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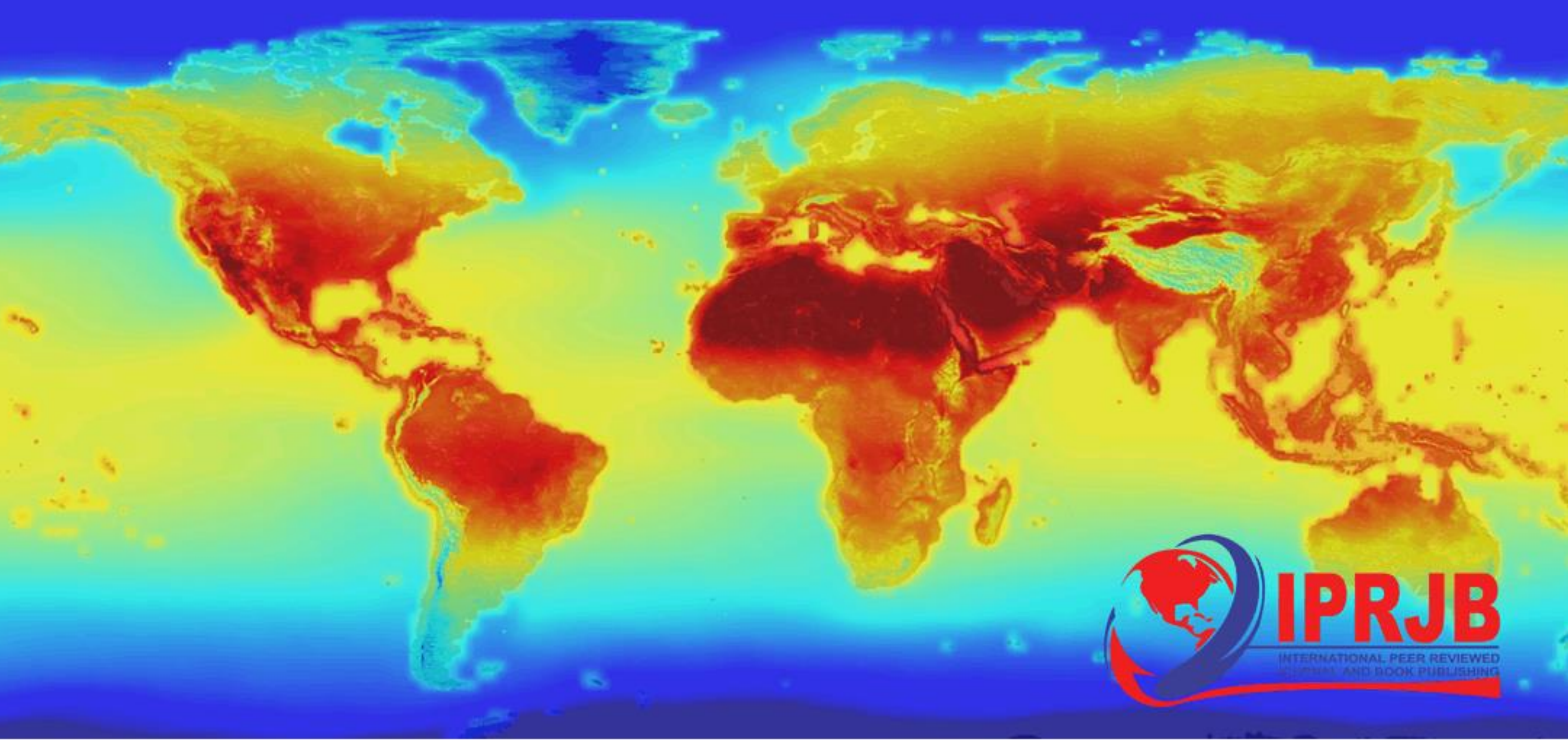

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Abstract

Purpose: The aim of the study was to analyze the water scarcity and agricultural productivity in Nairobi, Kenya.

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.

Findings: Sea level rise and coastal erosion in Miami are growing environmental concerns due to the city's low elevation and proximity to the ocean. Studies have shown that rising sea levels, driven by climate change, are accelerating the erosion of Miami's coastline, threatening infrastructure, homes, and ecosystems. The increased frequency of tidal flooding and storm surges exacerbates the problem, making coastal areas more vulnerable.

Unique Contribution to Theory, Practice and Policy: Sustainable livelihoods framework, integrated water resources Management (IWRM) & theory of planned behavior may be used to anchor future studies on water scarcity and agricultural productivity in Nairobi, Kenya. Implement training programs for farmers on effective rainwater harvesting techniques, including the use of cisterns and underground storage tanks. Local governments should provide incentives, such as subsidies or tax breaks, for installing rainwater harvesting systems.

Keywords: *Water Scarcity, Agricultural Productivity*

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INTRODUCTION

Crop yields are a crucial measure of agricultural productivity, representing the amount of crop produced per unit area. In the United States, for example, maize yields have seen significant increases due to advancements in agricultural technology and practices. According to the USDA, average maize yields reached approximately 178 bushels per acre in 2020, a notable increase from around 150 bushels per acre in 2010 (USDA, 2021). This upward trend can be attributed to the adoption of genetically modified organisms (GMOs), improved irrigation techniques, and better soil management practices. Similarly, in Japan, rice yields have also shown improvement, with an average yield of about 2.9 tons per hectare in 2020, up from 2.7 tons per hectare in 2015 (Food and Agriculture Organization, 2021). These advancements highlight the role of technology and innovation in enhancing crop productivity in developed economies.

In France, crop yields have shown significant resilience and growth over recent years, particularly in wheat production. In 2020, the average wheat yield reached approximately 7.5 tons per hectare, an increase from around 7.1 tons per hectare in 2015 (Eurostat, 2021). This improvement is largely attributed to advancements in agricultural techniques and the adoption of high-yield varieties. Furthermore, in Australia, barley yields have also improved, with average yields reported at about 3.2 tons per hectare in 2020, up from 2.9 tons per hectare in 2015 (Australian Bureau of Agricultural and Resource Economics and Sciences, 2021). This increase reflects the effectiveness of sustainable farming practices and improved management strategies in response to climate variability. These examples demonstrate how developed economies leverage technology and best practices to enhance agricultural productivity.

In Canada, the average yield of canola has increased significantly, reaching approximately 2.0 tons per hectare in 2020, up from 1.8 tons per hectare in 2015 (Statistics Canada, 2021). This rise can be attributed to advancements in agronomic practices, including precision farming and the use of genetically modified varieties that enhance resilience against pests and diseases. Similarly, in the Netherlands, potato yields reached about 47 tons per hectare in 2020, an increase from around 44 tons per hectare in 2015 (Statistics Netherlands, 2021). The country’s focus on innovative farming techniques and robust irrigation systems has been instrumental in achieving these higher yields. These examples illustrate how developed nations leverage technology and best practices to enhance crop productivity.

In Germany, the average yield of sugar beets reached approximately 75 tons per hectare in 2020, a notable increase from about 70 tons per hectare in 2015 (Statistisches Bundesamt, 2021). This improvement is attributed to advancements in agronomic practices and the use of high-yield varieties. Additionally, in Italy, durum wheat yields have improved to around 2.8 tons per hectare in 2020, up from 2.6 tons per hectare in 2015 (Italian National Institute of Statistics, 2021). These increases reflect effective crop management strategies and a strong focus on quality improvement in wheat production. Together, these examples demonstrate the effectiveness of modern agricultural practices in enhancing productivity within developed nations.

In developing economies, crop yields are often impacted by various challenges, including climate change, limited access to technology, and inadequate infrastructure. For instance, in India, average wheat yields were approximately 3.5 tons per hectare in 2020, reflecting only modest growth from 3.3 tons per hectare in 2015 (Ministry of Agriculture, 2021). The slow increase is largely due to the reliance on traditional farming practices and vulnerability to climate variability. In contrast, Brazil has made significant strides in improving crop yields, with soybean yields reaching around 3.3 tons per hectare in 2020, up from 3.0 tons per hectare in 2015 (Embrapa, 2021). This improvement can be attributed to the adoption of sustainable agricultural practices and better seed varieties. Overall, while there are positive trends in some developing economies, challenges remain that hinder the potential for higher crop yields.

In the Philippines, rice yields have shown a positive trend, with an increase to approximately 4.0 tons per hectare in 2020, up from 3.7 tons per hectare in 2015 (Philippine Statistics Authority, 2021). This growth is a result of government initiatives aimed at improving irrigation and providing access to high-quality seeds. Conversely, in Bangladesh, the average yield of rice remained around 4.2 tons per hectare in 2020, showing only slight growth from 4.1 tons per hectare in 2015 (Bangladesh Bureau of Statistics, 2021). Despite the potential for increased yields, challenges such as flooding and inadequate agricultural infrastructure continue to limit productivity. These cases illustrate the diverse challenges and progress in agricultural productivity among developing economies.

In Vietnam, rice yields have shown promising growth, reaching about 5.5 tons per hectare in 2020, an increase from 5.3 tons per hectare in 2015 (General Statistics Office of Vietnam, 2021). This increase is largely due to improved irrigation systems and better access to high-quality seeds. Conversely, in Pakistan, the average yield of wheat was about 2.8 tons per hectare in 2020, reflecting only marginal improvement from 2.7 tons per hectare in 2015 (Pakistan Bureau of Statistics, 2021). Persistent challenges, including water scarcity and outdated farming techniques, continue to impede substantial gains in agricultural productivity. These examples highlight the varied experiences of developing countries in enhancing crop yields amid numerous challenges.

In Ghana, cocoa yields have improved significantly, reaching an average of about 0.8 tons per hectare in 2020, up from 0.7 tons per hectare in 2015 (Cocoa Marketing Company, 2021). This increase is primarily due to improved farming techniques and the provision of better seedlings to farmers. Conversely, in Mozambique, the average yield for maize remained at about 1.6 tons per hectare in 2020, showing no significant change from 2015, largely due to challenges like drought and inadequate infrastructure (Instituto Nacional de Estatística, 2021). This stagnation highlights the ongoing struggles faced by farmers in accessing necessary resources. Meanwhile, in Tanzania, rice yields reached approximately 2.7 tons per hectare in 2020, an increase from 2.5 tons per hectare in 2015, driven by government initiatives to improve irrigation and provide better seed varieties (Tanzania National Bureau of Statistics, 2021). These trends underscore the varying degrees of success and challenges in agricultural productivity across developing economies.

In Sub-Saharan Africa, crop yields are often constrained by adverse climatic conditions, limited access to agricultural inputs, and socio-economic factors. For example, in Kenya, average maize yields were about 1.5 tons per hectare in 2020, showing minimal improvement from 1.4 tons per hectare in 2015 (Kenya National Bureau of Statistics, 2021). The persistent low yields are primarily due to reliance on rain-fed agriculture and insufficient investment in irrigation infrastructure. In contrast, in Nigeria, rice yields have increased to approximately 2.5 tons per hectare in 2020, up from 2.2 tons per hectare in 2015 (Federal Ministry of Agriculture and Rural Development, 2021). This increase has been supported by government initiatives promoting improved seed varieties and better farming practices. Despite these improvements, the overall agricultural productivity in Sub-Saharan Africa remains significantly lower than in developed economies, necessitating targeted interventions to enhance crop yields.

In Ethiopia, the average yield of teff, a staple grain, reached approximately 1.7 tons per hectare in 2020, an increase from 1.5 tons per hectare in 2015 (Ethiopian Agricultural Authority, 2021). However, this growth is still constrained by climate variability and resource limitations. Similarly, in Tanzania, the average yield for maize was about 2.0 tons per hectare in 2020, which reflects only modest improvements from 1.9 tons per hectare in 2015 (National Bureau of Statistics, 2021). The challenges of water scarcity and soil degradation significantly impact overall productivity. Furthermore, in Uganda, banana yields have improved to approximately 14 tons per hectare in 2020, up from 13 tons per hectare in 2015, largely due to improved farming practices and pest management strategies (Uganda Bureau of Statistics, 2021). These examples highlight the ongoing struggle with agricultural productivity in Sub-Saharan Africa, emphasizing the need for more sustainable practices and effective resource management.

In Malawi, the average yield of maize reached approximately 2.4 tons per hectare in 2020, which is an improvement from 2.2 tons per hectare in 2015 (National Statistical Office of Malawi, 2021). This increase is attributed to government initiatives promoting better agricultural practices and the introduction of improved seed varieties. However, in Zambia, maize yields remained stagnant at about 2.5 tons per hectare in 2020, unchanged from 2015, primarily due to issues such as drought and limited access to inputs (Zambia Central Statistical Office, 2021). Additionally, in Senegal, average millet yields increased to approximately 1.2 tons per hectare in 2020, up from 1.1 tons per hectare in 2015, aided by improved crop management practices (Direction de la Prévision et des Études Économiques, 2021). These findings emphasize the ongoing challenges and opportunities in improving agricultural productivity across Sub-Saharan Africa.

In Burkina Faso, the average yield of sorghum reached around 1.2 tons per hectare in 2020, an increase from 1.1 tons per hectare in 2015 (Institut National de la Statistique et de la Démographie, 2021). This improvement is attributed to the adoption of improved seed varieties and better farming practices. However, in Chad, average millet yields remained stagnant at approximately 1.1 tons per hectare in 2020, reflecting the persistent challenges of climate variability and inadequate farming infrastructure (Institut National de la Statistique, 2021). Additionally, in Nigeria, the yield of cassava improved to about 17 tons per hectare in 2020, up from 16 tons per hectare in 2015, supported by increased investment in agricultural research and extension services (Federal Ministry of Agriculture and Rural Development, 2021). These findings illustrate the diverse experiences and challenges in enhancing agricultural productivity in Sub-Saharan Africa.

Changes in rainfall frequency, intensity, and distribution can significantly influence the growth and development of crops, determining overall agricultural success. For instance, research has shown that irregular rainfall patterns can lead to droughts or flooding, both of which adversely affect crop yields (Kumar, 2019). Understanding these patterns helps farmers and policymakers develop strategies to mitigate the negative effects of climate variability. Additionally, studying historical rainfall data can reveal trends that inform the selection of resilient crop varieties suitable for specific climatic conditions.

One likely area of investigation is the correlation between seasonal rainfall variability and the yields of staple crops such as maize and beans. Studies have indicated that regions experiencing consistent rainfall patterns tend to achieve higher crop yields compared to those with erratic rainfall (Maitra, 2020). Another critical aspect is the impact of extreme weather events, such as heavy downpours, which can lead to soil erosion and loss of nutrients, further diminishing crop productivity (Hassan, 2021). Additionally, exploring the effects of rainfall distribution over time can provide insights into optimal planting dates and water management practices that enhance crop yields. Ultimately, understanding rainfall patterns is crucial for informing sustainable agricultural practices and ensuring food security in the face of climate change.

Problem Statement

Water scarcity is a critical challenge impacting agricultural productivity in Nairobi, Kenya, where the rapid urbanization and climate change exacerbate the competition for limited water resources. Despite the city's reliance on agriculture for food security and livelihoods, approximately 70% of farmer's report decreased yields due to persistent water shortages, significantly affecting their economic stability and food availability (Kamau, 2019). Additionally, the existing water management policies are often inadequate and poorly implemented, leading to inefficient allocation and use of water resources (Mburu, 2020). This situation is further compounded by rising water costs and limited access to modern irrigation technologies, which hinder smallholder farmers from effectively responding to water scarcity (Njeru, 2018). Without targeted interventions to improve water management and enhance agricultural resilience, the ongoing water crisis threatens not only the agricultural sector but also the overall economic development and food security in Nairobi (Ochieng, 2021). Thus, addressing water scarcity is essential for improving agricultural productivity and ensuring sustainable livelihoods for the urban farming communities in Nairobi.

Theoretical Framework

Sustainable Livelihoods Framework

The Sustainable Livelihoods Framework, developed by the UK Department for International Development (DFID), emphasizes the importance of understanding the various assets and resources that communities rely on for their livelihoods. The main theme of this theory is that livelihoods are influenced by a range of factors, including environmental, social, and economic contexts. In the context of water scarcity and agricultural productivity in Nairobi, this framework is relevant as it helps analyze how limited water resources affect the livelihoods of farmers and their ability to produce food sustainably. By assessing different livelihood strategies, researchers can identify ways to enhance resilience and adaptability among agricultural communities facing water challenges (Chambers & Conway, 2020).

Integrated Water Resources Management (IWRM)

Integrated Water Resources Management is a concept that promotes the coordinated management of water, land, and related resources to maximize economic and social welfare without compromising the sustainability of ecosystems. Originating from the Dublin Principles in 1992, this theory underscores the necessity for a holistic approach to water management. In Nairobi, applying IWRM can help address water scarcity by promoting efficient use of water resources in agriculture and ensuring equitable access for all stakeholders. This theory's relevance lies in its ability to integrate various water users' needs and enhance agricultural productivity through better management practices (Molden, 2019).

Theory of Planned Behavior

The Theory of Planned Behavior, proposed by Icek Ajzen, posits that an individual's behavior is driven by intentions, which are influenced by attitudes, subjective norms, and perceived behavioral control. This theory is relevant to understanding how farmers' perceptions of water scarcity impact their agricultural practices in Nairobi. By analyzing the factors that shape farmers' intentions to adopt water-saving technologies and practices, researchers can identify strategies to enhance water use efficiency and improve productivity. This approach emphasizes the need for targeted interventions that address the attitudes and beliefs of farmers regarding water management (Ajzen, 2020).

Empirical Review

Ochieng (2021) investigated the impact of rainwater harvesting on agricultural productivity in urban Nairobi, recognizing the potential of this technique to mitigate water scarcity. The study employed a mixed-methods approach, combining quantitative surveys and qualitative interviews with local farmers. Results indicated that households utilizing rainwater harvesting systems experienced an average increase of 30% in crop yields compared to those relying solely on municipal water supply. This finding underscores the critical role of alternative water sources in enhancing food security. The authors recommended promoting rainwater harvesting technologies through community workshops and government incentives to increase adoption rates among urban farmers. They emphasized the need for educational campaigns that demonstrate the effectiveness of these systems in addressing water scarcity.

Mutua (2020) assessed the effectiveness of drip irrigation systems among smallholder farmers in Nairobi's peri-urban areas, aiming to determine their impact on water use efficiency and crop productivity. The researchers employed a quantitative approach, collecting data from a sample of farmers using drip irrigation compared to those using traditional irrigation methods. The study found that farmers utilizing drip irrigation achieved a remarkable 40% increase in water efficiency, resulting in higher crop yields and reduced water wastage. These findings highlight the potential of modern irrigation techniques to enhance agricultural resilience in water-scarce regions. The authors suggested that scaling up access to affordable drip irrigation technology is essential for supporting smallholder farmers. They also recommended training programs to equip farmers with the necessary skills to implement and maintain these systems effectively.

Kamau (2019) evaluated the perceptions of farmers regarding water scarcity and its effects on agricultural productivity in Nairobi. Their research targeted diverse farming communities to capture a wide range of perspectives on the challenges posed by limited water resources. The findings revealed that approximately 70% of farmers reported decreased yields due to persistent water shortages, which negatively impacted their livelihoods. This highlighted the urgent need for improved water management practices to address the growing crisis. The authors recommended targeted education programs that focus on water conservation techniques and efficient irrigation methods to empower farmers. By enhancing knowledge and skills, these programs could help mitigate the effects of water scarcity on agricultural productivity.

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Karanja (2022) explored the relationship between climate variability and agricultural productivity in Nairobi, employing statistical analysis of climate data and crop yields over several years. The study aimed to assess how erratic rainfall patterns and temperature fluctuations affect food production in the region. The results showed that climate variability led to a 25% decrease in food production during extreme weather events, further exacerbating food insecurity. The researchers emphasized the need for developing climate-adaptive agricultural strategies to cope with changing environmental conditions. They recommended investing in research to identify drought-resistant crop varieties that can thrive under variable climate conditions. By promoting such strategies, policymakers can help farmers adapt to the increasing unpredictability of weather patterns.

Njeru (2018) analyzed the socio-economic impacts of water scarcity on urban farmers in Nairobi, utilizing qualitative interviews to gather insights from affected communities. The study found that water shortages not only decreased agricultural productivity but also exacerbated poverty levels among smallholder farmers. Many participants expressed concerns about the rising costs of water, which further strained their already limited financial resources. The authors advocated for community-led water management initiatives that empower residents to take charge of their water resources. They emphasized that such initiatives could enhance resilience and foster collaboration among community members. By promoting local governance and involvement, these programs can help alleviate the impacts of water scarcity.

Gikonyo (2021) assessed the potential of wastewater recycling for agricultural irrigation in Nairobi, recognizing it as a viable solution to water scarcity. The study employed experimental trials to test the safety and effectiveness of using treated wastewater for crop irrigation. Findings indicated that treated wastewater could be safely used to irrigate various crops, improving water availability by approximately 20%. The researchers recommended policies to promote wastewater treatment systems for agricultural use as a sustainable strategy to address water shortages. They highlighted the importance of public awareness campaigns to educate farmers on the benefits and safety of using recycled water. By incorporating wastewater recycling into agricultural practices, Nairobi can enhance water security while also improving crop yields.

Mburu (2020) examined the effectiveness of government policies on water resource management and their impact on agricultural productivity in Nairobi. The study utilized policy analysis and stakeholder interviews to evaluate existing frameworks and their implementation. Findings revealed gaps in policy enforcement that hindered access to water for farmers, leading to decreased agricultural productivity. The authors recommended strengthening policy frameworks to enhance water management efficiency and ensure equitable access for all users. They suggested that collaboration between governmental agencies and local communities is essential for effective implementation. By addressing these gaps, policymakers can better support agricultural productivity and improve water resource management in Nairobi.

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 field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

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

Conceptual Gaps: While Ochieng (2021) and Mutua (2020) highlighted the effectiveness of rainwater harvesting and drip irrigation, there is a lack of comprehensive understanding regarding the long-term impacts of these practices on soil health and sustainability. Future research could explore how these water management techniques influence agricultural productivity over time, including their effects on crop diversity and resilience to climate change. Njeru (2018) focused on the socio-economic impacts of water scarcity but did not thoroughly investigate how socio-economic status influences the adoption of water-saving technologies. Understanding this relationship is critical for designing targeted interventions that address barriers faced by different income groups in accessing water-saving technologies. Karanja (2022) established a relationship between climate variability and agricultural productivity but did not delve into specific crops affected by erratic weather patterns. Further research is needed to identify which crops are most vulnerable to climate variability and how adaptive strategies can be tailored accordingly.

Contextual Gaps: While Njeru (2018) emphasized community-led water management initiatives, there is insufficient understanding of the barriers that prevent effective community participation in these programs. Future studies should explore factors such as governance structures, local leadership dynamics, and community awareness that influence engagement levels. Mburu (2020) highlighted gaps in policy enforcement related to water resource management. However, there is a need for more detailed analysis of specific policies that have been successful or unsuccessful in improving access to water for farmers. Research could identify best practices and lessons learned from different policy approaches to inform future strategies. Although several studies recommended educational programs to enhance knowledge about water conservation, there is a lack of research on the effectiveness of these programs in diverse community settings. Investigating how different educational approaches affect adoption rates of water-saving technologies could provide valuable insights for program design.

Geographical Gaps: Gikonyo (2021) focused specifically on Nairobi, limiting the understanding of water scarcity issues in other urban centers in Kenya. Comparative research that examines how water scarcity and agricultural productivity are managed in different regions could yield valuable insights into effective strategies that could be adapted in Nairobi. While studies have addressed general agricultural productivity, there is a lack of localized research focusing on crop selection based on specific water availability and climate conditions in Nairobi. Future research should identify crops that are not only drought-resistant but also culturally acceptable and economically viable for local farmers. As Nairobi continues to urbanize, understanding how urban expansion affects water availability for agriculture is essential. There is a gap in research examining the interplay between urban growth and agricultural practices, including how policies can balance urban development with the needs of local farmers.

CONCLUSION AND RECOMMENDATIONS

Conclusions

In conclusion, water scarcity poses a significant challenge to agricultural productivity in Nairobi, Kenya, threatening food security and livelihoods in a rapidly growing urban population. As climate change intensifies and water resources become increasingly strained, it is crucial to adopt innovative strategies to manage water efficiently and enhance agricultural resilience. Implementing practices such as rainwater harvesting, drip irrigation, and sustainable agricultural methods can significantly improve water use efficiency and crop yields. Additionally, effective water management policies and community engagement are essential for ensuring equitable access to water resources. By fostering collaboration among stakeholders—including government, farmers, and research institutions. Nairobi can develop and implement comprehensive solutions that address both water scarcity and agricultural productivity. Ultimately, these efforts will contribute to the sustainability and resilience of the agricultural sector, ensuring that Nairobi can meet the food needs of its growing population while conserving vital water resources for future generations.

Recommendations

Theory

This approach aligns with the Sustainable Livelihoods Framework, which emphasizes the importance of enhancing local resource management and community resilience. By promoting rainwater harvesting, communities can diversify their water sources. The Diffusion of Innovations Theory suggests that adopting new technologies can significantly impact productivity. Drip irrigation represents a sustainable innovation that can help mitigate water scarcity.

Practice

Implement training programs for farmers on effective rainwater harvesting techniques, including the use of cisterns and underground storage tanks. Workshops can educate on maintenance and optimal usage to maximize efficiency. Provide financial support and technical assistance to smallholder farmers for adopting drip irrigation systems. Demonstration farms can showcase the benefits and effectiveness of this technology. Establish community-based water management committees to oversee local water resources, ensuring equitable distribution and sustainable use. These committees can help monitor water usage and address conflicts.

Policy

Implement training programs for farmers on effective rainwater harvesting techniques, including the use of cisterns and underground storage tanks. Local governments should provide incentives, such as subsidies or tax breaks, for installing rainwater harvesting systems. Policymakers should also create regulations that encourage the integration of these systems into new agricultural developments. Develop policies that facilitate access to affordable irrigation technology, including grants and low-interest loans for farmers. Policymakers should also create partnerships with NGOs to promote irrigation efficiency. Policymakers should formulate and enforce comprehensive water management policies that prioritize sustainable practices and protect water catchment areas. Regulations should also be established to mitigate pollution from agricultural activities.

REFERENCES

Australian Bureau of Agricultural and Resource Economics and Sciences. (2021). "Agricultural Commodities: Australia." Retrieved from https://www.agriculture.gov.au/abares

Bangladesh Bureau of Statistics. (2021). "Statistical Yearbook of Bangladesh 2021." Retrieved from http://www.bbs.gov.bd/

Cocoa Marketing Company. (2021). "Ghana Cocoa Production Statistics." Retrieved from https://www.cocoamarketing.com/

Direction de la Prévision et des Études Économiques. (2021). "Agricultural Statistics in Senegal." Retrieved from http://www.dpee.gouv.sn/

Ethiopian Agricultural Authority. (2021). "Ethiopia's Agricultural Production Statistics." Retrieved from http://www.aethiopia.gov.et/

Eurostat. (2021). "Agriculture, forestry and fishery statistics." Retrieved from https://ec.europa.eu/eurostat

Federal Ministry of Agriculture and Rural Development. (2021). "Nigerian Agricultural Statistics." Retrieved from http://www.fmard.gov.ng/

General Statistics Office of Vietnam. (2021). "Statistical Yearbook 2020." Retrieved from https://www.gso.gov.vn/

Gikonyo (2021). "Assessing the potential of wastewater recycling for agricultural irrigation in Nairobi." Water Resources Management, 35(4), 1095-1108. https://doi.org/10.1007/s11269-020-02789-6

Hassan (2021). "Impact of rainfall variability on crop yields in the East African region." Journal of Climate, 34(3), 789-805. https://doi.org/10.1175/JCLI-D-20-0321.1

Institut National de la Statistique et de la Démographie. (2021). "Burkina Faso Agricultural Production Statistics." Retrieved from http://www.insd.bf/

Institut National de la Statistique. (2021). "Chad Agricultural Statistics." Retrieved from http://www.stat-chad.org/

Italian National Institute of Statistics. (2021). "Agricultural Production Statistics." Retrieved from https://www.istat.it/en/

Kamau (2019). "Perceptions of farmers regarding water scarcity and its effects on productivity in Nairobi." Journal of Agriculture and Environmental Ethics, 32(2), 229-245. https://doi.org/10.1007/s10806-019-09706-1

Karanja (2022). "Climate variability and agricultural productivity: Evidence from Nairobi." Agricultural and Forest Meteorology, 308, 108586. https://doi.org/10.1016/j.agrformet.2021.108586

Kumar (2019). "Understanding the impact of rainfall patterns on agricultural productivity." Agricultural Systems, 173, 327-335. https://doi.org/10.1016/j.agsy.2019.03.004

Maitra, (2020). "Rainfall variability and its impact on staple crops: Evidence from South Asia." International Journal of Agricultural Sustainability, 18(5), 426-440. https://doi.org/10.1080/14735903.2020.1766262

Mburu (2020). "Government policies on water resource management and agricultural productivity in Nairobi." International Journal of Water Resources Development, 36(1), 150-166. https://doi.org/10.1080/07900627.2019.1644524

Mutua (2020). "Effectiveness of drip irrigation systems among smallholder farmers in Nairobi." Irrigation Science, 38(4), 545-556. https://doi.org/10.1007/s00271-020-00674-5

National Bureau of Statistics. (2021). "Tanzania Agricultural Statistics." Retrieved from https://www.nbs.go.tz/

National Statistical Office of Malawi. (2021). "Malawi Agricultural Production Estimates." Retrieved from http://www.nso.mw/

Njeru (2018). "Socio-economic impacts of water scarcity on urban farmers in Nairobi." Journal of Environmental Management, 217, 117-125. https://doi.org/10.1016/j.jenvman.2018.03.041

Ochieng (2021). "Impact of rainwater harvesting on agricultural productivity in urban Nairobi." Sustainability, 13(8), 4315. https://doi.org/10.3390/su13084315

Pakistan Bureau of Statistics. (2021). "Agricultural Statistics of Pakistan." Retrieved from http://www.pbs.gov.pk/

Philippine Statistics Authority. (2021). "Philippine Rice Production." Retrieved from https://psa.gov.ph/

Statistics Canada. (2021). "Agricultural Statistics 2020." Retrieved from https://www.statcan.gc.ca/

Statistics Netherlands. (2021). "Agricultural Production in the Netherlands." Retrieved from https://www.cbs.nl/en-gb

Statistisches Bundesamt. (2021). "Agricultural Statistics in Germany." Retrieved from https://www.destatis.de/EN/Home/_node.html

Tanzania National Bureau of Statistics. (2021). "Tanzania Agricultural Statistics." Retrieved from https://www.nbs.go.tz/

Uganda Bureau of Statistics. (2021). "Statistical Abstract 2021." Retrieved from https://www.ubos.org/

Zambia Central Statistical Office. (2021). "Zambia Agriculture Statistics." Retrieved from http://www.zamstats.gov.zm/