furthermore, pests and diseases pose threats to tree-crop production, this is because they damage crops and trees. Farmers reported termites, army worms, snails, slugs, fruit fries as common pests which attacked their crops. In relation, the emergence of crop diseases for example sigatoka (Kofi, *et al.,* 2003) in Ghana affected the productivity of tree-crop intercrop. For example, diseases and vermin including termites, rats and squirrels destroyed trees and crops on farmlands in Eastern Uganda (Basamba, *et al.,* 2016) lowering farmers' unit production per the cultivated land. On the other hand, respondents stated that fungal, mildew, bright, black spot, and bacterial wilt as the common diseases. Further, expensive pesticides and fungicides to control pests and diseases challenged tree-crop adoption. Farmers added that, despite being expensive, they are also unreliable and accessible, and where they are accessible, they are found expired. When such chemicals are used in crop production, they destroy the crop and trees most. Results are supported by Sebukyu and Mosango (2012) who claims that, diseases and pests, low prices for the tree-crop products, price fluctuations, inadequate markets for produce and longer distances limited farmers adopt and enjoy the benefits from tree-crop interactions.

In addition, land size and ownership limits adoption of tree-crop interactions by farmers. In most areas, people do not have land titles which limit their chances to grow long term trees and crops. The ownership of land determines the nature and type of trees and crops a farmer grow on the land and influences adoption too. Borelli *et al.,* (2018) assert that, lack of secure land tenure limit smallholder farmers to relish tree-crop benefits. This implies that, those with small plots rarely enjoy benefits from tree-crop interactions and limits tree-crop interaction adoption by farmers.

Likewise, climate change evidenced by drought, high temperature, floods, and unreliable rains and strong winds which occur and destroy crops. Farmers reported that because of climate change, farmers experience drizzles, prolonged dry spell, floods, and mist and fog. When these occur in a community, they damage crops, trees and animals. It was also reported that climate change and its constructs posed serious threats to farmers of which majority had given up on crop production. This is because their crops are hit by climate change effects lowering production potential and revenues. This concurs with results from a study carried in Bukomansimbi, where a respondent reported that between February and April, 2016 she lost four acres of bananas and cassava due to hot temperature, which left her without food and income to support her family both socially and economically (Mbowa *et al.,* 2020). This implies that in such areas, financial muscles of the farmers are handcuffed which escalate them into poverty.

More to that, inadequate competences (knowledge and skills) were reported as limitations to adoption of tree-crop interactions in Kyannamukaaka Sub County. It was revealed that some farmers lacked knowledge on what, where and how to plant trees and crops. This implies that farmers without skills limited their willingness to practice tree and crop interactions on their farm land. Further still, farmers were not aware which crops do better in intercrops, as they just plant "*to whom it may concern*". In such a scenario, farmers harvest poor yields as compared to their counterparts with skills in crop and tree growing. In support of the above claims, Kofi *et al.,* (2003) assert that lack of knowledge and education implies that farmers lack skills on which trees and crops to integrate better socioeconomic and ecological potentials. They further claim that when farmers lack adequate knowledge on tree-crop tenure, logging regulations and compensastion rights, it limits them to adopt and enjoy the benefts of tree-crop interactions.

Lastly, anthropocentrism limit adoption to tree-crop interaction in Kyannamukaaka Sub County. Anthropocentrism is "*a belief that humans are the most important creatures on the finite Earth*" (Safeopedia Inc, 2017) than any other organism and have a right to control and use nature in any way possible. Therefore, such a belief, man has degraded the environment escalating into climate change and its effects on communities. This implies that anthropocentric belief coupled with lack of knowledge and skills, limit farmers to adopt and enjoy tree-crop interactions. Based on that belief, man is undertaking dubious activities such as unsustainable agriculture, uncontrolled

grazing, fishing, construction and poor waste disposal which impact on land and lower its potentials to support tree-crop success.

Conclusion and Recommendations

The study concluded that tree-crop interactions were serviceable to community; however, observations showed that some households had no trees while others cut them unsustainably on their farmlands. Therefore, to increase adoption of tree-crop interactions and diversity, Kyannamukaaka Sub County and Masaka district should create awareness amongst farmers/communities and build their capacity in climate change resilience, underground forestry management, tree growing and energy efficient technologies. Further, Central Government should subsidize agricultural inputs that is, equipment, tools, materials, seeds, chemicals and fertilizers. This would enable farmers to purchase the required inputs and increase agricultural productivity.

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