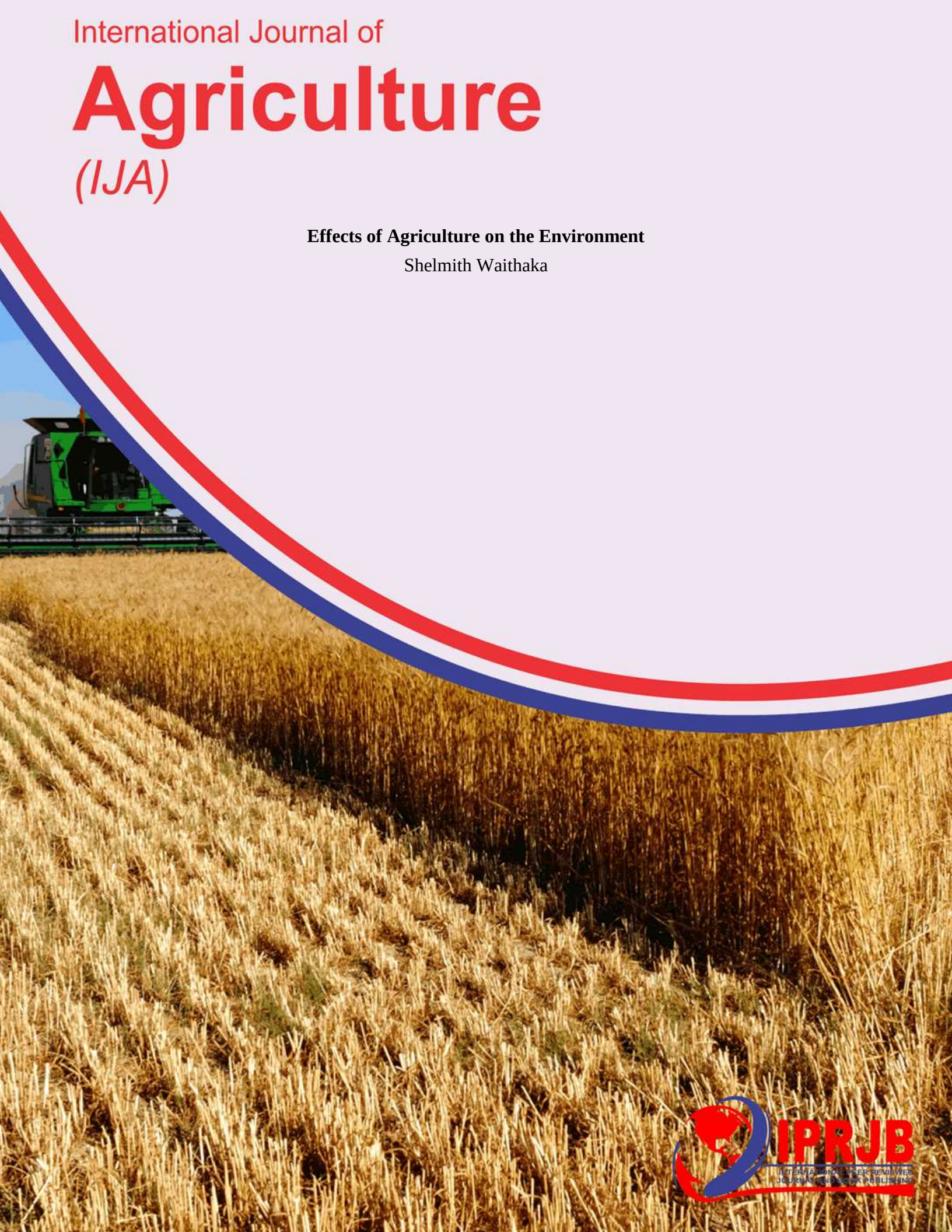
International Journal of
Agriculture
(IJA)

Effects of Agriculture on the Environment

Shelmith Waithaka



International Journal of Agriculture
ISSN 2520-4629X (Online)
Vol.8, Issue 1, No. 2. PP. 10 - 20, 2023

www.iprjb.org

Effects of Agriculture on the Environment

Shelmith Waithaka

Jomo Kenyatta University of Science and Technology

Article History

Received 16th March 2023
Received in Revised Form 25th March 2023
Accepted 13th April 2023

Abstract

Purpose: The aim of the study is to examine the effects of agriculture on environment.

Methodology: This study adopted a desktop methodology. This study used secondary data from which include review of existing literature from already published studies and reports that was easily accessed through online journals and libraries.

Findings: The study found that human involvement in agriculture has a negative impact on the physical environment leading to issues like soil erosion, loss of land cover, water pollution and air pollution. These activities include building residential structures, building public infrastructure, and engaging in agriculture.

Unique Contribution to Theory, Practice and Policy: The conservation model and diffusion model served as the study's pillars. This study suggests that project managers for agricultural development make sure that environmental concerns are addressed as a project gains momentum through implementation and that the Environment Impact Assessment process takes into account environmental issues raised when a project or plan is first discussed.

Keywords: *Environmental Impact Assessment, Agriculture, Environment*

International Journal of Agriculture
ISSN 2520-4629X (Online)
Vol.8, Issue 1, No. 2. PP. 10 - 20, 2023

INTRODUCTION

The necessity of boosting the positive and minimizing the negative environmental consequences in agriculture is widely acknowledged in order to maintain the sustainability of resource usage (Sala, 2017). However, because of the intricate interactions that agriculture has with the environment and natural resources, it is challenging to pinpoint the precise environmental effects that agriculture has. Although agriculture is a significant user of land and water resources, it is nonetheless dependent on both quantity and quality to survive. Although agriculture produces waste and pollution, it also recycles and conserves natural resources, alters the environment, and creates new wildlife habitats (Dhakal, 2019). Although most environmental effects are restricted to the industry, off-farm effects are also significant. Although some have national and international significance, the repercussions are frequently local and regionally focused.

Markets, farm management practices, structural change, technical breakthroughs, socio-cultural choices, and agricultural and environmental legislation are the key elements affecting how well agriculture performs in terms of the environment. They regularly interact with one another and send out contradictory messages (Song, 2020). But it's not simple to identify each of these forces at work and assess their relative importance. Assimilative capacity of ecosystems, farm design and farming practices, and the diversity of the natural resource base differ from place to place. Due to the prevalence of scattered, non-point source pollution in agriculture and the usually lengthy delays in the manifestation of environmental effects, such as groundwater pollution, it is challenging to distinguish the effects these various factors have on environmental outcomes (Cantonati, 2020).

A marked intensification of agriculture (more output per unit of land or labor) and farming on environmentally sensitive land have frequently been the results of rising food demand, policies encouraging production, and technological and economic changes, which in some cases have resulted in environmental harm (Tsoraeva, 2020). Among these negative repercussions are the loss of species, ecosystems, and natural aspects of the terrain, as well as water and air pollution. In other places, loss of water supplies and soil deterioration are also major issues. The provision of recreational services and aesthetic value are also examples of environmental benefits in some situations, as are their contributions to water accumulation and flood control, nutrient recycling and fixation, soil formation, carbon sequestration by trees and soil, and the protection of wildlife and biodiversity (Schröder, 2018).

Market price support, output payments (per output unit produced), and input subsidies (such as those that apply to fertilisers, pesticides, water, and energy) have been demonstrated to offer the highest possible incentive to boost commodity production, all other things being equal. This ranking of agricultural policy measures takes into account how they might affect production. A key factor in influencing the environmental effects of agricultural policy is raising land and other fixed asset values, which influence farm-level decision-making about the choice of farming practices (Czyewski, 2021). In general, the greater the incentive for monoculture, intensification (greater yields), or bringing marginal (environmentally sensitive) land into production, the greater the incentive to increase production of specific agricultural commodities, and the greater the pressure on the environment (Doering, 2018). On the other hand, a policy measure's potential

efficacy in accomplishing a particular environmental aim increases with how closely it can be tailored to that goal.

Although there have been conflicting results in terms of environmental performance, the agri-food sector in OECD countries has seen a stable trend in output increase, mostly due to higher productivity (Rabadán, 2020). If agriculture is to satisfy the anticipated rise in global food demand and end hunger, it would need to treble its output globally over the next 50 years. The question is whether agriculture can effectively meet the increasing global demand for food over time without compromising natural resources, including productive soils, clean air, ample supplies of water, conserved habitats, biodiversity, and landscapes, and can do so in ways that are acceptable to society.

Monoculture, which limits intended biodiversity to a single crop, has an impact on the type and quantity of related biodiversity (Engbersen, 2020). For example, monoculture systems, which offer habitat to a more constrained range of insects, might upset the balance of plant pests and their natural adversaries that may exist in polyculture fields. Bee, fly, moth, bat, and bird populations—which are crucial for agricultural pollination and pest control—tend to be less abundant in monocultures than in areas with a variety of foraging and nesting options. For instance, it has been discovered that shade-grown coffee systems support 90% more bird species than full-sun monocrop coffee fields in Colombia and Mexico. Reduced biodiversity has been found to make monoculture systems more vulnerable to insect invasion and plant viruses than polycultures (Altieri, 2020). Greater pest populations in monoculture rice systems are to blame for the decreased rice yields seen throughout Southeast Asia. Chemical pesticides must be used by farmers to control pests in monoculture crops, which has an adverse effect on water quality, wildlife populations, and public health.

Globally, the great majority of agricultural land is tilled in some capacity prior to each crop. Tillage can be carried out by farmers using hand tools, animal plows, or motorized machinery. Although some commercial farms in nations like South Africa, Zimbabwe, and Nigeria are increasingly employing tractor-powered tillage tools, most farmers in Africa still prepare fields by hand or with animal-drawn tools. Tillage negatively affects soil fertility, structure, and greenhouse gas emissions (Bhattacharyya, 2022).

Water quality can be greatly impacted by untreated livestock excrement. High levels of nitrogen, phosphorus, and potassium are present in manure, which can either enter water directly when animals graze close to streams or indirectly through runoff or groundwater percolation. As a result of the challenges in managing and treating huge amounts of manure, confined livestock systems pose particularly high risks of water pollution (Hu, 2017). For instance, industrial swine waste from China, Thailand, and Vietnam pollutes the South China Sea more than domestic human sources do in those three nations. Eutrophication, often known as high nutrient concentrations in water, can cause excessive bacterial and algal development as well as the extinction of local fish and plant species. Humans who utilize the water for drinking and for home purposes could also be at danger from health problems as a result of poor water quality.

Agriculture has been noted as a significant factor in the loss of biodiversity in many OECD nations, especially when it comes to habitat degradation brought on by changes in land use brought on by

intensification of farming practices (such as expanding field size, shortening crop rotations, and applying more fertilizer and pesticides) (Magrach, 2020). However, the end of farming has resulted in altered environments in a number of locations adopting certain farming techniques. This is particularly true in Europe, where many of the most valuable habitats for wildlife tend to be semi-natural settings and where species have coevolved over generations with traditional farming methods. In contrast, valued habitats are mostly connected to natural areas like grasslands, wetlands, native forests, and bush in nations like Australia, New Zealand, and North America (Mauerhofer, 2018). In certain situations, agricultural activities have put these places at risk. For instance, it is believed that some unique wildlife species have declined in the United States as a result of the conversion of grasslands and wetlands to agriculture.

Concerns about the preservation of landscapes associated with traditional agricultural practices have arisen in some OECD countries due to pressures on land use, the adoption of more intensive farming methods, and land abandonment, particularly in European nations, Japan, and Korea where such landscapes are typically regarded as having cultural significance (Fanelli, 2020). Although there are concerns about the loss of rural land to urban development in some areas, particularly in regions of the United States, and about rural depopulation in Australia, the preservation of rural landscapes is generally not considered a priority for government financial assistance in other OECD countries like Australia, New Zealand, and North America.

In places of heavy agricultural production, air pollution issues brought on by ammonia (acid rain), methyl bromide (ozone depletion), pesticide drift, crop burning, and disagreeable odors also tend to be more severe (Hsu, 2019). Methane and nitrous oxide are two gases emitted by agriculture that constitute a significant contributor to climate change and global warming. The production of biomass crops, including those grown for energy use, and the sequestration of atmospheric carbon in the soil are two agricultural practices that have the potential to have a significant mitigating impact on the process of global warming, according to estimates that agriculture currently accounts for OECD greenhouse gas emissions (Yoro, 2020). Long-term changes in temperature and rainfall patterns have an impact on agriculture, which puts pressure on farmers to adapt their farming practices, locations, and the products they produce.

Currently, farming is a major contributor to water pollution, which is a concern locally in Australia, Canada, and New Zealand as well as in some parts of Europe and the United States (Feio, 2021). In some OECD countries, the use of fertilizers in agriculture and animal waste from livestock is responsible for up to 40% of the nitrogen and 30% of the phosphate emissions in surface water, significantly adding to the issues of eutrophication, which causes the depletion of oxygen in water. Aside from harming aquatic species, pesticide runoff from agricultural land also reduces the quality of drinking water.

Major concerns include soil erosion brought on by both wind and water in the United States and in the Canadian wheat belt, as well as water-related erosion issues in Australia, New Zealand, and Mediterranean countries. Agriculture has contributed to soil erosion through certain practices like land-use conversion, tilling, or overgrazing (Borrelli, 2017).

Cross-compliance requirements tie receiving agricultural budgetary funds to having to fulfill specific environmental goals (Heyl, 2021). Farmers are not eligible for such subsidies if they

decide not to follow such rules. Thus, the environmental effects of production-related assistance payments are limited by environmental cross compliance. Cross-compliance requirements are well-established in the US and Switzerland and are spreading more and more throughout the EU (Mack, 2020). Some nations use cross-compliance requirements as a way to incorporate environmental goals into budgetary payments for agriculture. Although more research is still needed to fully understand how these policies relate to the environment.

Statement of the Problem

It is challenging and incomplete to attribute specific environmental effects to agriculture because of the intricate relationship that agriculture has with natural resources and the environment. Although agriculture is a significant user of land and water resources, it is nonetheless dependent on both quantity and quality to survive. Reduced planned biodiversity, untreated animal waste, water pollution, and soil erosion are only a few of the environmental repercussions of agriculture. According to Ngugi (2010) and Muli (2014), there is a contextual gap because those studies concentrate on how farm and urban agriculture affect the environment, whereas the current study concentrates on how all forms of agriculture affect the environment, which is why the study is necessary.

Theoretical Framework

Conservation Model

The English agricultural revolution brought about improvements in crop and livestock husbandry, while early German chemists and soil scientists proposed the idea of soil exhaustion (Moola, 2019). These ideas eventually led to the establishment of the conservation model of agricultural development. The conservation model focused on the development of a series of progressively complicated agricultural systems that required a lot of land and labor, the creation and application of organic manures, and labor-intensive capital formation in the form of physical infrastructure to make better use of available land and water. For the majority of farmers around the world, this paradigm represented the sole options for intensifying agricultural productivity (Nicholson, 2019). Clearly, agricultural development that fell under the purview of the conservation model was able to sustain rates of growth in agricultural production for comparatively lengthy stretches of time in many parts of the world. This pace of increase is incompatible with current rates of demand growth for agricultural output, which normally decline in developing nations. We can establish the impact of agriculture on the environment by using this model to better comprehend the interaction between agriculture and the environment.

Diffusion Model

The empirical observation of significant variations in labor and land productivity among farmers and areas is the foundation of the diffusion approach to agricultural development. According to this perspective, closing productivity gaps between farmers and between areas will lead to increased technical information diffusion and agricultural development (Berry, 2020). Even in pre-modern societies, the spread of better husbandry techniques was an important factor in productivity increase. Crop exploration and introduction received a lot of attention before the creation of current

agricultural research systems. Farmers' ideas are still tested and improved, as well as exotic crop types and animal species, even in countries with well-developed agricultural research institutes.

The association between diffusion rates and the personality, traits, and educational achievements of farm operators was highlighted in the development of the model. Since the development of agriculture economics as a distinct sub-discipline linking the agricultural sciences and economics in the later 19th century, the diffusion model serves as the primary intellectual foundation of much of the research and extension effort in farm management and production economics. When active farm management research and extension programs were first established, experiment-station research was only having a little impact on the increase in agricultural productivity (Emmanuel, 2022). The study of the diffusion process by rural sociologists contributed further to the efficient spread of recognized technology. As technical assistance and community development programs, based explicitly or implicitly on the diffusion model, failed to result in either rapid modernization of traditional farms or rapid growth in agricultural output, the limitations of the diffusion model as a foundation for the design of agricultural development policies became more and more clear. This model will aid in understanding how agriculture affects the environment.

Empirical Review

Ngugi (2010) discussed the effects of urban agriculture on Nairobi's ecology. As a case study, Kasarani Division was utilized. The major data collection method included both qualitative and quantitative surveys, with a pre-set structured questionnaire being utilized for quantitative data collection. In the qualitative study, direct observation was used. According to the report, urban farming in the Kasarani division significantly contributes to the population's food security. The study also demonstrates that extra food was sold to make money and that this money was then used for other purposes, such as eradicating idleness by hiring young people and paying for their school expenses, clothing, and investments. According to the report, most urban farmers use urban garbage when they farm, reducing pollution. Crop rotation, intercropping, and other soil conservation techniques are used, but mostly by those who have access to their own property and extension services. The study suggested that in order to promote safe and sustainable urban farming techniques, urban agriculture should be supported and policies should be devised.

Mbakai (2015) established how climate change and air quality affect how agricultural development initiatives are carried out. A descriptive survey research design was used for this investigation. Purposive sampling was utilized by the researcher to choose 90 participants. Quantitative information gathered through questionnaires. The study found that environmental impact assessments, which influenced the implementation of agricultural development projects in Limuru Sub-County, Kiambu County, heavily included air quality and climate change. The study also demonstrates the importance of environmental impact assessments, as possible air pollution emissions were taken into account when agricultural development projects in this region were implemented. This study makes the suggestion that project managers for agricultural development make sure the EIA procedure takes into consideration environmental concerns brought up when a project or plan is first considered and that all issues are addressed as a project picks up steam through implementation.

Safary (2016) evaluated how human activities in wetlands affect the surrounding physical environment. The study used a technique called purposive sampling. Questionnaires were used to gather the information. The research method used in the study was descriptive. The study found that human activities—including agricultural activities, the building of public infrastructure, and the construction of residential structures—have an adverse impact on wetlands' physical environment, leading to problems like soil erosion, a loss of land cover, water pollution, and air pollution. The study suggested utilizing national policy to get the community involved in educating people about the value of protecting wetlands, as well as assisting to clean up wetlands and plant trees upstream to protect riparian reserves.

Wanyiri (2012) highlighted the International Livestock Research Institute's plans for adapting to changes in the global economic environment. Secondary and primary data were employed in the investigation. Information was gathered through interviews. Data were analyzed using content and descriptive analysis. The study discovered that the economic crisis had reduced ILRI's financing for cattle research. According to the study's findings, ILRI staff members participated in developing the organization's response tactics to ensure that they were appropriate. All organizations, according to the study, should have carefully thought out plans for how they will react to changes in the external environment. Such planning ought to be made far in advance of any modifications. Employee participation in each stage of the change process is also advised by the study in order to minimize resistance.

Karuntimi (2012) assessed the relationship between genotype and environment in eucalyptus species growing in Kenya at several sites and identified genotype stability and pattern of response across environmental sites. The tree improvement program made use of eucalyptus research conducted by the Kenya Forestry Research Institute (KEFRI). The study showed that in order to guarantee their yield stability and economic profitability in Kenya, effective genotypes needed to be modified to a wide range of environmental circumstances.

Muli (2014) studied agricultural methods that can have an impact on the environment, the effects of irrigation on soil and water, and the environmental conditions in rivers whose water has been diverted for irrigation. Interviews were conducted using questionnaires. Using a method of systematic random selection, the respondents were chosen. The University of Nairobi's Land Resource Management and Agricultural Technology (LARMAT) facilities were used to analyze the soil and water. The study demonstrates that the rivers diverted for irrigation had fully dried up and that the aquatic flora, including rushes and sedges, had vanished entirely. The research urges local government entities to take action by implementing appropriate adaptation and mitigation measures, including the National Environmental Management Authority (NEMA) and Water Recourse Management Authority (WARMA).

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

RESULTS

The results were analyzed into various research gap categories, that is, contextual and methodological gaps.

Contextual and Methodological Gaps

Mbakai (2015); Wanyiri (2014); Karuntimi (2012) posit a conceptual gap as none of these studies addresses the effects of agriculture on the environment. Ngugi (2010); Muli (2014) and Safary (2016) present a methodological gap as these studies used descriptive research design while the current study adopts desktop study research design.

CONCLUSION AND RECOMMENDATIONS

Conclusions

The study comes to the conclusion that human activities on wetlands have an impact on the physical environment, leading to negative effects like soil erosion, a loss of vegetation cover, water pollution, and air pollution. These activities include agricultural activities, the construction of public infrastructure, and the construction of residential structures. The study also came to the conclusion that the majority of urban farmers used urban garbage to carry out farming, hence reducing pollution. Crop rotation, intercropping, and other soil conservation techniques are used, but mostly by those who have access to their own property and extension services. The study comes to the conclusion that environmental impact assessments are crucial and that efforts to enhance agriculture in this region took into account potential air pollution-causing emissions.

Recommendations

This study suggests that project managers for agricultural development make sure that environmental concerns are addressed as a project gains momentum through implementation and that the Environment Impact Assessment process takes into account environmental issues raised when a project or plan is first discussed. The study suggested that in order to promote safe and sustainable urban farming techniques, urban agriculture should be supported and policies should be devised. The study suggests that all companies develop well-thought-out responses to changes in the external environment. The research urges local government entities to take action by implementing appropriate adaptation and mitigation measures, including the National Environmental Management Authority (NEMA) and Water Recourse Management Authority (WARMA).

REFERENCES

Altieri, M. A., & Nicholls, C. I. (2020). Agroecology and the reconstruction of a post-COVID-19 agriculture. *The Journal of Peasant Studies*, *47*(5), 881-898.

Berry, F. S., & Berry, W. D. (2018). Innovation and diffusion models in policy research. *Theories of the policy process*, 253-297.

Bhattacharyya, S. S., Leite, F. F. G. D., France, C. L., Adekoya, A. O., Ros, G. H., de Vries, W., ... & Parra-Saldívar, R. (2022). Soil carbon sequestration, greenhouse gas emissions, and water pollution under different tillage practices. *Science of the Total Environment*, 154161.

Borrelli, P., Robinson, D. A., Fleischer, L. R., Lugato, E., Ballabio, C., Alewell, C., ... & Panagos, P. (2017). An assessment of the global impact of 21st century land use change on soil erosion. *Nature communications*, *8*(1), 2013.

Cantonati, M., Poikane, S., Pringle, C. M., Stevens, L. E., Turak, E., Heino, J., ... & Znachor, P. (2020). Characteristics, main impacts, and stewardship of natural and artificial freshwater environments: consequences for biodiversity conservation. *Water*, *12*(1), 260.

Czyżewski, B., Matuszczak, A., Grzelak, A., Guth, M., & Majchrzak, A. (2021). Environmental sustainable value in agriculture revisited: How does Common Agricultural Policy contribute to eco-efficiency?. *Sustainability Science*, *16*, 137-152.

Dhakal, B., & Kattel, R. R. (2019). Effects of global changes on ecosystems services of multiple natural resources in mountain agricultural landscapes. *Science of the total environment*, *676*, 665-682.

Doering, O. (2018). Federal policies as incentives or disincentives to ecologically sustainable agricultural systems. In *Integrating Sustainable Agriculture, Ecology, and Environmental Policy* (pp. 21-36). Routledge.

Emmanuel, M., Orieko, C. P., & Gichuru, K. J. (2022). Adoption-Diffusion Model of Farm Innovations: Its Applicability to Radical Terraces Project in Rwanda. *Turkish Journal of Agriculture-Food Science and Technology*, *10*(4), 579-586.

Engbersen, N., Stefan, L., Brooker, R. W., & Schöb, C. (2022). Using plant traits to understand the contribution of biodiversity effects to annual crop community productivity. *Ecological Applications*, *32*(1), e02479.

Fanelli, R. M. (2020). The spatial and temporal variability of the effects of agricultural practices on the environment. *Environments*, *7*(4), 33.

Feio, M. J., Hughes, R. M., Callisto, M., Nichols, S. J., Odume, O. N., Quintella, B. R., ... & Yates, A. G. (2021). The biological assessment and rehabilitation of the world's rivers: An overview. *Water*, *13*(3), 371.

Heyl, K., Döring, T., Garske, B., Stubenrauch, J., & Ekardt, F. (2021). The Common Agricultural Policy beyond 2020: A critical review in light of global environmental goals. *Review of European, Comparative & International Environmental Law*, *30*(1), 95-106.

Hsu, C. S., Robinson, P. R., Hsu, C. S., & Robinson, P. R. (2019). Safety and Environment. *Petroleum Science and Technology*, 395-480.

Hu, Y., Cheng, H., & Tao, S. (2017). Environmental and human health challenges of industrial livestock and poultry farming in China and their mitigation. *Environment international*, *107*, 111-130.

Karuntimi (2012). Genotype by environment interaction of eucalyptus species in Kenya

Mack, G., Ritzel, C., Heitkämper, K., & El Benni, N. (2021). The Effect of Administrative Burden on Farmers' Perceptions of Cross-Compliance-Based Direct Payment Policy. *Public Administration Review*, *81*(4), 664-675.

Magrach, A., & Sanz, M. J. (2020). Environmental and social consequences of the increase in the demand for 'superfoods' world-wide. *People and Nature*, *2*(2), 267-278.

Mauerhofer, V., Ichinose, T., Blackwell, B. D., Willig, M. R., Flint, C. G., Krause, M. S., & Penker, M. (2018). Underuse of social-ecological systems: A research agenda for addressing challenges to biocultural diversity. *Land Use Policy*, *72*, 57-64.

Mbakai (2015). Influence of environmental impact assessment on the implementation of Agricultural development projects in Limuru sub county, Kiambu county Kenya

Moola, F., & Roth, R. (2019). Moving beyond colonial conservation models: Indigenous protected and conserved areas offer hope for biodiversity and advancing reconciliation in the Canadian boreal forest1. *Environmental Reviews*, *27*(2), 200-201.

Muli (2014). Farming practices that could affect the environment, impact of irrigation on soil and water

Ngugi (2010). Potential impact of urban agriculture on the environment: a case study of Kasarani Division, Nairobi

Nicholson, E., Fulton, E. A., Brooks, T. M., Blanchard, R., Leadley, P., Metzger, J. P., ... & Ferrier, S. (2019). Scenarios and models to support global conservation targets. *Trends in ecology & evolution*, *34*(1), 57-68.

Rabadán, A., González-Moreno, Á., & Sáez-Martínez, F. J. (2019). Improving firms' performance and sustainability: The case of eco-innovation in the agri-food industry. *Sustainability*, *11*(20), 5590.

Safary (2016). The influence of human activities on wetlands on the physical environment.

Sala, S., McLaren, S. J., Notarnicola, B., Saouter, E., & Sonesson, U. (2017). In quest of reducing the environmental impacts of food production and consumption. *Journal of cleaner production*, *140*, 387-398.

Schröder, P., Beckers, B., Daniels, S., Gnädinger, F., Maestri, E., Marmiroli, N., ... & Sæbø, A. (2018). Intensify production, transform biomass to energy and novel goods and protect soils in Europe—A vision how to mobilize marginal lands. *Science of the Total Environment*, *616*, 1101-1123.

Song, B., Robinson, G. M., & Bardsley, D. K. (2020). Measuring multifunctional agricultural landscapes. *Land*, *9*(8), 260.

Tsoraeva, E., Bekmurzov, A., Kozyrev, S., Khoziev, A., & Kozyrev, A. (2020). Environmental issues of agriculture as a consequence of the intensification of the development of agricultural industry. In *E3S Web of Conferences* (Vol. 215, p. 02003). EDP Sciences.

Wanyiri (2014). The strategies used by International Livestock Research Institute to respond to the changes in the global economic environment

Yoro, K. O., & Daramola, M. O. (2020). CO2 emission sources, greenhouse gases, and the global warming effect. In *Advances in carbon capture* (pp. 3-28). Woodhead Publishing.