Impact of Innovation and Agricultural Cooperative Societies towards Ecological Equilibrium Among Rural Farmers in Kenya

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Abstract

Agricultural activities contribute heavily on climate change thus, its being challenged to adapt to its effects which involves the application of integrating socio-economic and ecological policies for greater resilience. Through cooperatives and innovations, promotion of agroecology which is the application of the principle of ecology in agricultural production is possible as ecology and agriculture are inter-dependent for global food production. Scientists are working in conjunction with farmers and other stakeholders to get solutions for challenges experienced locally instead of external and non-appropriate solution imposed to the locality. To enhance the resilience of farming system to climate change and improving the flow of ecosystem, farmers are being encouraged to form cooperative societies since agricultural cooperatives have great influence on agricultural activities and rural transformation. As a social enterprise, cooperatives are autonomous and voluntary associations for persons united to meet a common social-economic and cultural wants. As instruments, they support small-scale farmers leading to poverty alleviation and food security and could be linked inextricably to protection of ecology by safeguarding environmental domains through appropriate education and technology. Still they are invaluable and efficient for improving members social welfare at the same time combating factors that degrade forested areas that may lead to poverty. The study employs an in-depth desk review based on secondary sources complemented with case studies from informant interviews from farmers in rural Kenya. The conclusion of the study is that agricultural cooperative acts as an umbrella whereby the chain-link of production system like creation of production chains, inclusivity of the marginalized groups in a productive system, self-employment, and local markets vitalization are all enhanced through entrepreneurial affairs in the society.

Keywords: Agricultural Cooperatives, Agroecology, Small Scale Farmers, Technology, Innovation, Ecological Policies, Recycling, Diversification

Introduction

Cooperative movements emerged as a social response to the socio-economic structures underlying challenges unmistakably existing update. They cannot be excluded from the pressing needs and threats faced and call for solutions. The earliest recorded cooperative movement was in Scotland in 1761 with an ideology and philosophical principles of participatory, solidarity, and mutual assistance which signifies sustained development as it takes future generation into account[1].

Some scholars indicate that the cooperative arrangements like mutual insurance and the principle of cooperatives to business organization could have existed long before the recorded time when cooperative movement began[2]. Its emerging that through innovation, cooperatives could be the most desirable approach in promoting agroecology which is the application of the principle of ecology in agricultural production. This is due to the fact that both the field of ecology and agriculture are dynamic in response to rapid change in the global food system[3].

Most rural areas more so in Kenya are facing a series of challenges when it comes rural public affairs. Due to institutional decay, and in spite of economic development at county levels, the growth of rural residents' income is facing some challenges. In most rural areas there's a decline in natural and cultural environment. These are originating from the decline in the capacity of societal collective action (Tan, 2012).

Lack of collective and coordinated action and effective mechanism on farmers awareness creation on environmental conservation and control of pollution on natural environment are weak. These weaknesses have created a gap leading to challenges in environmental governance for rural farmers. Since a cooperative is a voluntary social response movement and agroecosystem on the other hand involves human community in shaping them, the political and social dynamics are central concerns in agroecology (Coe, 2019). The approaches on agroecological arises in response to agrarian crises hence, efforts to social movement that initiate widespread change.

Agroecological movement is gaining momentum through social and political arenas where organized peasants (cooperative) are globally defending their collective rights and advocating for diversified agricultural system by small scale farmers[4]. The advocacy of the social movement is meant to strengthen the connection between agroecology, environmental integrity, sovereignty of food and the right to food as people's sovereign right to control the producer and how they produce the kind of food. As a forum, agroecology is not just a narrow set of technologies but more of a political struggle that requires people to transform by challenging the societal power structures by addressing the imbalances and conflicts of interest so as to generate local knowledge and promote social justice and strengthen economic viability of the rural areas by nurturing culture and identity (Natalini, 2019).

The community social movements are important in respect to climate change as they can call for action in addressing the climate crisis like extinction rebellion and protesting against the impacts of mitigation

[1] https://ica.coop/en/cooperatives/history-cooperative-movement
[2] https://en.wikipedia.org/wiki/History_of_the_cooperative_movement
[3] http://dx.doi.org/10.4324/9781315618791.
[4] http://www.foodsovereignty.org/wp-content/uploads/2015/10/NYELENI-2015-ENGLISH-FINAL-WEB.pdf.

measures and people's livelihood (Hensby, 2019). The rural community's social cohesion, cultural and environmental values have weakened (Wang et al., 2016). The weakening has resulted from lack of capacity for collective action in creating environmental awareness among rural farmers which impacts on healthy development of cultural environment. These declining collective actions at grassroot levels is due to limited or non-existing governance leading such challenges as unequal distribution of resources, organizational instability and difficulty in decision making and implementation of required tasks[5].

Farmers in rural areas are seriously damaging or gradually losing their natural environment because the environmental awareness creation by grassroot organizations are either lost or poorly operationalized. The capacity and collective action on environmental awareness is declining in rural areas posing great challenges to sustainable development. To improve this situation, collective and collaborated action is required. Thus, farmers' cooperative societies in rural areas is vital part of governance and rehabilitation of the rural areas. Although there is decline in agricultural rehabilitation in rural areas, Chen et al., (2016) argues that there are still some factors with positive impact on rural area collective action.

According to Chen, Cooperatives have an advantage over some other forms of organizations in areas such as technology services, the procurement of agricultural material, product sales, and storage in warehousing and logistic. Through Cooperatives there is increased and probability of reducing the use of chemical fertilizers and pesticides (Zhu, and Wang, 2024). Cooperatives are a form of social network that helps farmers expand access to information and also enable the choice of environmental technology that is friendly (Li et al., 2018). Still, through cooperatives coordination, measurement of soil properties, fertilization and standardization can easily be adopted.

However, due to lack of effective and sufficient supervision, at times insufficient funds and also the operation that is not standardized, cooperative members are likely to be freelance in terms of production and management. The perception and impression of cooperative members greatly affect the performance and cohesion of cooperatives. At the same time, these could spill over in affecting the cooperation with other cooperatives in their roles, unification and quality production more so the agricultural cooperative production.

Cooperatives tend to take advantage of economies of scale and resource allocation by providing a collaborative and corporate platform for farmers. From Han, and Zhang (2015) observation, farmers could jointly purchase, sell agricultural products and also participate in innovative technological activities which could increase efficiency of production. As part of cooperative roles, members pursue interest, which is common hence, implement collective action thus, farmers tend to strengthen their sense of collective identity that enhance collective action and capacity that promotes sustainable development in rural areas (Kong, 2018).

As much as there is more room for improvement, studies indicate that agricultural cooperatives have a big role in promoting agricultural modernization. Such roles include research perspectives such as influence mechanism of cooperatives on rural area capacity and collective action unlike just focusing only on the dynamic mechanism of cooperatives from a micro perspective. Additionally, past studies lack theoretical

[5]. https://doi.org/10.3390/agriculture14010096

basis hence, limited empirical indicators thus, there is a need of analyzing the impact of cooperatives on the lives of rural residents[6].

Sinclair et al., (2019) observes that as agroecology gains momentum, it could be seen as contributing towards transformation of food system through application of ecological policies to agriculture in ensuring regenerative use of natural resources and ecosystem conservation. By embracing socio-cultural aspects in production and equitable food system, people can make choices on the kind of food to be produced and where it should be produced. Therefore, the need for agroecological equilibrium demands a combination of science practices and social movement which could complete each other.

Thus, the drivers of the society and environmental activity is leading to increased moralization of debates on food production which makes policy makers to act. The agroecological policies on food system transitions involves the normative elements such as being equitable and causative elements being more diverse farming system. In summary, the necessity of clarifying the normative assertions should be underpinned as transition for more resilience farming and a causative mechanism that could bring it.

In conclusion, the context of rural Kenya network indicates that through the model of agricultural cooperatives as a hub, there's promotion of agricultural development. As Schwettmann (2015) opines cooperative models are networks where producers can access a range of different services including credit, healthcare, agricultural inputs and extension services. Some of the services could be delivered directly by cooperatives in agricultural productions or delivered through partnering with other organizations. Therefore, the kind of social services offered to farmers by cooperatives such as transfer of agricultural production related knowledge practices and also governance issues related to agricultural production. The relevance of agricultural cooperatives in disseminating knowledge is emphasized here.

Objective of the Study

The study analyzes the Impact innovation and agricultural cooperative societies have towards ecological equilibrium among rural farmers in Kenya.

Specifically, the study delves to undertakes the following roles:

- The important social services the cooperatives provide to the members
- Challenges facing cooperatives and how they are attempting to overcome those challenges
- The importance of innovation & technology in increasing productivity in agricultural cooperative societies
- The linkage between innovation, technology & agricultural cooperatives and ecological sustenance

[6] https://www.mdpi.com/journal/agriculture

Methodology

The study employs an in-depth desk review based on secondary sources complemented with case studies from informant interviews from farmers in rural Kenya.

Data Analysis

The exploration of the collective actions of the farmers on the impact of the agricultural cooperatives shows that individual farmers are enhanced to participate in modern farming system. Majority farmers acknowledge the collective realization and mutual aid from agricultural cooperatives and organizations whereby agricultural producers are enabled to adapt to the needs of the market economy and also be able to overcome their scale of limitations thus, realizing a collective effect.

Through cooperatives and professional management, members allude to successful increase in participation and decision-making power at the rural setting. At the same time, in a collective bargain, there is improved product quality, market demands and economic efficiency. Integration of agricultural production resources has also been promoted courteous of agricultural cooperatives as observed by the farmers who are the beneficiaries of cooperative formations.

Out of collected information, it can be viewed that agricultural cooperative societies could foster farmers in mastering their key points on new technology through sharing of knowledge by different organizations' training and reducing farmers costs. In summary, cooperative societies have contributed to rural farmers and households to have strong voices when it comes to market players and enabling members to participate collectively in decision making process and on an equal footing.

The Justification of the Study

Majority of agricultural producers in Kenya are small-scale farmers in rural areas who make up 78 percent. While the sector contributes to 51 percent (26 percent directly and 25 percent indirectly) of the country's GDP. The agricultural sector also accounts for 60 percent employment and 65 percent of exports (World Bank, 2018). According to the report by the World Bank (2015) agricultural sector is dominated by small-scale famers who own between 0.2 and 3 hectares of land accounting for 78 percent of the total production and 70 percent of commercial production.

The commercial products that spur GDP include cash crops such as cereals and horticulture production. While the production of such products like cereals are low, and given that most of the poor are the ones involved in agricultural productivity, the sector plays a huge role in matters poverty reduction as indicated between 2005 and 2015[7].

Through agricultural cooperatives, small scale farmers could be enabled to increase productivity and efficiency more easily than through other means such as use of agrochemicals, hiring of more labour and the use of improved seeds which could not be the sole solution.

[7] https://assets.publishing.service.gov.uk/media/5c70028ee5274a0ecbe9a1c2/483_Agricultural_Productivity_in_Kenya_Barriers_and_Opportunities.pd

The study distinguishes the functions agricultural cooperatives societies can achieve in relations to nature conservation by small-scale farmers situated in rural areas. Some activities such as training and empowerments of members on land management in relations to environmental conservation can easily be enhanced[8]. The implication of the study could also be of help to small-scale farmers in developing countries in their transition through cooperatives in enhancing agricultural production and nature conservation. Therefore, exploring the impact of agricultural cooperatives on production and natures conservation for sustainability is conducive for policy formulation.

Empirical Literature Review

Most of the young people in rural Kenya are faced with challenges associated with increased growth of population hence, land pressure. Yeboah and Jayne, (2016) alludes that young people in rural Kenya more so one-quarter start their family lives without any inherited land from their parents. Therefore, the growth of population tends to drive steadily the average sizes of the farm such that between 1997 and 2010 Kenyan mean size of smallholder farms dropped between 2.28 hectares to 1.86 hectares. Olwande et al, (2015) observes that the size of land is proportionally associated with commercialization, limited land access and other assets are constraints to participation in markets. By the year 2010, about 40 percent of the Kenyan rural population was living on 5 percent of rural land (Muyanga and Jayne, 2014).

Numerous studies indicate the functions of cooperatives both at macro level; where regional or country's perspective are learned or at micro level, where examining impacts in relation to farmer and organizational behaviour. The outcome shows that cooperative memberships' impacts are mixed and could depend heavily on local context, other impacts could also be influenced by initiatives of national policies[9]. At the same time, Deng et al, (2016) observes that due to lack of control on the quality of agricultural products, the levels of heterogeneity being high in quality and associated with local small-scale farmers' products, the operation of most small-scale farmers with lack of effective support from external sources results into challenges of reducing transaction costs. Hence, cooperatives that sell on behalf of famers tend to increase the farmers power of price negotiation thus, widening their markets and channels of information on sustainable production and without affecting ecosystem negatively.

Trebling (2014) affirms the role of cooperatives membership as improving commercialization behavior of small-scale farmers, the commercialization on the other hand improves farm productivity and farm income at micro level. While improving income, food security is improved in addition, farmers negotiation ability is strengthened leading to increased levels of income to the farmer who are also members of the cooperatives.

Importance of Agricultural Cooperatives to Members

The study re-evaluates the role of farmer organizations more so agricultural cooperatives in their attempt to fill the socio-economic and political space emerging from the ruptures of global and local food situation (Vander Ploeg 2008). Traditionally, farmers could be characterized based on their economic production as private and profit oriented business. The small-scale producers more so subsistence farmers, better

[8]Sustainability 2020, 12, 8194; doi:10.3390/su12198194 www.mdpi.com/journal/sustainability
[9] (http://creativecommons.org/licenses/by/4.0/)

reorganized as semi-capitalist entities that engage in different overlapping social systems. At the same time, as private businesses who produce and sell for farm income thus being impacted by markets.

Subsistence agricultural production as livelihood activity, only centered on household production of food security yet limited inputs with little commercialization are fairly autonomous from a formal economic system. Additionally, the local non-economic exchange of goods through social networks instead of formal markets are common especially in the contexts of market failure (Mmari, 2015). This highlights how subsistence farmers are partially embedded in the market economy.

However, according to FAO, (2014) any formal or even informal/registered or unregistered membership based and a collective action institution that serves its members at rural setting whose livelihood is agriculture oriented such as crop growers, livestock, fisheries, and apiculture. The services that organizations provide aims at improving the livelihoods of the members including members easy access to information and advice, markets, the inputs and advocacy[10]. Therefore, subsistence farmers as individuals have little or no economic/political power hence, through collective action they have more power in protecting their interest that is offered by farmer organizations (Bernard and Spielman, 2009).

Kilelu et al. (2016) observes that actions taken collectively by advocacy and network, farmer organizations can play numerous roles in supporting farmers and the rural community in general as such times as economic transition aimed at maintain socio-political and economic sovereignty. This could enhance a competitive environment for their livelihood interests against more powerful actors. At the same time, farmers organizations could help create economies of scale reducing the cost of transaction while improving the farmers bargaining power.

In summary, the farmers organization/agri-cooperatives is an indicator of collective action in the economic empowerment of the members in agriculture value chain. The organizations could also be useful in providing a lot of social services through collective bargaining, in decision making process such market access reinforcement and enhancing market environment. The organization's tasks are: Economical functions; i.e production, supply, and marketing of goods and services. Social functions; education, health, cultural, provision of clean drinking water, mutual and supportive programmes. Representation; the interest of group being defended through advocacy on local and national and even international levels. And lastly, sharing of the information among the members.

Challenges Faced by Cooperatives and Attempt to Overcome them

According to Gout and Paassen (2012) when the government withdraws from agricultural markets, farmers face challenges in accessing important agricultural inputs like the right fertilizer and seeds. Additionally, accessing processing infrastructure both at international and local markets including new technologies becomes huge challenges faced by commercial and Subsistence farmers. Therefore, the withdrawal of the government from agricultural sector creates a mixed environment where there is both an opportunity and challenges for agricultural cooperatives. Although, cooperatives could fill the gap that is left after withdrawal of government and market failures through provision of selected range of specialized goods and

[10] http://www.ilo.org/public/english/employment/ent/coop/africa/index.htm;

services to the members. Indeed, these could serve as a competitive advantage yet, the cooperatives lack the capacity to meet all the needs in terms of goods and services of the members.

The networks of agricultural organizations are classified into horizontal relationship which links producers to other non-producing sector, vertical chains connect producers to agricultural markets and value chains. Even though agricultural extension service deserves great attention, the agricultural knowledge system and the role it plays in social and agricultural innovation should be integrated in rural agricultural development (Hermans et al., 2015). Farmers organizations in rural settings creates a social economy which is a kind of concept that designates enterprises and organizations that have specific feature of producing knowledge, goods and services at the same time pursuing socio-economic aims that foster solidarity.

The socio-economy incorporates other forms of activities in striving toward their goals that are geared to building social-cultural environment. This is done by strengthening political voice, community inclusion, representation of the marginalized groups, strengthening farmers agency and promotion of ecological conservation (Schwettmann, 2015). It should be noted that services provided by cooperatives are not exclusively at the interest of the members who receive the services, but community as well through broader spill-over effects. The services offered benefits both members and local communities through agricultural development implications hence, broader development of the community by poverty alleviation at the rural community levels.

Technology and Agricultural Cooperative Productivity

The impending climate change awareness and its challenges such as carbon emission from use of fossil fuels as discussed in the United Nations Conference on climate change in Copenhagen 2009 set the scene for historical meeting in Paris 2015 (COP 21)[11]. Over 186 countries agreed on the action plan of the intention to reduce greenhouse gas emission (GHG) with an aim of reducing the rising temperatures below 2^0 C[12].

As civil society groups, businesses, trade unions, investors, regions, and other signatories from every sector of society and the globe at large realizes that negative climate change threatens our ability and the ability of the future generations to live and thrive in a prosperous world[13]. Hence, taking strong action in reducing emissions not only reduces the risks of climate change but also deliver better growth and sustainable development.

Agricultural industries and the intensive farming are considered as the second cause for increasing man-made temperatures. Moreover, the huge amounts of chemical fertilizers used for the harvest, at the same time, agriculture requires more space since the demand for agricultural products are increasing due to increasing world population. These leads to clearing of forests which could absorb CO_2, and reduced man-made emission (Schlenz 2019).

[11] http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html.
[12] http://www.theguardian.com/environment/2015/jul/08/exxon-climate-change-1981-climate-denier-funding.
[13] https://www.melcrum.com/sites/default/files/scm15-9-for%20web.pdf.

Given these challenges associated with climate change, there is a need of thinking about the role of effective communication as an essential ingredient for mobilization, achieving buy-in and agreeing through consensus over priorities. For sustainability related issues to be conceived, communication plays a big role in definition, planning, discussion, and initiation within and between organizations. Communication becomes pragmatic if it educates, persuades, and alerts in helping people enact sustainable initiatives.

Communication occurs at the interpersonal, intrapersonal, group, organization, macro environmental levels. Hence, the role of collecting and gathering data for writing about sustainable reports can benefit both internal and external stakeholders. It is out of these reports that can help companies/organizations to set and measure goals, understand the social and environmental impacts of their actions and communicate about their socio-economic and environmental performance (Allen 2016). Decisions can be made based on the reports to shape the organizational policies and strategies to influence performance.

In the wake of modern technology, agricultural productivity has increased manifold. Farmers' produce crops and livestock quality have improved with reduced cost of production. It has also led to the development of new ways of marketing and distributing agricultural products. This has led to wider market exploration, additionally, creation of new jobs in agricultural sector has increased more so to young people. Some of the agricultural technology and mechanization include use of improved irrigation system necessitating growth of crops in dry areas[14]. Due to high yield of crops, food security has been improved with high nutritious and affordable foodstuffs. As much as technology increases production and through productivity the income of farmers is improved, new jobs are created hence the rural quality of life improves as agricultural technology makes the process of farming easier and more efficient.

Technology, Agricultural Cooperatives and Ecological Sustenance

By Kenyan government putting in place a 10-year agricultural sector transformation and growth strategy (2019-2029), priority has been on transforming subsistence and smallholder farmers to innovative, commercially oriented and modern agriculture. Modern technological tools help farmers to use precise amounts of input at the same time detecting some issues with their crops hence managing their farm operations[15]. Therefore, digital solutions adopted by farmers are facilitating businesses for better decision making.

According to Adil El Youssefi (2020) on 'Liquid Intelligent Technologies' recognizing that technology plays a great role in agricultural sector and is key for progress. The study suggest that the right application of technology can help in leveraging some challenges of food security today and for the future. The use of advanced devices and precision agriculture enhances profitable businesses, safe, efficient and a more friendly environment. The Internet of Things (IoT) ecosystem, such as sensors, data analytics, connectivity, and workflow automation platforms are promising in addressing some of these challenges affecting agroecological coexistence.

Internet Of Things (IoT) offers huge potential in enhancing agricultural productivity in meeting food demands. Therefore, Smart agriculture can utilize IoT based technologies to address the related challenges

[14] https://sageuniversity.edu.in/blogs/use-of-modern-technology-in-agriculture.
[15] https://liquid.tech/technology_has_the_potential_to_transform_kenyas_agricultural_sector/

for efficiency and maximized yields minimizing wastage while data collection and information analysis helps to control mechanism. Other popular technologies used in the agricultural sector include; Global Positioning System (GPS) technology that uses information from United States satellites to provide an accurate location almost anywhere on Earth. The technology is used in precision farming as a technology for finding out the field boundaries to help in correct application of fertilizers, herbicides and pesticides for efficiency and reduced wastage[16]. Both GPS and Geographical Information System (GIS) are useful in managing land in high region for commercial agriculture, GPS as used in finding the exact location of things while GIS used to record information on to the maps[17].

On the other hand, automation such as driverless tractors could be used to make labour cheaper, several tractors can be controlled remotely without direct human intervention. The automation technology is used in irrigation, sowing, weeding, harvesting and transplanting to reduce human labour[18]. Drones are also being used extensively in crop monitoring, surveying, mapping. At the same time can be used to collect data for planning and execution of the activities related to agriculture. Weather monitoring tools for data and information collection helps farmers make decision on the type of crops to be grown.

Additionally, soil sensors used to measure moisture levels in the soil, the temperatures and soil humous affecting crop growth. Such information can be transmitted wirelessly to farmers for adjustment in farming activities. Still, eco-robotics could produce autonomous robots that is powered by solar as green approach minimize and optimize crop and environmental damage and conservation subsequently[19].

In summary, technology can allow farmers and their families to be more productive economically, socially, and environmentally sustained. As the world population grows steadily with an average number of slightly below or above 7.7 billion people, there have to be a concerted effort of finding a solution of how these population will feed and the solution to these can only be found in agriculture. Therefore, finding solutions to the challenges faced by modern farmers such as labour shortage and consumer eco-friendly sustenance through embracing automated agriculture with similar innovations and the benefits derived in smart farming could serve as one among solutions to challenges of food security across the globe.

Challenges Facing Agri-Ecology Among Rural Farmers

According to Odame (2024) the youth who forms majority of the population are not being involved in agricultural enterprises, this makes the entrepreneurial sector to remain low as policies tend to exclude them from active participation. A major barrier being lack of ownership of land by the youth which hampers the

[16] https://education.nationalgeographic.org/resource/gps/
[17] https://www.google.com/search?q=different+between+gis+and+gps&oq=Different+between+GIS+and+G&gs_lcrp=EgZjaHJvbWUqBwgAEAAYgAQyBwgAEAAYgAQyBggBEEUYOTIICAIQABgWGB4yCAgDEAAYFhgeMgoIBBAAGAoYFhgeMggIBRAAGBYYHjIICAYQABgWGB4yCAgHEAAYFhgeMggICBAAGBYYHjIICAkQABgWGB6oAgCwAgA&sourceid=chrome&ie=UTF-8
[18] https://easternpeak.com/blog/smart-farming-how-automation-is-transforming-agriculture
[19] https://ecorobotix.com/en/

government effort towards addressing hunger and food security despite the commitment by the government in increasing agricultural products.

The average age of farmers in Kenya is about 60 years, yet youth's mobilization ability and support to linking the farmers to the markets and non-market agencies, protecting the farmers rights and assisting to improve the entrepreneurial skills is undoubtedly high. The involvement of the youth in agriculture hence, agricultural cooperatives will stimulate and spur the growth and sustenance of the sector. This however, requires the policies in place to be revised in favor of the youth, such policies that exhibit harsh business environment, youth's effort to access resources, registering and licensing of their business enterprises, lack of information about agribusiness enterprises as well as undefined business structures both at county and national governments.

Even though the agricultural value chain is wide, the youth can be involved in the high end of the value chain such as value addition and agro-processing if not direct food production. The high-end processes involve the adoption of modern technologies and innovation which is in the power of the youth. Such technology includes the adoption of Geographical Information system[20] (GIS) that can be used in agricultural mapping process which could lead to increased access to information by farmers leading to increased and improved production and increased research done by the youth[21]. This is because the youth are more interactive and connected by modern technology both as information and communication tool and improved production without jeopardizing the ecology. They have the potential, the connection and are influential to the community they come from as they continue to learn and unlearn about conservation of the environment from different organization globally (Balongo, 2022).

Conclusion

In conclusion, promotion of agroecology by integrating socio-economic and application of policies that enhance greater resilience of ecology could be achieved through cooperatives and innovation in the field of agriculture. This is because agricultural activities contribute to a great extend to challenges faced from climate change. Since ecology and agricultural production are interdependent, it is possible to improve global food production by application of the principle of ecology in agriculture. Modern scientists are working closely with farmers and other stakeholders to improve on the production through establishing local solution to the challenges faced rather than external. Scientists are promoting the adoption of smart farming (farm automation) which includes a number of technological innovations that optimizes food production process and improves on the quality. Thus, advanced farming technology becomes an essential part of farmers daily activities.

Therefore, since most of the challenges experienced by farmers are ecological responsibilities where the general public expects an eco-friendly, demonstrative and responsible approach to farming activities is

20 https://www.google.com/search?q=gps+meaning&oq=GPS+meaning&gs_lcrp=EgZjaHJvbWUqCggAEAAYsQMYgAQyCggAEAAYsQMYgAQyBwgBEAAYgAQyBwgCEAAYgAQyBwgDEAAYgAQyBwgEEAAYgAQyBwgFEAAYgAQyBwgGEAAYgAQyBwgHEAAYgAQyBwgIEAAYgAQyBwgJEAAYgASoAgCwAgA&sourceid=chrome&ie=UTF-8#ip=1

21 https://gisgeography.com/what-is-gis/

important. Such activities like reduced usage of environmental hazardous chemicals components (herbicides and pesticides) Agri-entrepreneurialism should consider solutions in response to the social and ecological demands found in farm automation. As indicated, smart agriculture is becoming an answer to consumer preferences where craving for plant-based healthier food products can be provided to meet the demand for consumers. In addition, labour shortage gap could be filled as many young people are no longer wishing to be farmers but the big population seeking to live an urban lifestyle. The modern agricultural practice like automation continues to revolutionize the world of agriculture.

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