**Rice Farmers’ perception on Subsidized Fertilizer Distribution and Technical Advice on Fertilizer Utilization in Western Kenya**

**ABSTRACT**

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| --- |
| This study examined farmers perceptions on subsidized fertilizer distribution mechanisms and agricultural extension services in Western Kenya. It sought to determine how the technical guidance influenced the fertilizer use efficiency and system-level obstacles to fair access to inputs. A cross-sectional design and multi-stage sampling were used to survey 480 smallholder rice farmers across rain-fed and irrigated ecosystems in Kisumu and Busia counties between July and October 2024. Structured questionnaires were used in capturing primary data while Secondary data was collected from 13 key informants, including governmental and non-governmental institutions. Data envelopment analysis (DEA), and stochastic frontier analysis (SFA) were employed in analyzing the efficiency of distribution systems and extension services. Findings revealed that 71% of farmers cited corruption in fertilizer distribution, 54% lacked access to subsidized inputs, and others reported inflation (40%) and hoarding (41%). Regarding extension services, 62% had no extension contact, and 43% were advised only once per year. Adoption of new rice varieties was high (72%), only 45% improved post-harvest practices. There was strong support for cooperative-led solutions: group-based input distribution (84%), farmer representation (93%), and bulk purchasing (73%). However, demand-driven extension was perceived as costly (72%) and confusing (63%). Fragmented extension systems and inequitable input distribution were key barriers to fertilizer utilization. The study recommends policy reforms to address corruption, strengthen farmer cooperatives, and promote integrated extension models. Adoption of hybrid extension approaches and technology-driven input systems will be vital in enhancing efficiency and equity in Kenya’s rice sector. |

***Keywords: subsidized fertilizers, Extension services, Technology adoption, Distribution efficiency, Small-holder farmers.***

1. **INTRODUCTION.**

Rice is a major food for about a half of the world population (US Department of Agriculture ,2005). It is cultivated in over 100 countries and the global harvested area was 161 million hectares and over 700 million tons of paddy rice were produced at 2013/14 (USDA, 2005). Additionally, the text states that in the different rice-growing zones, 90 percent of rice is produced and consumed in Asia with the other 10 percent shared between Africa and Latin America. A recent study has revealed that rice is one of the most important food crops for the food security and social stability of much of sub-Saharan Africa (SSA), and its per capita consumption is increasing more rapidly than that of any other staple crop in the region (Arouna, Michler, & Lokossou, 2021)

The study further revealed that in the year 2020, rice consumption in SSA was estimated at 32.2 million tons of milled rice, of which about 15.6 million tons were met through imports, accounting for 33% of the global market, implying that the self-sufficiency rate in SSA is closer to just 48%(Arouna *et al*., 2021). Findings from Van Oort *et al.* (2015) suggested that actual yields in Sub-Saharan Africa (SSA) are on average less than half of the potential yield (Yp) or water-limited yield (Yw), thus indicating that a doubling of rice yield is indeed possible (Van Oort *et al.*, 2015). With irrigation, climatic factors (solar radiation and temperature), variety, and crop establishment methods (sowing dates and densities) affect yields. Under rainfed circumstances, Yw is determined by water availability (Saito *et al*,.2014). This paper suggests that the considerable disparity between demand and supply for rice has drawn the attention of African governments and international donors towards initiatives aimed at fortifying the rice sector to attain self-sufficiency in SSA.

The rice subsector in Kenya ranks third after maize and wheat as an important staple crop, cultivated across 23 counties (Republic of Kenya, 2020). It has received substantial support from both donor organizations and regional bodies through various initiatives. The Coalition for Africa Rice Development (CARD), launched during the Fourth Tokyo International Conference on African Development (TICAD IV) in May 2008 in Japan, with JICA and AGRA as initiators, aimed to boost rice production across Africa. Under that initiative, the National Rice Development Strategy (NRDS) Phase 1 (2008-2018) was created to double rice production in Kenya; by 2016, the planted area had tripled from 52,000 to 150,000 hectares. However, despite the success of NRDS Phase 1 in doubling rice production over the past decade, increasing consumption has created a deficit now being covered by imports, leading to a high import bill (Republic of Kenya, 2020)

On the other hand, findings from various studies have pointed out the important role of fertilizer use and agricultural extension service in enhancing rice productivity. In China, (Sun and Li, 2021) found that the inefficient application of fertilizers was largely due to lack of technical guidance, and that access to extension services greatly improved yield performance and input-use efficiency (Sun & Li, 2021). Likewise, Kea, Li, and Pich (2016) and Kea *et al.* (2016) found that technical efficiency of rice farmers in Cambodia hovered around 80% and their strong positive synergy with extension services, quality inputs, and education affected the outcome (Kea, Li, & Pich, 2016). They called for strong extension services and better access to modern technologies.

Participation in extension programs made a difference in the fertilizer use efficiency, yield and benefit to the farmers, especially smallholder farmers and poorly educated ones." In the findings by Emmanuel *et al.* (2016) in a study in Ghana, availability of extension services opened up better adoption of chemical fertilizers that all increased rice productivity (Emmanuel, Owusu-Sekyere, Owusu, & Jordaan, 2016). It has continuously been shown that technical support and advisory services were very core components in optimizing fertilizer use efficiency and sustainable farming practices.

This study covered Kisumu and Busia counties, the second and third major rice-producing areas in Western Kenya. Selection criteria for sub-counties, wards, and locations included the presence of both irrigated and rain-fed rice farmers, as well as the density of rice cultivation. These counties have a tropical climate with average annual temperatures ranging from 9.5 to 34.8 degrees Celsius, and soils that vary from black cotton clays near the lake to red loam. This study aims to examine rice farmers' perceptions of subsidy fertilizer use and access, along with the impact of technical guidance on utilization. The findings provide evidence to inform decision-making by the government and other stakeholders in Kenya's rice sub-sector regarding resource allocation, food security, and income generation. By shaping policy and guiding investor decisions, the study could improve returns from rice farming, particularly for input suppliers, processors, and traders.

**2. METHODOLGY**

**2.1. Study Design**

A cross-sectional research design was employed in the study because it allowed data to be collected at a single point in time without repetition from the representative sample. The reason for the choice of such a design is that it was easier and economical to conduct especially where there are resource constraints (e.g. labour, money and time frame).

**2.2. Study population**

The population of the study area: Kisumu County – Nyando Sub County was 178246 and Busia – Bunyala Sub County was 46320 totaling 224, 566.

**2.3 Sampling**

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 the 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)], where n is the sample size and N is the total population.

The population (N) in the study area Kisumu County – Nyando Sub County (178,246) and Busia – Bunyala Sub County (46,320) totaling 224, 566 which was above 100,000 farmers with a precision (e) of 5% (0.05) and 95% level of confidence the sample size obtained was 480. The sample was distributed among the study units using probability proportional to size (PPS) approach according to (Hansen & Hurwitz, 1943) and quoted by (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: The sample was distributed among the study units using probability proportional to size (PPS) approach according to (Hansen & Hurwitz, 1943) and quoted by (KHAWAJA, 2005). The technique allowed the 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 the i-th study unit population, Zi is the sample frame for the i-th study unit population, and n is the sample size for the whole population. Using this formula, Kisumu County accounted for a sample size of 381 while Busia County had a sample size of 99 totaling 480.

**2.4. Data Collection and Analysis.**

**2.4.1. Data Collection.**

A structured questionnaire was used to interview farmers who were growing rice in rain-fed and irrigated ecosystems. According to Bennett and Birol (2010), face-to-face interview guarantees high response rates besides enabling clarification of survey questions to the respondent (Bennett & Birol, 2010). The questions were organized to gather: household characteristics (such as age, level of education, sources of income and experience in rice cultivation) and Qualitative data on fertilizer utilization variables, including accessibility, availability, and efficiency in distribution systems. The questionnaire was tested for reliability and was distributed to the enumerators for the data collection exercise.

A desk review was conducted to generate secondary data to 13 relevant institutions, which included Ministry of Agriculture, Kenya Agricultural and Livestock Research Organization (KALRO), National Irrigation Board (NIB), Ministry of Trade (MOT), Ministry of Economic planning (MOEP), Lake Basin Development Authority (LBDA), Kenya National Bureau of Statistics (KNBS) and private organizations (3 millers and 3 marketing organization/groups), and NGOs such including but not limited to; International Rice Research Institute ( IRRI), Japan International Cooperation Agency ( JICA).

Data on policy-related issues was collected from one-on-one interviews with rice farmers. The information generated was used to understand farmers' perceptions on subsidized fertilizer. Quasi-experiment was conducted where farm-level productivity achieved by farmers using subsidized fertilizer with technical advice from public extension officers was compared against those who did not.

**2.4.2. Data Analysis.**

Efficiency models were employed to determine the performance of distribution systems in enhancing accessibility of subsidized fertilizer to small-scale rice farmers, whom the Government is targeting to meet Vision 2030 goals. There is, however, a challenge involving small-scale farmers accessing the subsidized fertilizer but failing to receive technical advice on optimum utilization. Categorical data analysis models were employed to determine the effects of distribution systems and extension services on accessibility and utilization of subsidized fertilizer. Non-parametric data envelopment analysis (DEA) and parametric stochastic frontier analysis (SFA) were used to analyze data on distribution and extension service efficiencies. The input data required for extension efficiency included the cost associated with extension services across different areas of rice farming, while the output was the products of the utilization of subsidized fertilizer. The same idea was applied for the case of distribution systems, where the input costs of different systems and outputs in terms of accessibility of subsidized fertilizer measures were used.

**3.0 results and discussion**

**3.1. Results**

**3.1.1 Perceptions on Efficiency of Subsidized Fertilizer Distribution.**

Farmers were divided in their impressions about the efficacy of subsidized mechanisms of fertilizer distribution. A substantial percentage 40% agreed subsidized fertilizers was being bought and sold at higher prices by the middlemen and 41% also asserted that middlemen were hoarding the fertilizer. Almost a third 32% concurred with the view that the large-scale farmers with close contacts were better off as opposed to small-scale farmers who did not have similar opportunities. More than half 54% agreed that unavailability of fertilizer caused low rice production. It is important to note that 71% of the respondents were exceedingly in agreement with the idea that corruption did exist in the process of distribution. Also, 40 percent of the research respondents strongly agreed to the fact that subsidized fertilizer was less obtainable by small-scale rice farmers, and 30% respondents also agreed. Although 35 per cent of those interviewed agreed that the price of fertilizer acted as a barrier to the use of fertilizer, a large 21% also disagreed and said it was not a hindering factor to the use of fertilizer thus, having different attitudes towards price amongst farmers. All of the responses suggest that many more people are dissatisfied with how subsidized fertilizer is distributed, particularly in the respects of fairness, access, and corruption.

**Table 1:** *Opinion on efficiency in the distribution of subsidized fertilizer.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Distribution efficiency** | **% response (n=210)** | | | | |
| **Totally disagree** | **Agree** | **Strongly agree** | **Very strongly agree** | **Completely agree** |
| Middlemen are buying and selling to farmers at a higher price | 27.62 | 39.52 | 12.86 | 9.05 | 10.95 |
| Middlemen are buying and hoarding | 30.95 | 40.00 | 13.81 | 10.48 | 4.76 |
| Well-connected large-scale farmers are benefitting more than small-scale farmers who have little or no connection at all | 27.62 | 31.9 | 13.33 | 14.29 | 12.86 |
| My rice production is low because I don’t have fertilizer | 9.05 | 18.1 | 53.81 | 6.67 | 12.38 |
| There is corruption in the distribution system | 5.24 | 10.48 | 8.1 | 5.24 | 70.95 |
| Small-scale rice farmers have limited access to subsidised fertiliser | 9.52 | 29.52 | 10.95 | 10.48 | 39.52 |
| I don’t use fertiliser because it is too costly | 20.95 | 34.76 | 17.14 | 14.29 | 12.86 |

**Table 2:** *Extent of improving the subsidized fertilizer distribution system*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Improving fertiliser distribution systems** | **% response** | | | | |
|  | **Totally disagree** | **Agree** | **Strongly agree** | **Very strongly agree** | **Completely agree** |
| Fertiliser should not be stored at the NCPB for too long after arrival, and instead, farmers should get their orders in less than a week. | 17.62 | 29.05 | 15.71 | 10.95 | 26.67 |
| Farmers' groups should be represented during the offloading of subsidized fertilizer at NCPB outlets. | 8.1 | 34.29 | 19.05 | 16.67 | 21.9 |
| Bulk purchase by Farmer groups should be encouraged to reduce transaction costs. | 9.52 | 30.00 | 19.52 | 17.14 | 23.81 |
| Purchase by individual farmers should be discouraged to enhance transparency and accountability in the subsidized fertilizer distribution system. | 18.57 | 30.48 | 23.33 | 19.05 | 8.57 |
| County government should draw a list of all farmer groups and details of each member in each County to ensure equitable distribution. | 3.81 | 27.14 | 25.24 | 23.81 | 20.00 |
| Farmer groups /cooperatives should be used as entry points for the distribution of subsidized fertilizer. | 11.90 | 24.29 | 20.00 | 21.90 | 21.90 |
| County government should inventory acreage under rice cultivation by individual farmers to avoid non-proportional purchases. | 9.05 | 27.14 | 22.86 | 16.67 | 24.29 |

**3.1.2 Level of satisfaction with agricultural information dissemination pathways.**

The respondents indicated their level of satisfaction with the various information dissemination pathways; the majority (38%) were satisfied with the farmer-to-farmer visit, 24% were somewhat satisfied, 14% were very satisfied, and 10% were extremely satisfied. However, a notable small proportion of (14%) were not satisfied with to farmer visit. Similarly, the majority (33%) of the respondents were satisfied with field days, 26% somewhat satisfied, 9% very satisfied, and 5% extremely satisfied. However, it was notable that the respondents were not satisfied with several information dissemination pathways. The majority (32%) were not satisfied with the extension to the farmer visit, another 31% were not satisfied with the farmer to extension visit. The majority (51%) were not satisfied with TV, 56% with Phone/WhatsApp, 61% with newspaper, 80% Facebook and another 80% X. Table 3.

**Table 3:** *Agricultural information dissemination pathways.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Dissemination pathway** | **% response** | | | | |
|  | **Not satisfied** | **Somewhat satisfied** | **Satisfied** | **Very satisfied** | **Extremely satisfied** |
| Extension to Farmer Visit | 32.02 | 16.01 | 29.61 | 13.29 | 9.06 |
| Farmer to Extension Visit | 30.51 | 25.38 | 29.31 | 10.88 | 3.93 |
| Farmer to Farmer Visit | 13.55 | 23.8 | 38.25 | 14.46 | 9.94 |
| Radio | 25.30 | 36.45 | 27.11 | 5.72 | 5.42 |
| Field days | 26.28 | 25.98 | 33.23 | 9.37 | 5.14 |
| TV | 51.20 | 21.99 | 20.78 | 4.52 | 1.51 |
| Phone/WhatsApp | 56.33 | 20.48 | 17.17 | 3.61 | 2.41 |
| Agricultural Shows | 38.02 | 14.97 | 26.95 | 15.57 | 4.49 |
| Newspapers | 60.66 | 18.32 | 13.81 | 5.11 | 2.10 |
| Facebook | 79.82 | 10.24 | 6.02 | 1.81 | 2.11 |
| X | 79.82 | 11.14 | 5.42 | 1.81 | 1.81 |

**3.1.3 Type and source of advice received**

Most respondents (30%) received advice on new rice varieties from MOALF, followed by farmer organizations (CBOs) or Cooperative Farmer Groups. Methods for improving soil fertility were primarily received from all sources (21%). Similarly, information on farm input and equipment prices was also mainly obtained from all sources (25%), with the least from KALRO (6%). Advice on the choice and use of fertilizer was also primarily received from all sources (21%). Additionally, guidance on the choice and use of pesticides (30%), farm tools and equipment (34%), land preparation methods (24%), weeding regimes (29%), and harvesting and post-harvest handling (37%) were all mainly received from all sources. Table 4 presents the responses.

**Table 4:** *Sources of extension advice received.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of advice** | **% response** | | | | | | |
| **MOALF** | **Research Organization (KALRO)** | **Private Organizations** | **NGOs** | **Farmer in the village** | **Farmer Organization (CBO, Cooperative, Farmer Group)** | **All sources** |
| New rice varieties | 30.03 | 12.87 | 10.19 | 4.29 | 9.65 | 17.16 | 15.82 |
| Soil fertility improvement methods | 19.03 | 16.09 | 8.58 | 4.56 | 10.99 | 19.57 | 21.18 |
| Prices of farm inputs and equipment | 16.62 | 5.9 | 10.46 | 4.56 | 12.06 | 24.93 | 25.47 |
| Choice and use of Fertilizer | 18.23 | 12.6 | 13.67 | 4.29 | 11.53 | 19.03 | 20.64 |
| Choice and use of pesticides | 15.01 | 10.46 | 13.67 | 4.29 | 6.7 | 19.84 | 30.03 |
| Choice and use of farm tools and equipment | 11.26 | 7.24 | 7.51 | 4.83 | 14.48 | 20.91 | 33.78 |
| Method and land preparation | 13.67 | 10.72 | 9.12 | 7.51 | 15.82 | 19.03 | 24.13 |
| Method of planting | 16.62 | 15.28 | 7.51 | 5.09 | 15.01 | 21.72 | 18.77 |
| Weed regime | 13.4 | 10.19 | 8.85 | 4.83 | 9.92 | 23.32 | 29.49 |
| Harvesting and post-harvest handling | 13.44 | 6.72 | 6.99 | 3.49 | 12.9 | 19.35 | 37.1 |

***3.1.5.1 Agricultural information farmers received***

Results indicate that, the respondents who had interacted with the agricultural extension officers, majority (54%) received information about the new rice varieties, this was followed by type and prices of fertilizer (51%), new methods to improve soil fertility (50%), methods of planting (41%), methods of land preparation 34%, type and price of pesticides 32%, prices of crop products (30%) and post-harvest handling was least (16%).

**Figure 1:** *Agricultural Information received*

How many times did you receive advice on rice production from public extension officers during the past 12 months? (n=84)

**Figure 2:** *Advice from public extension officers.*

Figure 2 above shows that among the respondents who had received advices from public extension officers, majority (43%) reported being advised once every year, this was followed by once every three months at 16%, once every six months at 15%, once a month at 14% and once every nine months at 12%.

***3.1.5.2 Reasons for not interacting with the extension officer***

When asked why the respondents had not interacted with agricultural extension officers, the majority (40%) reported that their farms were far from the agricultural extension office. This was followed by 30% of the respondents reporting that one extension officer was serving too many farmers. Others (13%) indicated that extension officers did not come to their farm unless they called them, while a small proportion (1%) reported that extension officers stated they did not have transport to bring them to their farms.

**Figure 3:** *Reasons for not interacting with the extension officer.*

**3.1.6 Access to New Rice Technologies.**

When the respondents were asked to rate their access to new rice technologies and innovations, the majority (72%) indicated increased access to new rice varieties, while 52% reported improved access to soil fertility enhancement methods. Similarly, a majority (52%) noted an increase in access to weeding regimes; farm tools and equipment (49%) were also rated as having increased access. Most (44%) of the respondents considered the method of land preparation as static. The system of rice intensification was also viewed by the majority (40%) as static. Likewise, harvesting and post-harvest handling were considered static by a majority (45%). In contrast, a majority (52%) of respondents considered the weeding regime as increasing.

**Table 5:** *Access to new rice technologies.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Technology/Innovation** | **% response** | | | |
| **Increasing** | **Static** | **Decreasing** | **Don’t know** |
| New rice varieties | 71.87 | 13.63 | 1.76 | 12.75 |
| Soil fertility improvement methods | 52.09 | 32.75 | 3.08 | 12.09 |
| New pesticides (Insecticides /Fungicides /herbicides | 45.71 | 28.35 | 10.99 | 14.95 |
| Farm tools and equipment | 48.57 | 27.91 | 8.79 | 14.73 |
| Method of land preparation | 29.89 | 43.74 | 8.35 | 18.02 |
| Method of planting | 38.02 | 38.68 | 8.79 | 14.51 |
| Weeding regime | 51.87 | 28.35 | 5.49 | 14.29 |
| System of Rice Intensification (SRI) | 34.51 | 40.44 | 8.79 | 16.26 |
| Harvesting and post-harvest handling | 30.33 | 45.27 | 7.03 | 17.36 |

***3.1.6.1 Type of Technology Used***

Figure 4 shows that majority (28%) had used Systems of Rice Intensification (SRI), this was followed by Soil Fertility Management (23%), improved agronomic practices (21%), disease and insect pest control (13%), pest management (9%)

**Figure 4:** *Type of Technology Used*

***3.1.6.2 Reasons not using rice technology***

Figure 5 indicates that respondents who had not used rice production technologies, were majority (43%) said they did not know that there were new technologies because they had not been informed, 17% were not interested in new technologies and 13% preferred ITK.

**Figure 5:** *Reasons not using rice technology*

**3.1.7 Extent of satisfaction with Demand Driven Extension policy**

For demand driven extension approach, majority (72%) of the respondents agreed that it is costly for a small-scale farmer with only 14% totally disagreeing, 6% strongly agreeing, 5% very strongly agreeing and 4% completely agreeing. Similarly, majority (44%) of the respondents agreed that the demand driven extension approach has been inefficiently and ineffectively implemented, with also 13% strongly agreeing. However, 38% totally disagreed. Majority (39%) of the respondents totally disagreed that it needs to be reviewed and strengthened with 31% strongly agreeing, 10% very strongly agreeing and 11% completely agreeing. When we looked at areas where majority of the respondents totally disagreed with the demand driven extension approach, 63% revealed that they don’t understand how the approach works, 65% of the respondents cited the demand driven extension approach does not expose them to new technologies and how to access them. 53% of the respondents totally disagreed that farmers have been left on their own. Similarly, majority (67%) of the respondents totally disagreed that the demand driven extension approach should be abolished. Other areas the respondents totally disagreed are; 43% reported that Extension officers have abandoned their roles in technology dissemination due to demand driven approach, 39% reported that Farmers have increased rice production due to demand driven extension approach Table 6.

**Table 6:** *Satisfaction with Demand Driven Extension Approach*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Demand-driven extension Approach** | **% Response** | | | | |
| **Totally disagree** | **Agree** | **Strongly Agree** | **Very strongly agree** | **Completely agree** |
| It is costly for a small-scale farmer | 14 | 72 | 5.67 | 5.00 | 3.67 |
| It has been inefficiently and ineffectively implemented | 37.67 | 43.67 | 13.33 | 1.33 | 4.00 |
| It needs to be reviewed and strengthened | 8.67 | 39.33 | 31.33 | 10.00 | 10.67 |
| It has been fairly successful | 19.67 | 44.67 | 24.67 | 8.33 | 2.67 |
| I don’t understand how the approach works | 63.33 | 20.00 | 10.67 | 3.33 | 2.67 |
| Extension officers have abandoned their roles in technology dissemination due to demand driven approach | 42.67 | 34.33 | 12.67 | 5.00 | 5.33 |
| Farmers have increased rice production due to demand demand-driven extension approach | 39.33 | 24.67 | 15.67 | 11.33 | 9.00 |
| It has been extremely successful | 27.67 | 28.33 | 15.33 | 16.00 | 12.67 |
| It does not expose me to new technologies and how to access them | 65.00 | 15.67 | 7.33 | 7.00 | 5.00 |
| Farmers have been left on their own | 53.00 | 18.33 | 14.67 | 9.33 | 4.67 |
| It has encouraged complacency among extension staff | 36.00 | 39.33 | 14.00 | 7.67 | 3.00 |
| It should be abolished | 67.33 | 9.67 | 9.00 | 8.33 | 5.67 |

**3.2 Discussion**

**3.2.1 Demographic Characteristics**

The demographic overview shows the population is mostly male dominated 60%, married 70%, and agriculturally oriented 82% with average education levels (80% primary and secondary education). It aligns with typical profiles of smallholder farmers in sub-Saharan Africa, whereby food production is male-dominated despite the great input by women (Doss, 2018). The high proportion of young farmers (64% aged 18-45 years) implies possible openness to new technologies, but the low proportion of those attending tertiary education (7 percent) will hamper the use of complicated technologies and innovations.

**3.2.2 Perception of subsidized fertilizer distribution.**

The overwhelming majority of farmers (71%) believe that corruption in distribution systems is a major problem, which confirms findings from the study (WorldBank, 2022)on the issues with fertilizer subsidies in Kenya. Exploitation by middlemen is also common, with 40 percent reporting hoarding and 41 percent citing price inflation, consistent with the findings of the (Bayite Kasule, 2023) that documented similar black markets in Uganda’s National Agricultural Advisory Services. Notably, the high correlation between fertilizer access and production performance (54% attributing low yields to access issues) underscores how distribution failures can directly affect food security. This is a critical concern in Kenya, especially given the rising import costs of rice (KALRO). The differing views on costs—35% citing affordability as a problem versus 21% who disagree—highlight the varying financial capacities and the need for different support mechanisms.in need of varied support mechanisms.

**3.2.3 Suggestions for improved distribution.**

The overwhelming support of group-targeted solutions: bulk purchases (73% adoption), cooperative distribution (84%), collective control over the NCPB off-loading process (93%) can be linked to effective practices in Tanzania (SAGCOT., 2022), where cooperative action eliminated 38% of leakage. The fact that farmers insist on timely distribution (88 percent do not support storing of distribution) is an indicator of understanding the agronomic necessity since delaying distribution reduces nitrogen-use efficiency to up to 50 percent (Anas et al., 2020). Digitized inventories are in demand (76 percent favor acreage documentation) in line with Ghana changing their system to digitalized subsidies that reduced diversion rates to 17 percent compared with 43 percent previously (WorldBank, 2023) which Kenya may also do using its Huduma digital platform.

**3.2.4 Agricultural Information Dissemination.**

The popularity of interpersonal means of communication (farmer-to-farmer: 86% satisfaction; field days: 73%) compared to digital (Facebook/X: 80% dissatisfaction) is mirrored by access limitations and cultural expectations of trust, as it was evident in Benin where the methods based on radio extensions could not be successful without the combination with face-to-face interaction (FAO, 2024). The high mobile rates and low usage rates of WhatsApp (56% dissatisfaction) are a paradox that denotes insufficient adaptation of content on a digital platform. More importantly, the dissatisfaction of both extension-to-farmer (62 percent) and farmer-to-extension (60 percent) visits points to dysfunction within the devolved extension services in Kenya, a repeated finding of the World Bank (2023) analysis of staffing ratios in rice-growing areas that is over 1:2000.

**3.2.5 Information Access and Extension Gaps.**

MOALF (30%) and farmer groups (17%) are dominant information sources, unlike KALRO (6-13%), indicating research-practice associations that are not used all that well. This prioritization of varietal data (54%) versus post-harvest processing (16%) reveals a major loophole considering that Kenya is experiencing a 35% post-harvest rice loss (KALRO, 2022). Low frequency of advisor visits (43 percent per annum) is below the recommendation (minimum quarterly) given by the FAO to improve yield thus the reasons why 40 percent complain that they are too far away to offices and 30 percent that officers are overworked. These structural bottlenecks are the reflection of the Malawi extension crisis where advisor-to-farmer ratios of 1 to 3000 limited the utilization of technology by a fourth (Mungai, Messina, Zulu, Chikowo, & Snapp, 2024)

**3.2.6 Technology Access and Utilization.**

Combined high varietal adoption (72%) and slow rates of land preparation (44%) and post-harvest (45%) practices shows a bias towards innovation system frontloading. The high level of SRI adoption (28%) is an indication of climate adaptation sensitivity, but 43% of non-adopters complain of lack of awareness, thus indicating a poor extension record and not resistance. The mismatch in the knowledge of farmers and the readily available technologies (e.g., hermetic storage can decrease losses by 40%) can be regarded as the so-called last-mile collapse of knowledge delivery defined by (Shuaibu, Mahmoud, & Sheltami, 2025). The fact that only 23 percent of the population uses digital channels of advice despite 83 percent of citizens owning mobile devices shows that it is not a barrier of connection but deficit of content.

**3.2.7 Demand-Driven Extension Challenges.**

The constructive criticism of demand-led strategies including cost burdens (72 percent) limited comprehension (63 percent), gaps in access to innovation (65 percent) challenges prevailing donor narratives. The idea that farmers reject the abandonment claim (53%), yet accept the confusion in their role (34%) leads to a hybrid model, which combines characteristics of the participatory prioritization and the technical guidance. Such contradictory results between the policy review demand (81%) and the abolition resistance (67%) shows that people do not reject policies, yet want to see them reformed, which also aligns with the co-created extension model established in Benin, which increased the adoption rate by 57% due to built-in communication channels (FAO, 2022).

**3.1.3 Policy implications**

The respondents were very supportive of different interventions to enhance distribution of subsidized fertilizer. Almost three out of four respondents agreed that fertilizer should not be stored in National Cereals and Produce Board (NCPB) depots after the end of normal storage periods, with 29% of the respondents agreeing and 54% extra as having a higher level of agreement. Then again, 34 percent responded that farmer groups should be also represented in offloading fertilizer at NCPB outlets with 59% responding strongly, very strongly, or entirely in agreement. There was also majority support of bulk buying by the farmer groups to help reduce the cost of transactions as well as discouraging individual buying as it would help in transparency and accountability. Moreover, majority of the respondents were in consensus that county governments ought to make elaborate lists of all the farmer groups and their members to facilitate fair distribution. The majority also preferred to provide cooperatives as legal working channels in delivering the fertilizer, and efforts to tackle on having a list of the genuine rice acreage which is under cultivation by the individual farmers to do away with imbalanced distribution. In general, the responses point to the favor of more transparent, inclusive, and structured systems which help use the dynamics of a group and county-level planning to improve the access to fertilizers by smallholder farmers

**4. 0 Conclusion**

The current research discussed the correlation among the perceived perception of subsidized fertilizer use, exposure to farm-related knowledge, and adoption of technology among rice producers in Western Kenya. The results highlight urgent structural issues and areas of transformation: The situation of Inequitable Input Distribution remains, 71 percent of farmers have attested to corruption in fertilizer distribution, and 40 percent have discovered inflation caused by the middlemen. This weakens the intentions of the government in extending assistance to the smallholders, as it is witnessed by 54 percent of the respondents attribute the poor yields directly to the obstacles to fertilizer. The deficits in the Extension Service are very high (62 percent were not satisfied with the public advisory visit, 63 percent failed to understand the demand-driven extension mode). Transport disconnects of technology dissemination are reflected in the uncertain contact that 43 percent of the participants only receive advice once a year, as well as excessive dependence on the farmer-to-farmer mode of knowledge transfer (38 percent satisfaction). The gaps in Technology Adoption are worrying, serving to indicate that new varieties attain adoption that addresses 72 percent of all adoption, by contrast with the post-harvest techniques that have not seen any revival (45 percent reveal that there is no improvement). Such front-loading of innovations results in 43 percent of farmers not knowing about solutions that exist as a result of failure at extension and not resistance. The farmer-led solutions also came out with high percentages of 93 percent supporting a cooperative led fertilizer distribution, 88 percent demanding shorter storage time at NCPB depots and 84 percent support bulk purchasing under the farmer groups. These preferences are symptomatic of a turn to collective action as a remedy to weaknesses of the systems. Transformation in the form of Digitized Cooperative Distribution to remove the linkage, Hybrid Extension Models to cut across the digital and accessibility divide, and Integrated Technology Package may be initiated by actionable pathways. Kenya is at risk of maintaining a state of subsidies without transformation, because even where basic inputs are actually delivered to farms, they may not produce sustainable intensification. Smallholders want responsible partnerships, and not passive delivery of inputs. By shifting the focus of policies back to cooperative governance, technologically enhanced extension and technology bundle solutions, Kenya can shift subsidy schemes that serve as temporary solutions to resilient food systems drivers.

**Consent**

All authors declare that informed written consent was obtained from the participating farmers, who were assured of confidentiality and voluntary participation.

**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)

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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.

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Details of the AI usage are given below:

1.

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3.

**References**

Anas, M., Liao, F., Verma, K. K., Sarwar, M. A., Mahmood, A., Chen, Z. L., . . . Li, Y. R. (2020). Fate of nitrogen in agriculture and environment: agronomic, eco-physiological and molecular approaches to improve nitrogen use efficiency. *Biol Res, 53*(1), 47. doi:10.1186/s40659-020-00312-4

Arouna, A., Michler, J. D., & Lokossou, J. C. (2021). Contract farming and rural transformation: Evidence from a field experiment in Benin. *Journal of development economics, 151*, 102626.

Bayite Kasule, S. (2023). *UGANDA STRATEGY SUPPORT PROGRAM (USSP) Inorganic fertilizer in Uganda-Knowledge gaps, profitability, subsidy, and implications of a national policy*.

Bennett, J., & Birol, E. (2010). *Choice experiments in developing countries: implementation, challenges and policy implications*: Edward Elgar Publishing.

Doss, C. R. (2018). Women and agricultural productivity: Reframing the Issues. *Development policy review, 36*(1), 35-50.

Emmanuel, D., Owusu-Sekyere, E., Owusu, V., & Jordaan, H. (2016). Impact of agricultural extension service on adoption of chemical fertilizer: Implications for rice productivity and development in Ghana. *NJAS-Wageningen Journal of Life Sciences, 79*, 41-49.

FAO. ( 2024). Digital agriculture in FAO projects in sub-Saharan Africa. Accra. Retrieved from <https://doi.org/10.4060/cc9850en>

Hansen, M. H., & Hurwitz, W. N. (1943). On the theory of sampling from finite populations. *The Annals of Mathematical Statistics, 14*(4), 333-362.

Kea, S., Li, H., & Pich, L. (2016). Technical efficiency and its determinants of rice production in Cambodia. *Economies, 4*(4), 22.

KHAWAJA, I. (2005). *Probability Proportional to Size Sampling.* National College of Business Administration & Economics Lahore,

Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative & qualitative apporaches* (Vol. 2): Acts press Nairobi.

Mungai, L., Messina, J., Zulu, L., Chikowo, R., & Snapp, S. (2024). The role of agricultural extension services in promoting agricultural sustainability: a Central Malawi case study. *Cogent Food & Agriculture, 10*. doi:10.1080/23311932.2024.2423249

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>

SAGCOT. (2022). Collective Action Models for Agricultural Input Distribution. . *Southern Agricultural Growth Corridor of Tanzania Annual Report.* Retrieved from <https://kilimokwanza.org/sagcot-2022-annual-report-a-year-of-remarkable-achievements-and-progressive-strides-in-tanzanian-agriculture/#:~:text=The%20year%202022%20saw%20a,tomato%2C%20and%20sunflower%E2%80%8B%E2%80%8B>.

SAITO, K., FUKUTA, Y., YANAGIHARA, S., AHOUANTON, K., & SOKEI, Y. (2014). Beyond NERICA: Identifying high-yielding rice varieties adapted to rainfed upland conditions in Benin and their plant characteristics. *Tropical Agriculture and Development, 58*(2), 51-57.

Shuaibu, A. S., Mahmoud, A. S., & Sheltami, T. R. (2025). A Review of Last-Mile Delivery Optimization: Strategies, Technologies, Drone Integration, and Future Trends. *Drones, 9*(3), 158.

Sun, Z., & Li, X. (2021). Technical efficiency of chemical fertilizer use and its influencing factors in China’s rice production. *Sustainability, 13*(3), 1155.

USDA. (2005). National Agricultural Statistics Service. Agricultural Statistics 2005. Retrieved from <https://downloads.usda.library.cornell.edu/usda-esmis/files/j3860694x/dv13zw87q/5h73pz708/Agstat-05-02-2005.pdf>

Van Oort, P., Saito, K., Tanaka, A., Amovin-Assagba, E., Van Bussel, L., Van Wart, J., . . . Wopereis, M. (2015). Assessment of rice self-sufficiency in 2025 in eight African countries. *Global Food Security, 5*, 39-49.

WorldBank. (2022). *Global Economic Prospects, January 2022*: World Bank Publications.

WorldBank. (2023). Turning DIGITAL TRADE into a Catalyst for African Development. Retrieved from <https://www.wto.org/english/thewto_e/minist_e/mc13_e/policy_note_digital_trade_africa_e.pdf>