Influence of Fertilizer Subsidy Policy on Land Allocation for Rice Production in

Western Kenya

**.ABSTRACT**

|  |
| --- |
| It is recognized that one of the factors that hinders realization of the goals set out in the Kenya’s Agricultural Policy, is the high cost of farm inputs that limits smallholder rice farmers’ capacity to expand area under rice cultivation. This study, therefore, examines how Kenya’s fertilizer subsidy policy influences land allocation for rice cultivation among smallholder farmers in Kisumu and Busia Counties, Western Kenya. A cross-sectional research design was employed targeting a sample of 480 smallholder farmers, who were randomly selected in the study area. Primary data was collected using structured questionnaires. After adjusting for labor inputs and irrigation status, land distribution patterns were analyzed under various fertilizer use categories, namely; subsidized, unsubsidized, both subsidized and unsubsidized and none. The statistical techniques (descriptive analysis and non-parametric tests (Kruskal-Wallis, Mann-Whitney U)) revealed that land use was dominated by rice (62%) as opposed to maize (37%). Farmers who used only one category of fertilizer, allocated 1.70-1.31 acres of land, while farmers who used both subsidized and unsubsidized fertilizer categories dedicated a much larger amount of land of 1.91 acres to rice cultivation. Irrigated ecosystems had significantly larger rice acreage (2.25 acres) than rain-fed ecosystems (1.64 acres) which were significantly different (P>=0.005). The results indicated that land allocated to rice production was influenced by access to both fertilizer categories ( a combination of subsidized and unsubsidized). The study however, found that subsidized fertilizer did not significantly influence land allocation to rice cultivation. |

*Keywords: Fertilizer subsidy, land allocation, smallholder farmers, rice production, irrigation ecosystems, agricultural policy, Western Kenya*

1. INTRODUCTION

In Kenya, rice is one of the most important crops, and it comes after maize and wheat. Nevertheless, the production does not match the constantly increasing demand, which grows by 12 % each year, leaving the country with no other choice but to resort to expensive imports (Republic of Kenya, 2020). The smallholder farmers that constitute the majority of the players in the Kenyan rice sector have massive challenges, as the costs of inputs are high, especially for fertilizer, thereby reducing productivity and profitability (Nkuba et al., 2016). To overcome this challenge, the Kenyan government came up with the idea of the National Fertilizer Subsidy Program (NFSP), which could help lower production costs and secure food security. Although earlier works have studied the impacts of fertilizer subsidies on yield and profitability, they have not specifically studied the impact of fertilizer subsidies on land allocation decisions of the country's smallholder rice farmers.

Rice cultivation is a dominant economic activity in Western Kenya, especially in Kisumu and Busia counties, and on average, it keeps thousands of households economically engaged. Farmers, however, tend to reserve little land for rice according to Makate *et al*. (2016) and Takeshima et al. (2021) because of high production costs, opportunity costs for other crops, and inefficiency in the distribution of inputs. It is essential to understand the impacts of subsidized fertilizers in land-use decisions to optimize agricultural policies and sustainable intensification (Adiraputra & Supyandi, 2021). Additionally, subsidization of agricultural inputs has been described as the strategic instrument of intensifying farm productivity and improving food security in the developing nations (Jayne et al., 2018). Subsidies on fertilizer specifically seek to address the market failures by reducing the price ceiling to acquiring productivity-enhancing technologies, more so in cases involving resource-constrained smallholder farmers (Srivastava et al., 2023). As a reaction to the situation of low agricultural productivity and poverty in rural areas, several governments in sub-Saharan Africa began to reintroduce the input subsidies as a policy response (Kato & Greeley, 2016). In Kenya, the National Fertilizer Subsidy Program (NFSP) was proposed in 2008 with a view to raising agricultural output through improved accessibility and a lower price of fertilizer. Researchers like Puntsagdorj et al. (2021) and Mallick and Dash (2024) have analyzed the effect of the subsidy on yield, adoption, and the profitability of the farmers. Yet, there has been scant focus on the subsidy on land allocation choices, especially under competing crop choices and ecosystem constraints.

Fertilizer subsidies have had both high and low results on the land use worldwide. As an illustration, Dorairaj and Govender (2023) found out that 67% of agricultural land in Malaysia was allocated to rice after receiving subsidized support. Equally, Lagasca et al. (2024) discovered that the farms that got fertilizer subsidies dedicated much more in the Philippines to the planting of rice. This is corroborated by the Induced Innovation Theory (Lemessa et al., 2019), according to which, at lower input prices (e.g. through subsidies), flow of agricultural land to input-intensive crops becomes more likely to happen. Although there is evidence of the impact of subsidy on productivity, the connection between fertilizer subsidy and land redistribution in production of rice is an under-researched issue in Kenya. The literature review has not adequately discussed the influence of structural factors, such as availability of irrigation facilities and use of labor, poor targeting of subsidies, on decision to increase acreage of rice agricultural production in high-potential areas in Kenya, like the Kisumu and Busia counties. Whereas previous research has been done to assess the effects of subsidized fertilizer on rice yields and input use, few studies have paid attention to the role of subsidized fertilizer in land allocation to rice production. It is also noted that previous studies have not explored this gap under irrigation and rain-fed ecosystems in Kenya. Such a gap does not provide policymakers with enough evidence to restructure subsidy programs in line with the Kenya Vision 2030 and the Agricultural Sector Development Strategy (ASDS, 2020).

This study aims to bridge the above research gap by evaluating the influence of subsidized fertilizer on land allocated to rice cultivation among smallholder farmers in Kisumu and Busia counties.

methodology

**2.1 Study Design**

This study adopted a cross-sectional research design to examine the relationship between fertilizer subsidy policies and land allocation for rice production in Kisumu and Busia Counties. The design allowed for data collection at a single point in time while capturing variations across different ecosystems (irrigated vs. rain-fed).

**2.2 Study population**

The population of rice farmers (N) included in the study area of Kisumu County (Nyando Sub County) was 178,246, while Busia County (Bunyala Sub County) was 46,320. The population of the study area was used to calculate the sample size.

**2.3 Sampling Approach**

Multi-stage sampling was used to select two Locations from two Wards in each selected Sub- County in the target County. The target Counties (Kisumu and Busia) were purposively selected. The criteria of selection were existence of improved rain-fed and irrigated rice farms. A sampling frame was obtained from Ministry of Agriculture at Sub County, Ward and Location levels. Simple random sampling techniques was used to select sampling units. The sampling unit was the household. A household in this study was referred to as a single person or group of persons who live and eat together and share common living arrangements i.e. share expenses. The sample size was determined using Glenn D Israel’s formula (2008).

Glenn D Israel’s formula specification:

n = [N/ (1+N (e2)],

The population (N) in the study area of Kisumu County (Nyando Sub County) was 178,246, while Busia County (Bunyala Sub County) was 46320). The population totaled 224566 which with, with a precision (e) of 5% (0.05) and 95% level of confidence gave a sample size of 480.

The sample was distributed among the study units using probability proportional to size (PPS) approach according to Hansen *et al* (1943) and quoted by Iffat Khawaja (2005). The technique allowed sample size to be distributed according to the population of farmers in each study unit (location) using the formula below:

, where ni is the sample size for i-th study unit population, Zi is sample frame for i-th study unit population and n is the sample size for the whole population. Using the formular Kisumu County was allocated a sample size of 381 while sample size allocated to Busia County was 99.

**2.3 Data Collection Methods**

The study employed a multi-method approach to data collection, combining primary and secondary sources. Structured questionnaires were administered through face-to-face interviews with 480 smallholder farmers, gathering detailed information on land allocation patterns, fertilizer usage (subsidized, unsubsidized, both, or none), production costs, and yield measurements. Secondary data from the Ministry of Agriculture, KALRO, and county reports provided contextual information and historical trends. This triangulation of methods ensured comprehensive data collection while enhancing the study's validity through multiple verification sources.

**2.4 Variables**

The dependent variable was land allocated to rice (acres). At the same time, the independent variables included fertilizer use categories (subsidized, unsubsidized, combined, none), the farming ecosystem (irrigated/rain-fed), and socio-economic factors (farm size, labor, access to extension services).

**2.5 Analytical Techniques**

The study employed robust analytical techniques to examine the relationship between fertilizer use categories and land allocation. Descriptive statistics provided an overview of land use patterns and farmer demographics. Multiple regression analysis quantified subsidy impacts while controlling for labor inputs and ecosystems (irrigated vs rain-fed). Non-parametric tests (Kruskal-Wallis and Mann-Whitney U) compared median land allocations across different fertilizer use categories, accommodating non-normal data distributions. This multi-faceted analytical approach enabled a comprehensive assessment of both direct effects and systemic efficiency in fertilizer subsidy implementation.

**2.6 Validity and Reliability**

To ensure data quality, the study implemented rigorous validity and reliability measures. A pilot test with 30 farmers refined questionnaire clarity and consistency before full deployment. Cronbach's alpha (α=0.70) verified internal reliability for Likert-scale items measuring farmer perceptions. Three agribusiness specialists who evaluated question relevance and coverage of key constructs established content validity through a comprehensive review. These methodological safeguards strengthened the study's credibility by minimizing measurement errors and ensuring the instruments accurately captured the intended variables related to fertilizer subsidy impacts.

3.0 results and discussion

**3.1 Results**

**3.1.1** **Land allocation to various enterprises**

The farmers’ land size ranged from 0.25 to 25 acres (an average land size of 2.5 acres), suggesting a relatively large number of smallholder farmers in western Kenya (Table 1). The respondent’s farming activities were diversified, with 62% of farmers producing rice, followed by maize at 37%. Sorghum, sugarcane, and other crops were, however, grown by significantly fewer farmers. It is postulated that a farmer’s decision on land allocation is influenced by the value of each enterprise on his farm. Farmers in western Kenya grow multiple crops; hence, land allocation to rice is likely to be directly affected by resources at the farmer's disposal and the value of the produce. Rice, as the main cash crop, is expected to receive greater land allocation. Table 1 below shows land allocation to various crops in Western Kenya.

**Table 1.** *Mean Land allocation to rice and other crops in Western Kenya*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop** | **Period 2022/23** | | | | | **Period 2023/2024** | | | | | | **Mean Change** |
| **Obs** | **Min** | **Max** | **Mean** | **Std** | **Obs** | **%** | **Min** | **Max** | **Mean** | **Std** | **+** |
| Rice | 135 | 0.08 | 4.6 | 1.07 | 0.6 | 135 | 35 | 0.15 | 4;5 | 1.04 | 0’7 | + |
| Maize | 169 | 0.09 | 4.8 | 1.05 | 0.67 | 169 | 36.9 | 0.01 | 5 | 1.06 | 0.66 | + |
| Sorghum | 35 | 0.01 | 2.5 | 0.93 | 0.63 | 35 | 7.7 | 0.25 | 3.6 | 1.02 | 0.74 | + |
| Sugarcane | 21 | 0.5 | 3 | 1.01 | 0.52 | 21 | 4.6 | 0.25 | 3 | 1.05 | 0.54 | + |
| Other crops | 40 | 0.09 | 1.8 | 0.56 | 0.39 | 40 | 8.8 | 0.01 | 1.8 | 0.53 | 0.41 | - |
| Vegetables and fruits  The mean land size owned by farmers is 2.49±2.28 acres with a range of (0.25 – 25) acres. | | | | | | | | | | | |  |

**Figure** **1:** *Land allocation to rice and other crops*

***3.1.2* Area under rice cultivation by ecosystems**

Results in Table 2 indicate that there was no significant difference in acreage put under rice cultivation in irrigated ecosystems between farmers (N=62) using both fertilizer categories (2.09 acres) and farmers (N=62) using subsidized fertilizer (2.02 acres). Kruskal-Wallis Test was applied to determine whether the median acreage variation between fertilizer subcategories (subsidized, unsubsidized, both or none) is statistically significant across ecosystems or not. Additionally, the Mann-Whitney U Test was applied in the case of pairwise comparisons in the few-groups-to-compare (fertilizer vs. no fertilizer) situation. Respondents (N=112) using unsubsidized fertilizer reported a mean acreage of 1.31 acres, which was not significantly different from the mean acreage of 1.82, reported by respondents (N=14) who did not use fertilizer in the irrigated ecosystem. Rain-fed rice farmers using various fertilizer categories reported mean acreage values which were not significantly different. Overall, there was no significant difference in acreage between farmers (N=88) using both categories (1.91) and farmers (N=129) using subsidized fertilizer categories with a mean acreage of 1.70. Farmers (N=18) who did not use fertilizer reported a mean acreage of 1.64, which was not significantly different from farmers (N=154) using the unsubsidized fertilizer category with a mean acreage of 1.31.

**Table** **2:** *Overall acreage under rice cultivation by ecosystems*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Fertilizer category** | Irrigated | | |  | Rain fed | | |  | Overall | | |
| **N** | **acreage** | **SSDd** |  | **N** | **Acreage** | **SD** |  | **N** | **Acreage** | SD |
| Both Sub and Unsub | 62 | 2.02a | 1.25 |  | 26 | 1.64a | 1.30 |  | 88 | 1.91a | 1.27 |
| Subsidized | 62 | 2.09a | 1.30 |  | 67 | 1.34a | 0.69 |  | 129 | 1.70a | 1.09 |
| Unsubsidized | 112 | 1.31b | 0.72 |  | 42 | 1.29a | 1.13 |  | 154 | 1.31b | 0.85 |
| None | 14 | 1.82ab | 0.82 |  | 4 | 1.00a | 0.00 |  | 18 | 1.64ab | 0.80 |
| Mean |  | 1.71A |  |  |  | 1.37B |  |  |  | 1.59 |  |
| p-value |  | <0.001 |  |  |  | 0.38 |  |  |  | <0.001 |  |
| CV |  | 60.8 |  |  |  | 70.3 |  |  |  | 63.9 |  |

**3.1.3. Area under rice cultivation by County**

Results in Table 3 from the Kruskal-Wallis Test indicate that there was a significant difference (p=0.01) in mean acreage put under rice cultivation in the irrigated ecosystem in Busia and Kisumu Counties. Farmers (N=27) using the subsidized category in irrigated ecosystem reported significantly larger mean acreage of 2.47 compared to other Categories. Non-fertilizer users (N=2) in Busia County reported an insignificant but larger mean acreage of 2.25 compared to both (N=34) with a mean acreage of 1.83 and unsubsidized (N=24) with a mean acreage of 1.51. In Kisumu County, Farmers (N=28) using both fertilizer categories in irrigated ecosystems reported significantly larger mean acreage of 2.25. Farmers (N=35) reported that the second largest acreage was 1.80, and it was put under an irrigated ecosystem in Kisumu County. There were no farmers in Busia County using both fertilizer categories under the rain-fed ecosystem. Farmers using other categories did not report a significant difference in mean acreage. Subsidized fertilizer users (N=6) reported a mean acreage of 1.05, followed by non-fertilizer users (N=14), 1.0 acres and unsubsidized users (N=14), reporting 0.79 acres. In Kisumu County, farmers (N=26) using both categories reported an insignificantly larger mean acreage of 1.64, put under rice cultivation in a rain-fed ecosystem, followed by unsubsidized (1.54), subsidized (1.37) and non-fertilizer (1.0).

**Table 3****:** *Area under rice cultivation by County*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Fertilizer category** | Busia | | | | Kisumu | | | | Overall | |
| Irrigated | | Rain-fed | | Irrigated | | Rain-fed | |
| **N** | **acreage (SD)** | **N** | **acreage (SD)** | **N** | **acreage (SD)** | **N** | **acreage (SD)** | **N** | **acreage (SD)** |
| Both sub and unsub | 34 | 1.83 (0.98) ab | 0 | - | 28 | 2.25 (1.50) a | 26 | 1.64 (1.30) a | 88 | 1.91 (1.27) a |
| Subsidized | 27 | 2.47 (1.30) a | 6 | 1.05 (1.46) a | 35 | 1.80 (1.25) ab | 61 | 1.37 (0.58) a | 129 | 1.70 (1.09) a |
| Unsubsidized | 24 | 1.51 (0.56) b | 14 | 0.79 (0.26) a | 88 | 1.26 (0.75) b | 28 | 1.54 (1.31) a | 154 | 1.31 (0.85) b |
| Non | 2 | 2.25 (0.35) ab | 1 | 1.00 (-) a | 12 | 1.75 (0.87) ab | 3 | 1.00 (0.00) a | 18 | 1.64 (0.80) ab |
| Mean |  | 1.95 |  | 0.87 |  | 1.58 |  | 1.46 |  | 1.59 |
| p-value |  | 0.01 |  | 0.78 |  | <0.001 |  | 0.50 |  | <0.001 |
| CV |  | 51.3 |  | 91.8 |  | 65.7 |  | 66.7 |  | 63.9 |

**3.3 Discussion**

The study presents vital information about smallholder farmers in Western Kenya (Kisumu and Busia Counties), regarding their decisions on agricultural land use. The prevailing smallholder farming ecosystems exist due to an average farm size of 2.5 acres, which demonstrates alignment with the typical agricultural description of sub-Saharan African rural communities (Saunders et al, 2012). Moreover, results reveal that rice cultivation accounted for 62% of farming activities while maize cultivation amounted to 37%. The total number of farmers who grew sorghum, sugarcane, fruits and vegetables amounted to only a small fraction of the respondents. The data shows that most farmers choose rice cultivation because of its status as a profitable cash crop in the region. Rice cultivation in Kenya has received substantial government backing through irrigation support, along with input subsidies, which motivates farmers to expand their rice cultivation practices further (Takeshima et al, 2021). The farming practices demonstrate utility-maximization principles according to Ricker-Gilbert et al. (2024) because farmers distribute agricultural land to crops that achieve optimal income while dealing with resource limitations, where economic advantages of rice production function as the leading decision factor for land use among farmers.

Between the seasons 2022/23 and 2023/24, the acreage change in land allocation for rice cultivation was insignificant because the mean acreage reached 1.07 acres and stabilized at 1.04 acres. The data indicates that rice continues to hold its value and importance within the farming system. The mean acreage of maize and sugarcane demonstrated parallel stability although sorghum mean acreage increased slightly because environmental changes made these crops more durable (Makate et al., 2012). A breakdown of the data reveals the amount of fertilizer used together with the irrigated versus rain-fed production environment, which determines the area under rice cultivation. The usage of subsidized fertilizers under irrigation led farmers showed increased land allocation by 2.09 acres on average, although unsubsidized fertilizer users produced only 1.31 acres. Research has shown that farming subsidies positively affect smallholder farmers' input usage and productivity (Morris, Kelly, Ron J. Kopicki, & Byerlee, 2007).

Research findings indicated that fertilizer categories did not affect rice growing acreage under rain-fed conditions (p = 0.38). Rain-fed rice farmers view their operations as high-risk and with low expected returns, so expansion of farmland occurs less frequently, regardless of fertilizer consumption. Regression analysis results confirm previous findings since farmers who use unsubsidized fertilizer and practice agriculture in rain-fed conditions exhibit significantly less rice cultivation land. High input costs along with environmental uncertainty act as significant barriers to intensifying rice cultivation under rain-fed farming systems, according to the regression analysis results. Negative relationships were found between environmental uncertainty and input costs and rice acreage, with β = -0.63 and β = -0.32 (*P* < 0.01).

The acreage under rice cultivation in Busia County differed substantially from the acreage in Kisumu County. The number of people in Busia who used government-subsidized fertilizer in their irrigated area of 2.47 acres increased, showing higher levels of government support absorption. The farmers in Kisumu County who used both subsidized and unsubsidized fertilizer increased subsidized cultivation in their fields by 2.25 acres, which could be related to efficient extension support and expanded resources in this area. The distinct characteristics of each County shape results because county-level policies, market access, and infrastructure variations may play a significant role in this outcome. The investment in irrigation infrastructure by Kisumu County authorities may explain why irrigated systems in this area received larger average rice farming allotments. The variations in spatial conditions call for region-specific solutions to establish fair agricultural potential.

The surveyed farmers demonstrate economic rationality by using land allocation strategies according to their calculated crop value estimates. Among our surveyed farmers, rice receives the most allocated land because it has both high commercial value and public support via irrigation infrastructure and subsidy programs. The main barriers to agricultural development exist among farmers who work with rain-fed cultivation and who cannot afford government-supported farming products, such as subsidized ones (Jayne & Rashid, 2013). Future intervention policies need to enhance irrigation system expansion and improve both the affordability of agricultural inputs and their accessibility.

**3.3.1 Policy implications**

Although the fertilizer subsidy policy was established to boost agricultural productivity and food security, it has had multi-faceted consequences when it comes to land distribution among smallholder rice farmers in Western Kenya (Kisumu and Busia counties). The research shows that poor performance in the distribution and extension services in government subsidies, is inefficient hence, limits land usage in rice farming.

First, land use differences have occurred due to unequal access to subsidized fertilizer. Subsidized fertilizer inputs are sometimes hard to acquire on the part of smallholder farmers, as there is systemic corruption and favouritism on the part of the large-scale producers. This would restrict them from accessing subsidized fertilizer which is a hindrance to boosting rice production even with the subsidy policy. The solution to this should include the government tightening the monitoring policies to ensure transparent and equal distribution, whereby the deserving smallholder farmers who depend on rice to earn a living are protected from unscrupulous large scale rice farmers. Second, delays in the supply of the subsidized fertilizer cause delays in planting, resulting in inefficient land use. Any delay in inputs might cause input-receiving farmers to reduce the area under rice cultivation or replace it with less intensive crops

4.0 Conclusion

This paper offers important insights into the impact of fertilizer subsidy policies on the land allocation among rice farmers in Kisumu and Busia Counties in Western Kenya. The results indicate that, as much as subsidies can be effective in promoting rice production, they have enormous challenges ascribed to their current applications, so they cannot be effective. The study indicates that the farmers with access to both unsubsidized and subsidized fertilizer assign more acres to rice production than farmers with access to a single fertilizer source, implying that secure access to fertilizer would allow increased allocation of land for rice production.

The above findings point to critical recommendations where the government should institute a digitized, farmer-balanced distribution system focusing on smallholder farmers to boost their accessibility to subsidized fertilizer. Second, further research should be conducted to determine why farmers used both subsidized and unsubsidized fertilizer.

Ethical approval

The study adhered to strict ethical guidelines throughout the research process. Prior to data collection, informed consent was obtained from all participants, ensuring their voluntary participation. Respondent confidentiality was protected through complete data anonymization, with all personal identifiers removed. Formal research approval was obtained Great University of Kisumu’s Scientific and Ethical Review Committee (GLUSERC) and the Kenya's National Commission for Science, Technology and Innovation (NACOSTI), confirming the study met national ethical standards for scientific research involving human subjects.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

References

Adiraputra, P., & Supyandi, D. (2021). The effectiveness of fertilizer subsidy: how the impact to the production. *SOCA: Jurnal Sosial Ekonomi Pertanian, 15*(2), 345-356.

Dorairaj, D., & Govender, N. T. (2023). Rice and paddy industry in Malaysia: governance and policies, research trends, technology adoption and resilience. *Frontiers in Sustainable Food Systems*, *7*. <https://doi.org/10.3389/fsufs.2023.1093605>

Jayne, T. S., Mason, N. M., Burke, W. J., & Ariga, J. (2018). Review: Taking stock of Africa’s second-generation agricultural input subsidy programs. *Food Policy*, *75*, 1–14. <https://doi.org/10.1016/j.foodpol.2018.01.003>

Kato, T., & Greeley, M. (2016). Agricultural input subsidies in Sub-Saharan Africa. *IDS Bulletin*, *47*(2). <https://doi.org/10.19088/1968-2016.130>

Lagasca, A. C., Baltazar, E. G., Mercado, J. J. S., Kwan, R. L., Valiente, E. M., & Duria, J. J. C. (2024). Empowering Rice Farmers in Nueva Ecija, Philippines: A Strategic Approach to Boosting Income through Special Purpose Rice Production. *Open Journal of Ecology*, *14*(03), 199–214. <https://doi.org/10.4236/oje.2024.143012>

Lemessa, S. D., Yismaw, M. A., & Watabaji, M. D. (2019). Risk induced farmers’ participation in agricultural innovations: evidence from a field experiment in eastern Ethiopia. *Development Studies Research*, *6*(1), 106–117. <https://doi.org/10.1080/21665095.2019.1629323>

Mallick, M., & Dash, A. (2024). A study of fluctuation and development trend in kharif rice cultivation in Odisha, India. *International Journal of Plant & Soil Science*, *36*(4), 362–368. <https://doi.org/10.9734/ijpss/2024/v36i44489>

Makate, C., Wang, R., Makate, M., Mango, N., & SpringerPlus. (2016). Crop diversification and livelihoods of smallholder farmers in Zimbabwe: adaptive management for environmental change. *Springerplus, 5*(1), 1135. doi:10.1186/s40064-016-2802-4

Nkuba, J., Ndunguru, A., Madulu, R., Lwezaura, D., Kajiru, G., Babu, A., Ley, G. (2016). Rice value chain analysis in Tanzania: identification of constraints, opportunities and upgrading strategies. *African Crop Science Journal, 24*(1), 73-87.

Puntsagdorj, B., Orosoo, D., Huo, X., & Xia, X. (2021). Farmer’s Perception, Agricultural Subsidies, and Adoption of Sustainable Agricultural Practices: A Case from Mongolia. *Sustainability*, *13*(3), 1524. <https://doi.org/10.3390/su13031524>

Republic\_of\_Kenya. (2020). Ministry of Agriculture, Livestock, Fisheries and Cooperatives State Department for Crop Development and Agricultural Research. National Rice Development Strategy-2 (2019–2030) Retrieved from <https://riceforafrica.net/wp-content/uploads/2021/09/NRDS2_Kenya_en.pdf>

Ricker-Gilbert, J., Mather, D. L., Maredia, M. K., Olwande, J., & Khaled, N. B. (2024). Evaluating Kenya’s National Fertilizer Subsidy Program: Implementation, Crowding-out, and Benefit-Cost Analysis.

Srivastava, P., Das, A., Gupta, K., Muthukumaran, M., Kurdekar, A. K., Sharma, U., & Zaman, M. I. (2023). Impact of nano and non-nano fertilizers on rice quality and productivity: a review. *International Journal of Environment and Climate Change*, *13*(8), 973–987. <https://doi.org/10.9734/ijecc/2023/v13i82035>

Takeshima, H., Yamauchi, F., & Enomoto, M. (2021). Agricultural, Economic, and Human Development: Joint Research Contributions of Japan and International Food Policy Research Institute. *Japan Agricultural Research Quarterly: JARQ, 55*(Special), 521-531.