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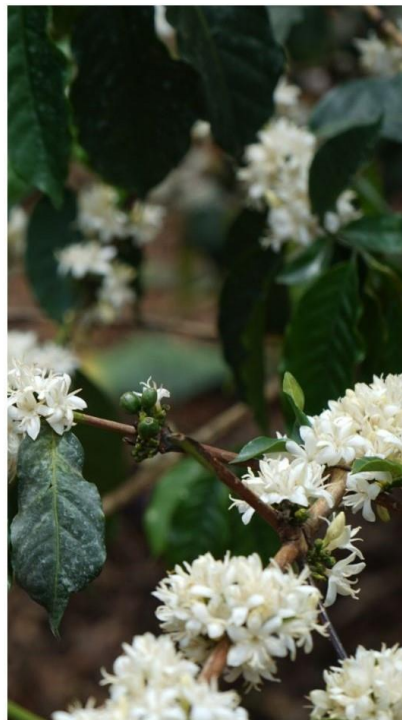
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Assessment of the E-voucher System on the Livelihood of Smallholder Farmers in Kathakwa

Elias Johnen, Spyridoula Loukopoulou, Cristina Marin, Hyojung Yun



Abstract

In a global context of rising fertilizer prices and climate instability, Agricultural Input Subsidies (AIS) serve as a crucial strategy to support smallholder farmers and ensure food security. This study aims to investigate how the subsidized fertilizer (e-voucher system) affects the livelihoods of smallholder farmers in Kathakwa, Embu County, Kenya. It also seeks to understand how it works in practice, map stakeholders involved and assess the perceptions of smallholder farmers. While previous research suggests the effectiveness of AIS in enhancing productivity and income, common challenges include the lack of private sector involvement. The present study had 27 participating farmers and the research design used a mixed approach, where both quantitative and qualitative data were collected by using a questionnaire, semi-structured interviews, a focus group discussion, participant observation and a GPS mapping. The study indicates that the current e-voucher system operates differently from what prior research implies. Specifically: subsidized inputs are limited to fertilizers; private suppliers like agro-dealers are not involved, the National Cereals and Produce Board serves as the exclusive seller; and the Kibugu Coffee Cooperative Society is an alternative collective selling point, offering subsidized fertilizers on credit to local farmers. While some farmers using the system report some improvements in livelihood, no definitive correlation is established. The study highlights cash availability and accessibility as primary challenges encountered by farmers willing to use the system. Consequently, it offers an overview of recommendations from system stakeholders aimed at improving smallholder farmers' livelihood in Kathakwa.

Keywords: Kenya, Embu, fertilizer, subsidized, livelihood, smallholder, perceptions

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Lastly, the creation of this report was made possible through the participation of the villagers and farmers of Kathakwa location, who were always very welcoming and willing to answer our questionnaire and interview questions, as well as participate in the focus group discussion. Moreover, we are grateful for the time of officials such as the Chief, Agriculture Extension Officer, Cooperative Coffee Society manager and NCPB manager, who were very willing to answer our questions and always welcoming.



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Acronyms

AEO Agriculture Extension Officer
AGRA Alliance for a Green Revolution in Africa
AIS Agriculture Input Subsidies
CAN Calcium ammonium nitrate
CCS Coffee Cooperative Society
DANIDA Danish International Development Agency
DAP Diammonium phosphate
EU European Union
FAO Food and Agriculture Organization
FGD Focus Group Discussion
GIZ German Corporation for International Cooperation
IBRD International Bank for Reconstruction and Development
IDA International Development Association
IFAD International Fund for Agricultural Development
IMF International Monetary Fund
ISP Input Subsidy Programs
KES Kenyan Shilling
MoA Ministry of Agriculture
NAVCDP National Agricultural Value Chain Development Project
NCPB National Cereals and Produce Board
NPK Nitrogen Phosphorus and Potassium
OECD Organization for Economic Cooperation and Development
PRA Participatory Rural Appraisal
SSA Sub-Saharan Africa
UN United Nations
WB World Bank

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Introduction

Background

Agriculture is the cornerstone of Kenya's economy, underpinning the livelihoods of its residents and serving as a key national development pillar, as it employs 40% of the total population and accounts for over a third of Kenya's GDP (USAID, 2023). Given its critical role, the government is actively implementing measures to bolster agriculture, aiming to enhance food security by supporting smallholder farmers (County Government of Embu, n.d.). This strategy is supported by substantial aid from global actors such as the World Bank (WB), African Development Bank (ADB), the European Union (EU), member state agencies like the Danish International Development Agency (DANIDA) and the German Corporation for International Cooperation (GIZ), and United Nation (UN) bodies, such as the Food and Agriculture Organization (FAO) and the International Fund for Agricultural Development (IFAD), with the overall aim to enhance productivity and sustainability (Borter & Malik, 2023).

Building on this strategy, the WB allocated \$750 million in the International Development Association (IDA) credit and additional \$250 million loan through the International Bank for Reconstruction and Development (IBRD) to assist in Kenya's rising government financial struggles prompted by the COVID-19 crisis (World Bank, 2020). Consequently, the National Agricultural Value Chain Development Project (NAVCDP) was designed to improve market access and value addition for 500,000 small-scale farmers, positioning them as key contributors to agricultural development across 26 counties in Kenya (World Bank, 2022). It concentrates on enhancing nine critical value chains, providing specialized support for fundamental agricultural sectors such as coffee, and tea (Ibid). Moreover, UN international organizations FAO and IFAD, as well as the Organisation for Economic Co-operation and Development (OECD) promote recommendations and policies on digital agricultural solutions for succeeding self-sustainable farming (OECD, 2023). One of the policy recommendations is the implementation of an e-voucher system, depicting the influence of these big actors in the decision-making of Kenya.

Increase of Input Costs and the Launch of E-voucher System

In 2020, COVID-19 supply chain problems, high input costs, reduced production in Europe, and export restrictions from China caused a worldwide increase in fertilizer prices (ReliefWeb, 2022). In Kenya, this situation saw fertilizer prices soaring by 50–60% during 2020-2021 (ibid), exacerbating the trend of rising agricultural input costs in the past decade.

To mitigate rising agricultural input costs, the Government of Kenya introduced the idea of an e-voucher system in 2015, becoming fully operational by 2020. This system, part of the National Value Chain Support (NVCS) and Post-Covid-19 Economic Stimulus Programmes, subsidized 40% of the costs for fertilizers, seeds, pesticides and other agro-chemicals with farmers covering the remaining 60%. The program works through a mobile app for transaction verification and aims to reduce farmers' financial burdens and elevate their socio-economic status (Ngotho, 2021).

First Phase of E-voucher System Implementation in Kenya

In 2020, the first pilot project was initiated, involving agro-dealers from 12 counties as the selling points for subsidized inputs for around 200,000 farmers (eVuna, 2020). To participate, agro-dealers had to

register with the Ministry of Agriculture (MoA) and utilize the eVuna app, developed by the Kenyan government's chosen digital solutions firm. They needed to meet specific qualifications, including business registration and compliance with various regulatory bodies. Meanwhile, farmers received the e-voucher code via SMS specifying the number of 50kg bags they could purchase at a subsidized price, which depended on the farm size. Farmers needed to ensure they had enough money in their M-PESA accounts, Kenya's mobile money transfer service. The pilot phase in Embu county was only targeted at coffee and tea farmers in Embu county. Agro-dealers verified vouchers using the app, and farmers paid 60% of the input's market price, with the government covering the remaining 40%. Transaction details were reported to the MoA to monitor voucher distribution and payments to agro-dealers (ibid).

Literature Review

Agricultural Input Subsidies (AIS) are globally recognized strategies aimed at addressing the challenge of rising agricultural input prices, especially for small-scale farmers (Dhillon & Moncur, 2023). Fertilizers and high-yielding seeds are in high demand. While Asia and Latin America have experienced significant agricultural growth, Africa has seen limited progress (OECD, 2011). Consequently, AIS programs play a crucial role in Sub-Saharan African (SSA) countries, with extensive research exploring their effectiveness in the region.

Agricultural Input Subsidies (AIS) as an effective system

Nguyen et al. (2023) found that AIS significantly boosted yield, income, living standards, and food security using a meta-analysis method including 12 studies examining subsidy programs from 11 countries in SSA and one in China. In the same line of argument, the 2014 Mozambique E-voucher Programme *MDG.1c* implemented by FAO showed that increased input access enhanced productivity, expanded cultivation areas, and uplifted incomes, leading to a virtuous cycle of investment in equipment and infrastructure (FAO, 2020). Moreover, Malimi (2023) investigated the impact of AIS on labor productivity in maize-planted plots in Tanzania resulting in an increase in farm productivity.

In a report by the Alliance for a Green Revolution in Africa (AGRA), Input Subsidy Programs (ISP) have effectively boosted input use, maize cultivation, productivity, and food security, especially under favorable economic and weather conditions (Nhlengethwa et al., 2023). On the other hand and from an economic perspective, the expenses associated with implementing ISP in SSA tend to outweigh the benefits (ibid).

Challenges of AIS and “Smart” Subsidy programs as an improvement

Previous research identifies challenges of AIS such as poor farmers' limited access to AIS, as these initiatives are costly and subsidy programs tend to favor wealthier, well-connected farmers disproportionately (OECD, 2011). Similarly, Rickert-Gilbert et al. (2009) emphasized the importance of targeting fertilizer subsidies at farmers with limited market access or those for whom buying fertilizer is financially challenging, noting this approach yields the greatest productivity gains.

Furthermore, concerns emerge over the sustainability of these gains beyond the subsidy period (FAO, 2020). Marinus et al. (2023) emphasize the need for comprehensive strategies to enhance agricultural sustainability in SSA. They advocate for integrating input subsidies and co-learning initiatives to address environmental and economic challenges, particularly emphasizing the importance of sustainable intensification through AIS (ibid).

In order to address these challenges, there is an international interest to develop so-called “smart” subsidies to ensure, among other objectives, an effective “exit strategy” to limit political influence and ensure long-term sustainability (OECD, 2011). Moreover, targeting specific farmers and focusing on market-based solutions are at the core of “smart” subsidies theory to avoid a deviation from the intended recipients, smallholder farmers (Chirwa & Dorward, 2013).

Effectiveness of the E-voucher System in Kenya

Overall, previous literature on the effectiveness of AIS in Africa is focused on SSA countries, but there is scarce research on the specific case of Kenya. However, a very recent study published by Njagi et al. (2024) examines the impact of the e-voucher system in Kenya, with a focus on whether the private sector, meaning agro-dealers, should be involved in the current system. As a result, the study presents accessibility as the main challenge, where high transportation costs, lengthy queues at collection NCPB depots, and delays during pickup raise the need for a private sector distribution of the subsidized fertilizer (ibid). Lastly, results suggest that the allocation of subsidized fertilizer was disproportionately directed towards the high-potential maize cultivation areas of the country (ibid).

Identification of Research Problem

Although aimed at ensuring food security and, therefore, enhancing smallholder livelihoods, the current e-voucher system's impact in Kenya is questioned in this study. Previous literature outlines the current complex global context of ongoing global increase in fertilizer prices and political instability, as well as the overall theory behind AIS and e-voucher systems in SSA, where common benefits and challenges are explained. However, there is a lack of existing literature on whether the system is fulfilling its purpose for smallholder farmers in Embu county on a local scale.

Furthermore, the fact that the system is very recent and the lack of previous case studies for the specific situation in Kibugu, where coffee and tea are the main cash crops of the region, generates a gap in the existing literature.

As a result, this study aims to find out how the e-voucher system is working in reality in Kathakwa, Kibugu, as well as understanding the perceptions of small-scale farmers on their first-hand experience with the system, challenges, benefits and suggestions for improvements.

Objective(s) and Research Question(s)

Objective: To find out how the e-voucher system is working, how it is being used, and how it is affecting the livelihood of the actor in the agricultural sector, especially farmers, by answering the following overall research question: How is the subsidized fertilizer e-voucher system affecting the livelihood of the smallholder farmers in Kathakwa, Embu County in Kenya? To do so, livelihood is measured by 3 indicators: productivity, income and living standards.

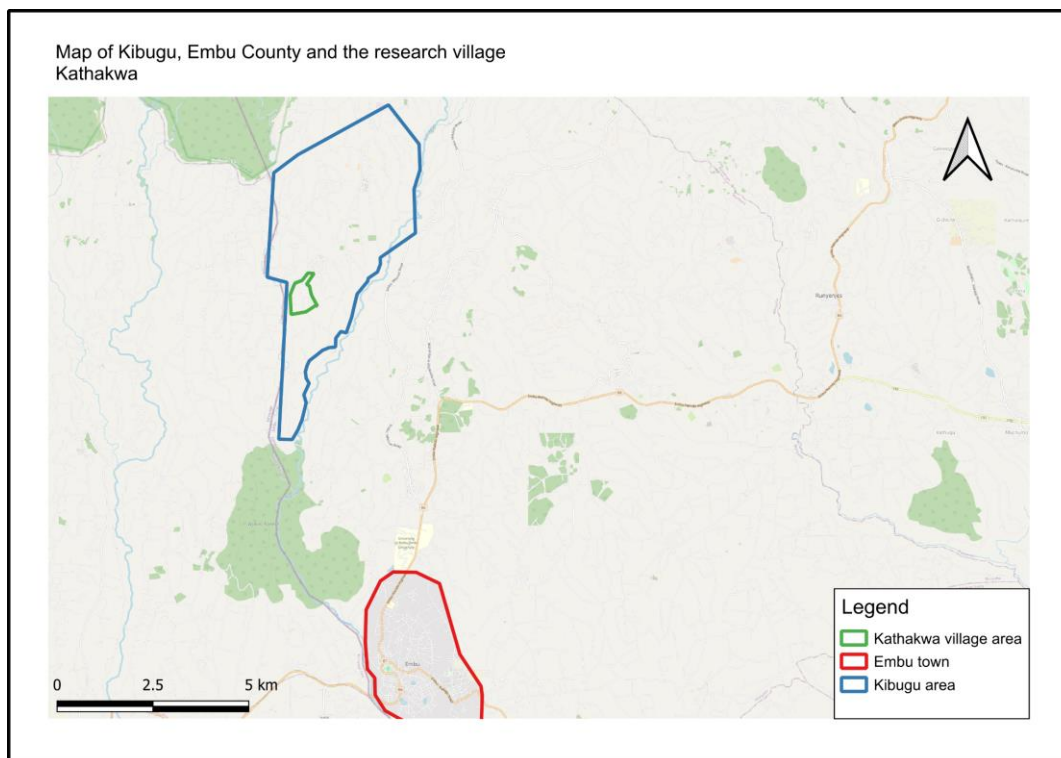
Research Questions:

- How is the e-voucher system implemented in Kibugu, Embu County for smallholder farmers?
- What are the perceptions of the farmers and other agriculture actors about the e-voucher system in the Kibugu region?
- How effective is the e-voucher system for farmers in terms of productivity?

Description of Study Area/Village

This study was conducted in Kathakwa village within Kibugu, in Embu county (see Map 1), located around 120 km northeast of Nairobi and with a population of 516,212 (49% – male and 51% – female) (County Government of Embu, n.d.). It is divided into 4 sub-counties: Manyatta, Runyenjes, Mbeere North, and Mbeere South (ibid). The indigenous populations of Embu County are the Embu, Mbeere, and Kamba ethnic communities (ibid).

In Embu county, about 70.1% of the population works in agriculture, with nearly 88% of households engaged in farming activities, focusing on cash crops like coffee, tea, macadamia, and miraa, alongside food crops such as maize, beans, and bananas (ibid). The region features diverse soil types, ranging from volcanic Humic Andosols in the uplands to Rhodic and Humic Nitisols in the plateau and volcanic footridges. Under different crops such as coffee and tea, the soil structure varies, but overall, they are prone to erosion under intensive cultivation (Muya et al., 2009).



Map 1: Map of Kibugu, Embu County and the research village, Kathakwa

Methodology

Table 1: Overview of Used methods

| Method | Sample Size and Sampling Structure |
|----------------------------------|---|
| Unstructured Interviews | 6 convenience sampled, unstructured interviews with: <ul style="list-style-type: none">- 3 host families (one member each)- 2 guides- 1 elder |
| Survey | 27 convenience sampled farmers in Kathakwa village |
| Semi-Structured interview | 11 purposively sampled interviews with: <ul style="list-style-type: none">- 4 farmers (3 users, one non-user)- Kibugu Chief- Agriculture Extension Officer (AEO)- Cooperative Coffee Society (CCS) Manager- National Cereals and Products Board (NCPB) Manager- 2 agro-dealers from Embu town- 1 agro-dealer from Kibugu |
| Focus Group Discussion | 4 purposively sampled farmers with different farm sizes |
| Participant Observation | <ul style="list-style-type: none">- Note-taking and observation |
| GPS | <ul style="list-style-type: none">- Polygon Drawing- Mark setting (users and non-users) |

Rationale for Choosing Methods

This study employs a mixed-methods approach, integrating both qualitative and quantitative research methods to achieve a comprehensive analysis of the e-voucher system. This approach facilitates triangulating data from multiple sources and perspectives, reinforcing the validity of our research findings.

Unstructured Interviews

Prior to the semi-structured interviews, we held unstructured interviews as a gate opener to understand the e-voucher system in practice. Our host families, one elder and two guides were our interviewees, and they assisted us in selecting relevant participants and developing survey questions that reflect the current system functionality.

Survey

The survey was a key component of our data collection, offering a full overview of the Kathakwa farmers's demography and farming practices, as well as the functionality and perceptions on the e-voucher system.

We piloted our test survey with three farmers. With modified questions, 27 convenience sampled farmers within Kathakwa responded to the questionnaire. Starting with basic demographic and farm-specific questions, the survey was designed to distinguish users and non-users of the e-voucher system. Furthermore, aligning with our research questions, we asked farmers about their perceptions on their livelihoods, indicated by productivity, income, and living standards. The survey played a critical role in selecting participants purposely for following in-depth interviews. The survey was conducted using Google Forms, and MS Excel was used for the data analysis, data cleaning and conducting t-test with 95% confidence level.

Semi- Structured Interviews

Our goal in conducting semi-structured interviews was to gather holistic insights into the system from all stakeholders, including those directly involved in the e-voucher system and those indirectly affected by it. We aimed to enhance our understanding of their experiences and insights focusing on:

- The operational aspects of the e-voucher system, through discussions with the village chief, the AEO, the NCPB manager, agro-dealers, and the CCS manager.
- Stakeholder views on the system's implementation, involving the previously mentioned individuals along with interviews from four farmers, including both three users and a non-user of the system.

We recorded the interviews under participant consent alongside the notes taken. Instead of transcribing the full interview, we used Nvivo, Excel and Word to code the notes. We categorized codes based on our research objectives and identified gaps, starting from initial reaction and accessibility into broader themes such as perceptions, challenges, and advantages. Afterwards, we conducted a thematic analysis to discover patterns within the interviews, which were then triangulated with findings from other research methods.

Focus Group Discussion (FGD)

The final qualitative approach in this study was a two-hour FGD, conducted at the end of our fieldwork with participants representing four different farm sizes. Our purpose was to explore the agricultural value chain, identify key actors, and understand farmers' preferences and perception on e-voucher by observing dynamics among farmers. We conducted a Participatory Rural Appraisal (PRA) activity, involving a stakeholder mapping exercise as a first step, and a follow-up conversation with open-end questions on the utilization of subsidized fertilizer and the farmers' preferred fertilizer suppliers. There was one main moderator facilitating the PRA and the discussion, while other members contributed with additional follow up questions.

We coded the notes taken during the FGD in Excel by grouping the information by themes, similarities and differences among participants. Through observing the dynamics among farmers, we captured the relation between acres and preferred fertilizer stores.

Participant Observation

The main objective of participant observation was to gain insight on the practical process of acquiring fertilizer through the e-voucher system. We observed the process of queuing, took photographs and

notes at NCPB depot in Embu town, to contrast this with the practical challenges previously mentioned by farmers in surveys and semi-structured interviews.

GPS

To visualize the research area, we conducted a digital mapping. It highlighted the spatial distribution of e-voucher users and non-users. While conducting the survey, each household was marked in Google Earth and later, Polygons were drawn to discover spatial patterns. Then we used QGIS to finalize the map.

Results & Analysis

E-voucher System Functionality

In this section, we explore the e-voucher program's functionality, focusing on its processes, the roles of stakeholders, and the details of its implementation. Our objective is to fully understand how the program is implemented, highlighting both its intended and actual outcomes.

Our analysis indicates significant discrepancies between the anticipated and actual execution of the e-voucher system. Firstly, it is highlighted that the subsidy is limited to fertilizers, excluding other agricultural inputs. A second key discovery is the exclusion of agro-dealers from the distribution chain, with NCPB currently serving as the primary distributor for individual purchases made through M-PESA. The third insight introduces a new participant, the CCS, which operates as a collective for farmers, offering fertilizers on credit.

System in Practice

Whereas the 2020 pilot system registered 15,000 farmers, the current e-voucher system significantly increased the number of registered farmers in Kenya to 108,000, as reported by the AEO. The system now features automatic voucher redemption, eliminating the need for manual processing by agricultural officers. Unlike the initial pilot, which subsidized various inputs including fertilizer, seeds, and agro-chemicals, the current model focuses solely on subsidizing fertilizer. Under this updated system, farmers can purchase subsidized fertilizer at a final price of 2500 KES, covering 60% of the cost.

Upon receiving a voucher code via smartphone with the number of 50kg bags that they are able to purchase at a subsidized price, farmers have 30 days to use it, with a potential extension of another 30 days. During this time, they are directed to the NCPB depot to purchase subsidized fertilizer, no longer from agro-dealer stores. Figure 1 represents a visualization of the current e-voucher system's purchase chain. The NCPB, under the MoA, promotes food security and is the only distributor of subsidized fertilizer in Embu, located 10 kilometers from Kibugu. Additionally, farmers must ensure their M-PESA accounts have sufficient funds to purchase the assigned fertilizer bags based on their farm size. However, unpredictability of the SMS arrival makes payment planning difficult for farmers.

Another key finding in relation to the current system functionality is that the farmer registration for the e-voucher program does not require growing specific crops, though it initially targeted coffee and tea producers.

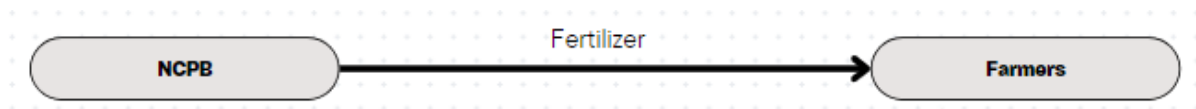


Figure 1: Current e-voucher system purchase chain of subsidized fertilizer

The CCS has emerged as a crucial player in the current system. Owning five coffee factories, with one in the study village of Kathakwa and the rest in Embu County, the CCS is managed by farmers. It aims to represent them, handling the collection, purchase, and sale of coffee. Additionally, the CCS now sells fertilizers to Kibugu farmers, stepping into roles typically held by agro-dealers. Managing these sales through a farmer-elected board underscores its extensive involvement in the coffee sector and its support for the agricultural community under a credit system.



Picture 1: Coffee Cooperative Society

In the e-voucher system, the CCS is registered as a collective farmer, purchasing fertilizer in bulk from the NCPB at 2500 KES per 50kg bag, the same rate individual farmers pay. However, CCS includes additional costs for transport and management. Farmers accept these costs for convenience and due to financial constraints, such as difficulty traveling to NCPB and the lack of cash for M-PESA payments. To address this, CCS offers a credit system: it provides fertilizer on credit, sells processed coffee from January to May, deducts the fertilizer cost, and pays the remaining profits to farmers. Additionally, CCS advances 20 KES per kilogram of coffee in December, creating a cycle that enables farmers to bypass the cash requirement (see Figure 2).

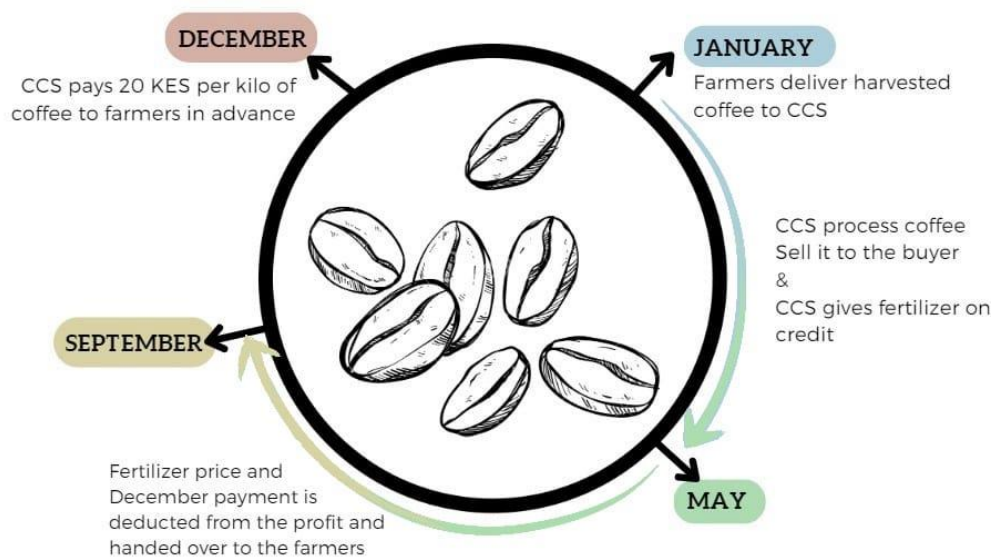


Figure 2: Credit system operated by the CCS for coffee production

Stakeholders within the E-voucher System

One of the main outcomes of this research was the mapping of the system-relevant stakeholders. The financing of the program is based on different main international organizations or donors. The system's main donors and implementers, supporting the MoA, have established the e-voucher system. The MoA uses NCPB to distribute products aimed at improving agricultural infrastructure. Distribution occurs through individual purchases or via cooperatives, with the CCS buying fertilizer directly from NCPB for farmer distribution. Research revealed that farmers can also purchase fertilizer from Tea or Macadamia Factories, though it's uncertain if their purchasing systems, like the CCS's credit system, are similar. Agro-dealers offer commercial fertilizer and other inputs as an alternative. Through the CCS, farmers sell their produce to factories or companies further up the value chain for subsequent processing steps, such as roasting (see Figure 3).

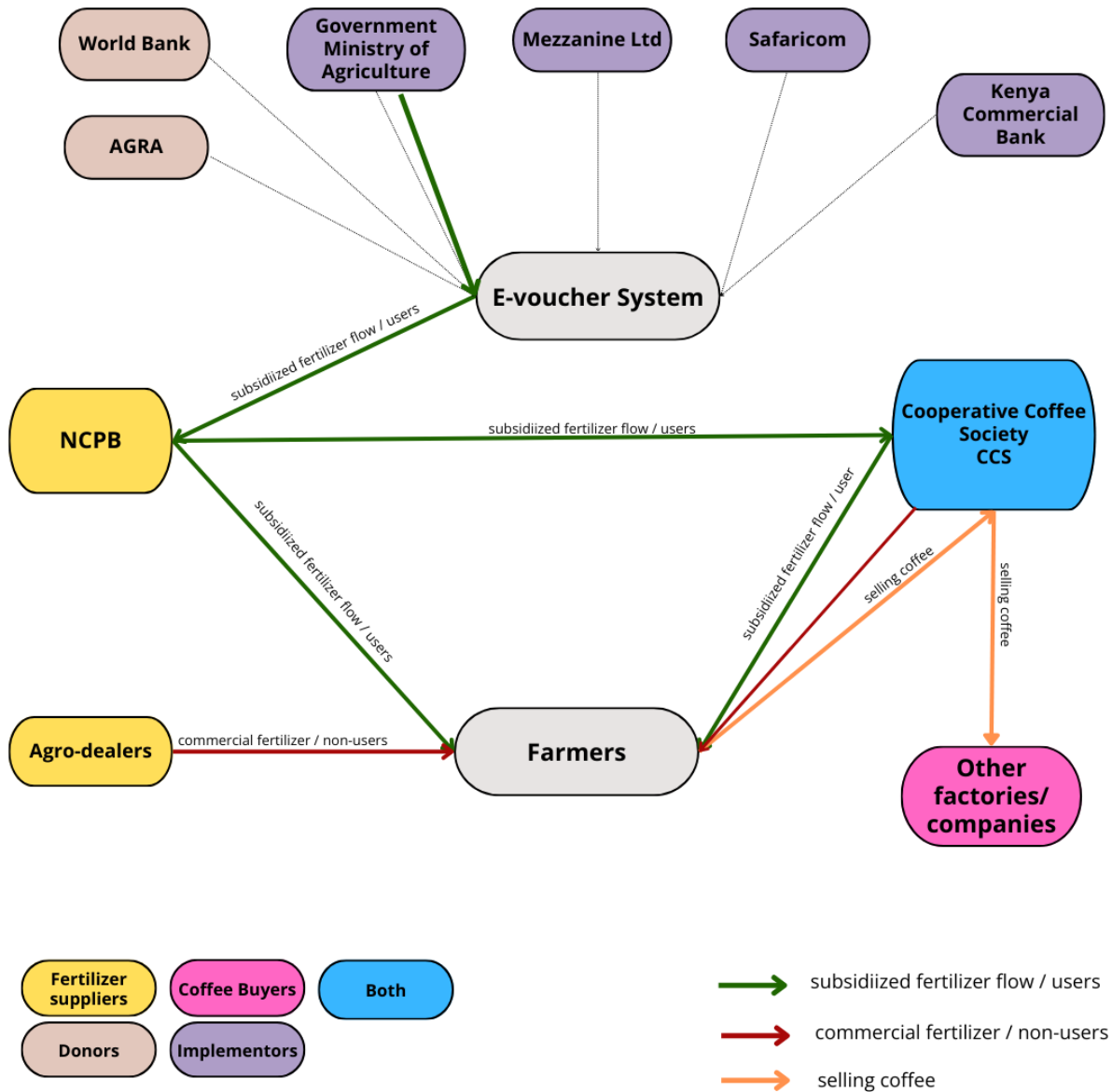


Figure 3: Stakeholder map for the e-voucher system

Sensitization Process

During interviews with the AEO and the chief, a crucial inquiry was how Kibugu's population learned about the fertilizer subsidy program and whether any educational initiatives were undertaken. The AEO disclosed that he personally informed farmers at monthly meetings, framing the program as a national food security measure created by the government. Moreover, the rising global fertilizer prices made it easier to persuade farmers of the program's value as a means to reduce input costs. Additionally, the chief noted that chiefs were trained on the e-voucher system to inform, educate and guide farmers through group or individual meetings.

Registration Process

Upon initiating the e-voucher system, the government first trained local chiefs on its operations. Government clerks from the MoA worked closely with the chief to identify the farmers. Then, they visited farmers to collect data such as farm size, crop types, and farming practices through biometric

devices and questionnaires. Once this data was collected, it was automatically sent to MoA's central system and the farmers were officially registered in the e-voucher program. Afterwards, an SMS with a numerical code was then sent to the farmer's smartphone as well as the exact amount of fertilizer bags they have been assigned, hence that was dependent on the farm size in acres (see Table 2). The code was the actual e-voucher, which needed to be redeemed at the NCPB depot. Each farmer is allowed to buy bags for both planting and top-dressing fertilizer per season.

Table 2: Amount of fertilizer bags allowed to purchase, dependent on acre size

| Acres | Bags |
|-----------------------|---------------|
| 1 acre of land | max. 2 bags |
| 3 acres of land | max. 12 bags |
| 15 acres of land | max. 60 bags |
| over 25 acres of land | max. 100 bags |

Farmers' Profile: Descriptive Statistics

Demographic

The study is centered on small-holder farmers residing in Kathakwa village within Kibugu. A total of 27 farmers participated in our questionnaire, with 55% being males and 45% females. The data revealed that a majority of farmers were elders, with 55.6% aged over 61 years. Regarding other age ranges, 14.8% fell between 51 to 60 years, 11.1% between 41 to 50 years, another 11.1% between 31 to 40 years, and 7.4% were between 20 to 30 years old. On average, each household comprised 3.6 individuals, with 2 being the most common number of people per household. Education-wise, one-third of respondents had completed Secondary school, while another third had attained education up to Primary school level. Additionally, over a quarter had achieved education at the College level, and a minority (7.4%) reported having no formal education.

Cash & Staple Crops

Regarding farming practices, the average farm size among the 27 respondents was 1.84 acres, with 1 acre being the modal value. Analysis of the data delineates that the predominant cash crops cultivated in Kathakwa village were coffee, macadamia, and tea (see Figure 4), with all respondents engaging in coffee cultivation as a source of income. Coffee was the most profitable crop for almost all respondents, followed by macadamia and tea, respectively.

The primary staple crops cultivated by farmers included maize, cultivated as the principal staple crop by two thirds of respondents. Secondly, bananas were grown for both commercial and staple purposes, although solely for staple purposes by over one-third of participants, as shown in Figure 4. Additionally, beans emerged as the third most common staple crop.

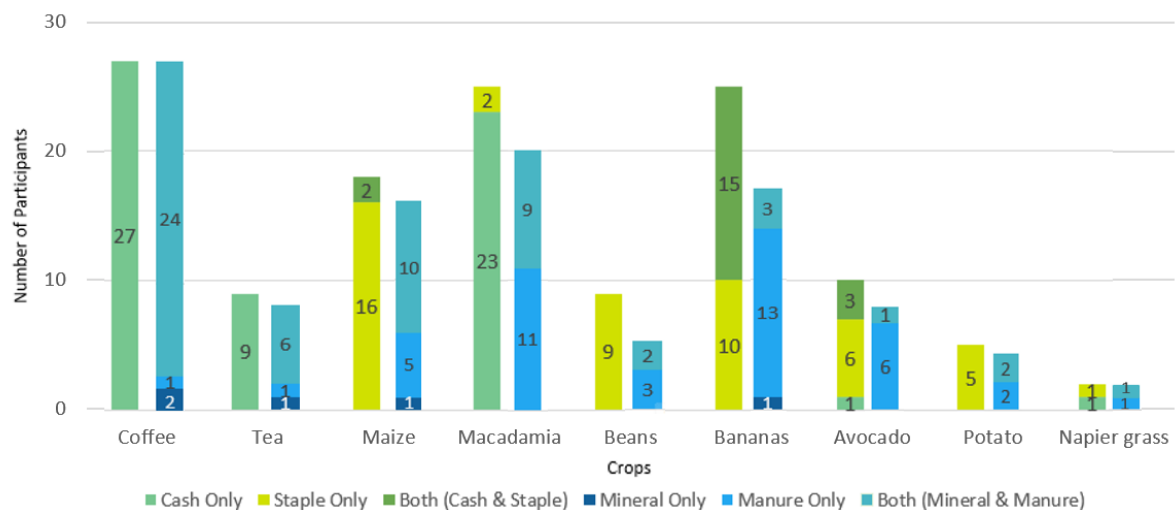


Figure 4: Survey results: Types of crops, their purpose and fertilizer type used

Farm Area

Moreover, coffee dominated the farm area for almost all respondents, while macadamia ranked as the second largest crop in terms of farm area for over a third of participants, followed by tea and bananas. However, precise determination of the exact acreage occupied by each crop proved challenging for farmers due to the widespread implementation of intercropping techniques.

Fertilizer Use

Regarding fertilizer application, Figure 4 shows that most of the coffee farmers use both mineral and organic fertilizers, a common practice among three-quarters of tea growers. In contrast, nearly half of macadamia and banana growers prefer only organic fertilizers, with 36% of macadamia farmers and a smaller portion of banana farmers using both types. Additionally, one-third of banana farmers do not use any fertilizer. About 67% of respondents use several inorganic fertilizers like Nitrogen Phosphorus and Potassium (NPK), Diammonium phosphate (DAP), and Calcium ammonium nitrate (CAN) across various crops, while one farmer practices organic cultivation exclusively.

Assessing Farmers' Perceptions of the E-Voucher System

In this section, we examine the perspectives of local farmers on the e-voucher system, including their adoption or non-adoption, its advantages and challenges, and its impact on livelihoods.

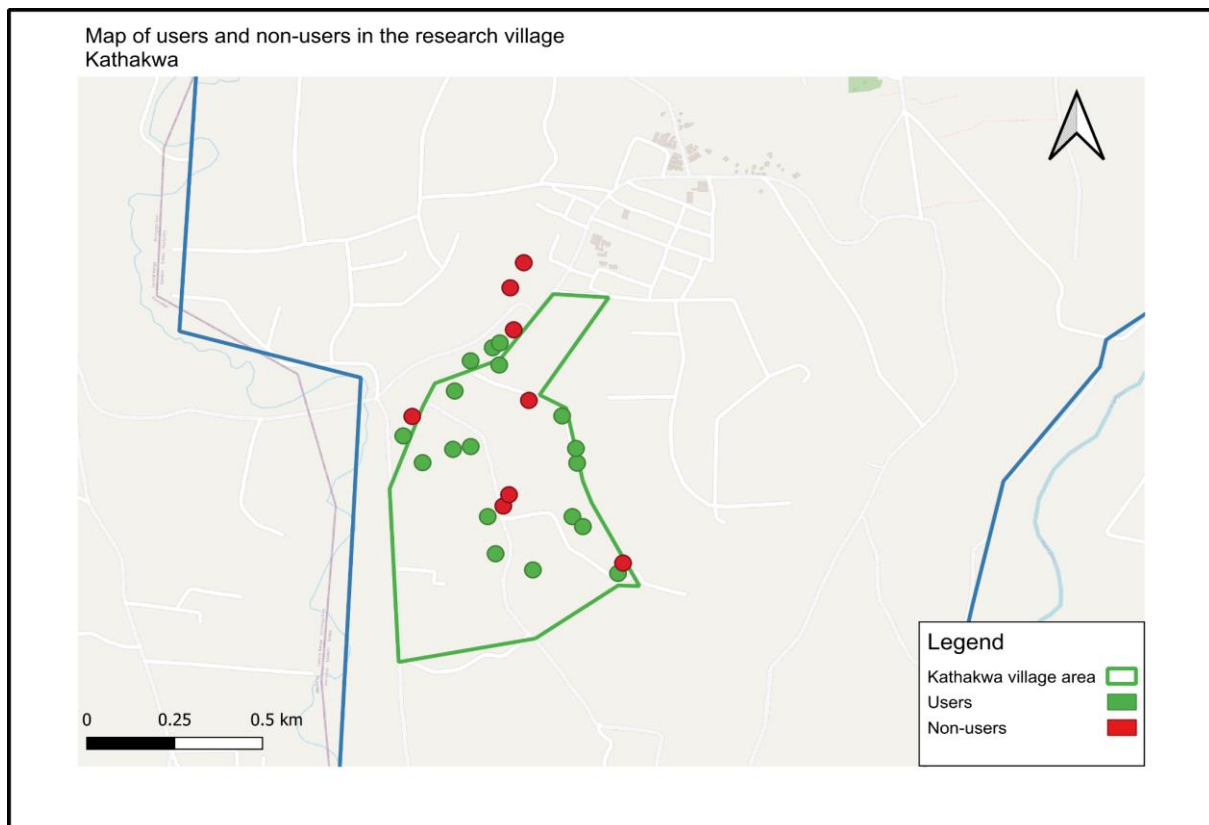
Users & Non-Users

To explore the impact of the e-voucher system on the livelihoods of smallholder farmers, we categorized participants into users and non-users based on their responses in the survey. This classification, as depicted in Figure 5, revealed that approximately 70% (19) were users of the system, while around 30% were non-users (8).

In our survey, we initially asked about the use of subsidized fertilizer, as indicator for being a user or not. However, we later discovered that the CCS occasionally participated in this system, a detail that the farmers were not aware of. To address this, we used various indicators to clarify our definitions, resulting to the above statistics.

- Users are identified as farmers who engage in any of the following activities: visiting the NCPB to purchase fertilizer, acquiring subsidized fertilizer from the CCS, or those who reported utilizing it through various or using all the channels including CCS, NCPB, and Agro dealers.
- Non-users are identified as farmers who indicated in the survey that they do not purchase subsidized fertilizer either from NCPB or CCS, are not registered in the system, pay more than 2500 KES for their fertilizer, and provided no other evidence in their responses of using subsidized fertilizer from any specified suppliers.

Among the 27 survey respondents, only three were not registered, showing a high success rate in the registration phase. All participants (survey and Semi-structured interviews) received no prior training



Map 2: Map of users and non-users in the research village Kathakwa

or awareness about the system, with most of them learning about it through media and/or the chief. Twenty percent (6) became aware on the registration day itself, through the clerks. In the area, as presented in the Map 1 no spatial patterns were noticed for being a user or a non-user.

Preferences in Selecting Fertilizer Supplier

According to the survey results, almost half (47.4%) of the users purchase the subsidized fertilizer exclusively from the CCS through the credit system, whereas only one respondent (5.3%) selects it exclusively from the NCPB. The rest of the respondents use multiple suppliers, as demonstrated in Figure 5. Similarly to the users' preference, half of the non-users (4) acquire their fertilizers from the CCS, and the rest from others, as presented in Figure 5. Among all respondents, only one practices organic farming.

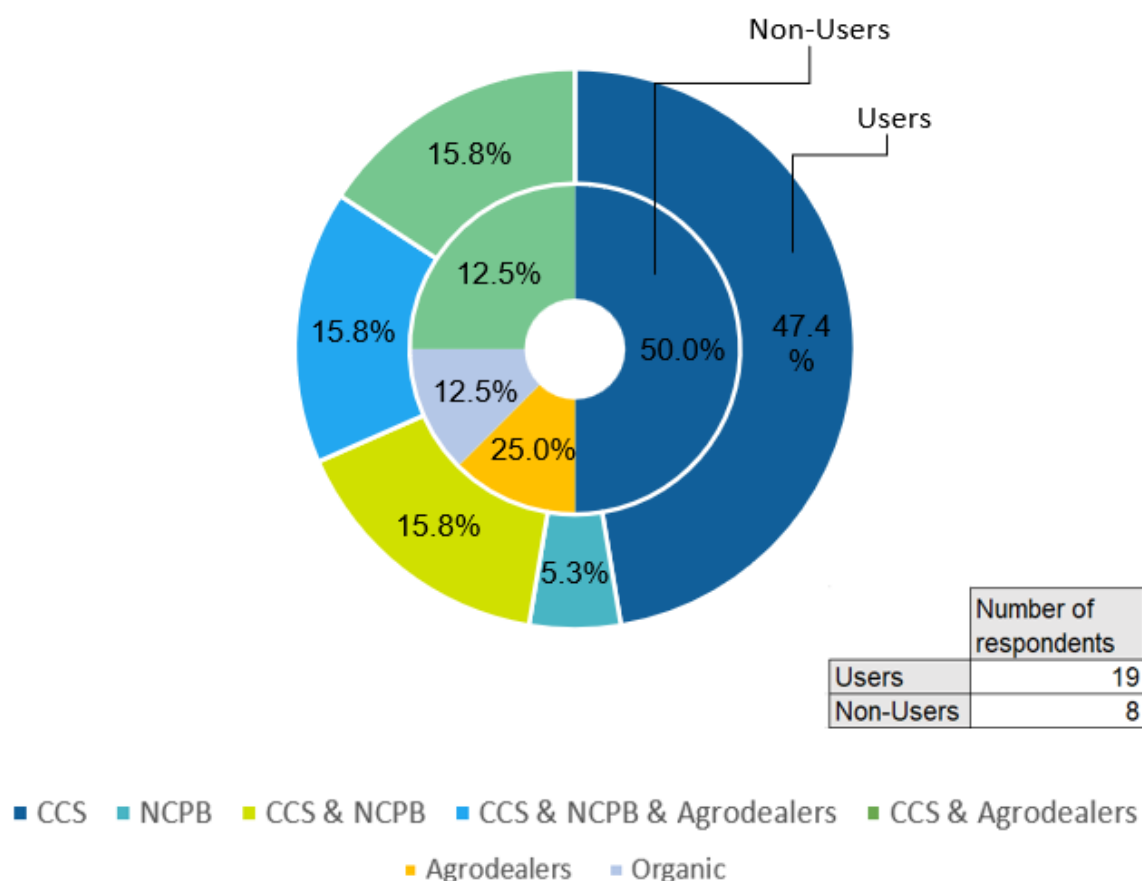


Figure 5: Survey results: Percentage of Users and Non-Users Preferences in Selecting a Fertilizer Supplier

In analyzing the correlation between farm size and farmers' preferences for selecting fertilizer suppliers, we found that owners of larger farms, especially those with six acres, use all the possible suppliers (CCS, NCPB, and Agro-dealers). This strategy is linked to occasional stock shortages or the unavailability of preferred fertilizer types at NCPB and CCS, as mentioned by a larger-scale farmer and in the FGD. Consequently, farmers requiring substantial quantities of fertilizer, are compelled to seek multiple vendors to satisfy their demands as presented in the Figure 6. This behavior was corroborated by the FGD participatory map, in which the two farmers with larger operations than their counterparts illustrated their practice of procuring fertilizers from multiple sources. This observation was further supported by their relatively greater access to cash and ability to afford additional conveniences, such as owning a vehicle, which simplifies the transportation of purchases from the NCPB, and affordability to pay higher prices in agro-dealers.

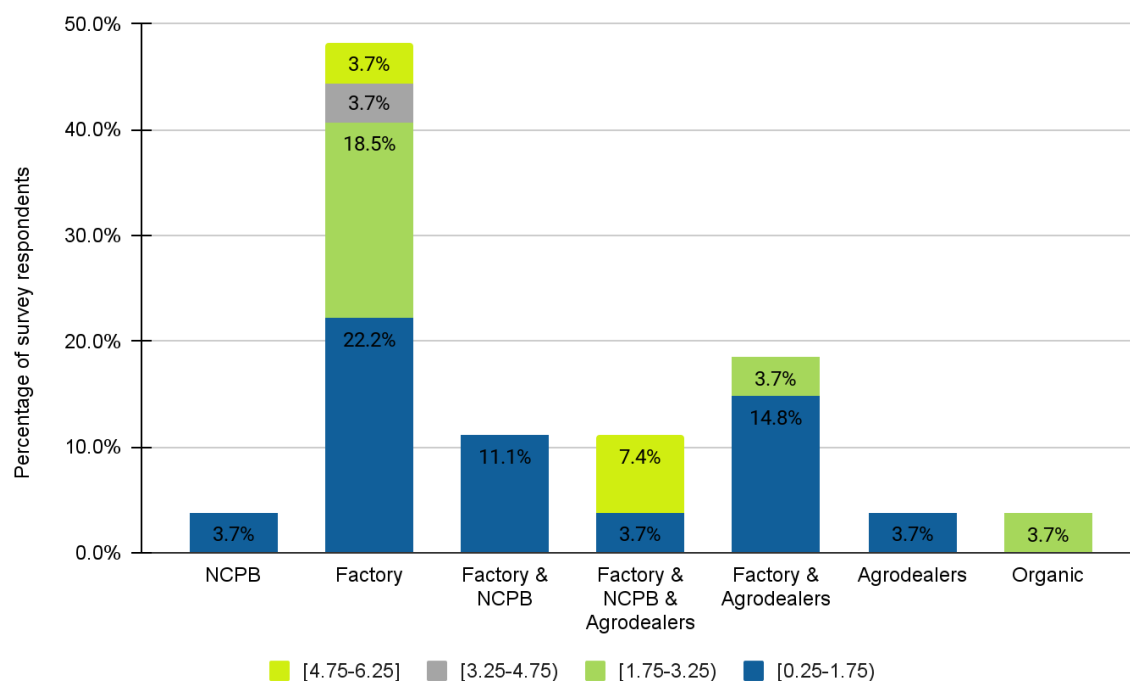


Figure 6: Survey results: Relation between farm size & fertilizer supplier preferences (Users and Non-Users)

On the other hand, the smallest-scale farmers, particularly those with holdings of 0.25 and 0.5 acres, show a preference for utilizing the CCS and its credit system (Figure 6). Further insights from FGD with two smallholder farmers, underscore a preference for purchasing fertilizer exclusively through the NCPB. Despite potential cash flow constraints, these farmers express a determination to secure the necessary funds for their fertilizer needs. The reason they provided is that the timing of payments to the factory coincides with a period when any financial loss - due to the credit - would have a disproportionately large and negative impact on their annual income. However, both expressed a preference for agro-dealers as their most reliable supplier, despite higher costs. They emphasized the benefits of agro-dealers, noting their convenient locations and the availability of fertilizers in quantities less than the standard 50 kg bags. Additionally, all the FGD participants (small, medium, and large-scale farmers) appreciated the wider variety of inputs available for purchase on-demand, allowing farmers flexibility and independence from the government's subsidy distribution schedule.

Perceptions: Advantages, Challenges of the System

About half of the survey respondents (14) - users and non-users - acknowledged the benefit of lower costs as their main reason for using or registering the system. All interviewees similarly responded, however, half preferred the credit system offered by their cooperative for purchasing subsidized fertilizer due to the occasional lack of cash and the challenges related to distance, as depicted in Figure 7. The majority of interviewees highlighted the lower price offered through the program as a substantial advantage, particularly when comparing costs to those at agrovet stores. Moreover, the guaranteed quality provided by the government also played a significant role in their positive assessment of the program.

The most significant challenge highlighted by all the interviewees and survey respondents was the distance to the NCPB, especially concerning the associated transportation costs. The non-user interviewee perceived the system as neither innovative nor beneficial, primarily due to the issue of

distance. In this section of the survey, conducted with 18 respondents, approximately 85% of survey respondents described the distance as a "difficult or very difficult" barrier to accessing subsidized fertilizer from the depot. This issue is compounded by additional challenges such as transportation costs, which are at least 500 KES, the time consumed in transit, and occasionally extra expenses related to handling the 50kg bags, as detailed in the semi-structured interviews.

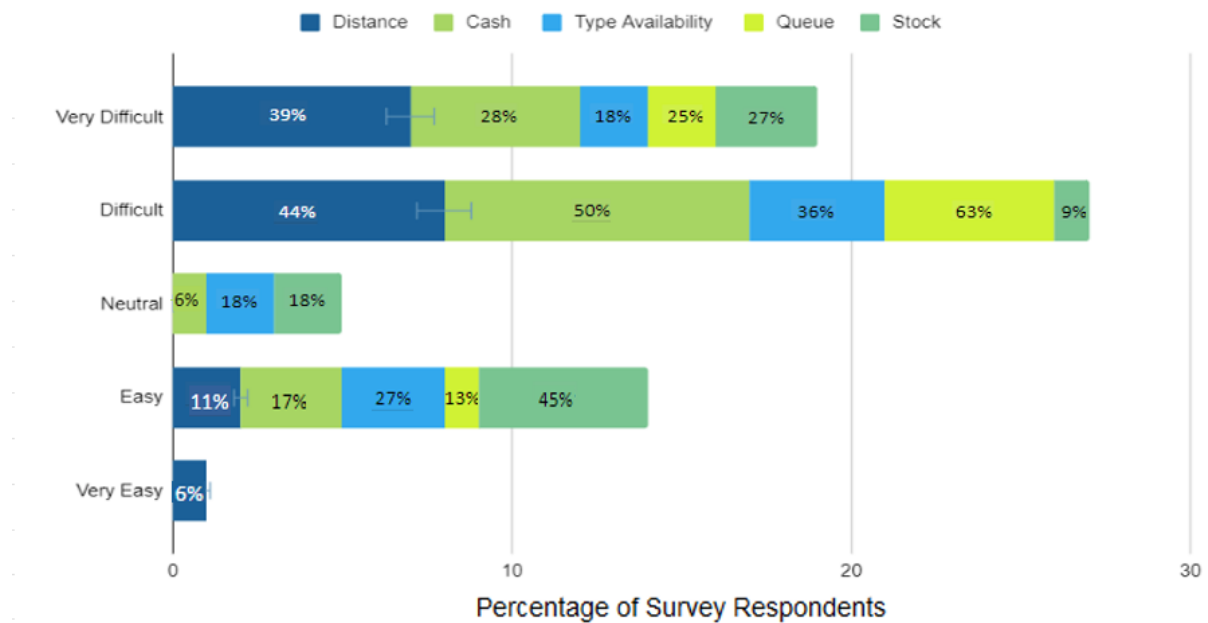


Figure 7: Survey results: Difficulty Ranking of Challenges: Distance, Cash Availability, Distance, Type Availability, Stock Storage and Queue

Additionally, the availability of cash within the timeframe allotted for e-voucher usage emerged as a critical concern. About 80% of this section's respondents identified cash availability as a 'difficult or very difficult' obstacle, as presented in Figure 7. Similarly, all the interviewees expressed difficulty in securing the necessary funds within the one-month deadline period. Specifically, one interviewee maintained a neutral stance towards the new system, finding the credit system advantageous to their needs.

Moreover, the time spent in long queues was highlighted as a 'difficult' challenge by the majority of the total 8 respondents of this part, as depicted in Figure 7. The high demand and large crowds waiting at the depot frequently result in stock shortages of the preferred fertilizer type, forcing farmers to return on another day to collect their fertilizers, as mentioned in the semi-structured interviews. Among the 11 respondents surveyed, most did not consider the availability of their preferred fertilizer as a significant obstacle preventing them from visiting the NCPB.

Impact of the Subsidized Fertilizer on Livelihoods

In this part of our analysis, we investigate the impact of subsidies on farmers' livelihoods through three critical indicators: productivity, income, and living standards. We assess farmers' views using survey data and validate these findings with a t-test analysis on yield, alongside statistical evaluations of fertilizer usage.

Farmers' Perspectives

In this section of the survey, conducted with 12 respondents, 75% (9) reported that subsidized fertilizer positively impacted their crop production, whereas only 3, disagreed, as indicated in Figure 8. Regarding the impact on income, the responses were almost equally divided between agreement and neutrality. Regarding the impact on living standards - defined as noticeable improvements in household amenities and material comfort - opinions were divided. Approximately 40% of respondents either disagreed or somewhat disagreed, while another 40% ranged from somewhat agreeing to agreeing, illustrating a broad spectrum of views on the matter. This suggests that while farmers recognize an enhancement in productivity and income, their overall living standards do not seem to be impacted to the same degree.

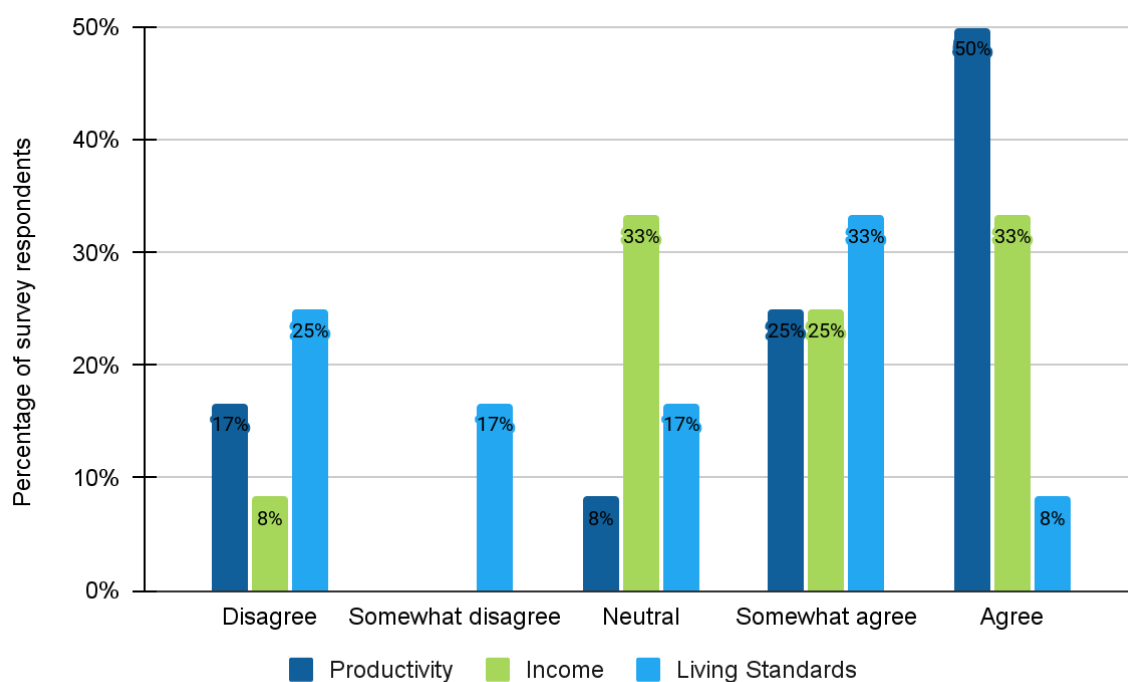


Figure 8: Survey results: Farmers' Perspectives on the Impact of Subsidized Fertilizer on Productivity, Income, and Living Standards

Impact of E-voucher System on Yield Productivity

As mentioned above, the purpose of agricultural subsidy was to bolster food security. To measure whether the food security has been improved, the yield was used as an indicator as it is strongly related to food security. Yield is defined as total production of crops in kilograms per acre. In this section, we will analyze whether the program is serving its own purpose by comparing user's yield and non-users' yield following the general overview of production. We specifically focus on coffee because all of the surveyed farmers grow coffee, and 92.6% of the respondents indicated coffee accounts the most area of the farm.

The data from the CCS manager indicates there was a general decrease of coffee production in the Kathakwa region over the past five years as depicted in Table 3. Kathakwa experienced a slight uptick in production for 2021 and 2022; however, productivity plummeted by almost 50% in 2023 due to a

coffee disease. This information was confirmed by the manager and supported by discussions with farmers during the data collection process of surveys and interviews.

Table 3: Kathakwa's and CCS' total coffee production 2018-2024

| Kathakwa Production (kg) | | Total CCS Production (kg) | |
|--------------------------|------------|---------------------------|--------------|
| 2018/2019 | 640,356.00 | 2018/2019 | 2,361,095.50 |
| 2019/2020 | 495,122.50 | 2019/2020 | 1,832,023 |
| 2020/2021 | 439,401.00 | 2020/2021 | 2,194,723.50 |
| 2021/2022 | 459,301.00 | 2021/2022 | 2,306,191.00 |
| 2022/2023 | 493,801.50 | 2022/2023 | 2,426,247.00 |
| 2023/2024 | 274,473.50 | 2023/2024 | 1,753,344.50 |

Alongside the total yield of coffee, it is essential to analyze whether there is a significant difference between the means of coffee yields of users and that of non-users. As described in farmer's perception chapter, users are the farmers who acquire their fertilizers directly from NCPB or from the CCS, and the non-users are the ones who do not benefit from government subsidy neither directly nor indirectly. Based on the survey, 19 farmers were classified as users and 8 farmers classified as non-users. As the survey used a convenience sampling strategy and as yield is a continuous indicator, the data will result in a normal distribution. However, since there are more users than non-users, an unequal variance t-test with 0.05 as alpha value was used.

Using t-test, we found that the P value is 0.29275, which is bigger than the alpha value, 0.05. Therefore, it indicates that the coffee yield of e-voucher users is not significantly different from that of non-users either.

Impact of the E-voucher System on Fertilizer Use

Regarding fertilizer use, a significant difference has been observed between users and non-users. Results from our survey suggest that the average total use of fertilizer last year by the 19 users was 400 kg, whereas the mean amount for the 8 non-users last year was 163 kg. Moreover, the mode value for users was 250 kg of total fertilizer use last year, whereas the modal value for non-users was 50kg. Lastly, the range was calculated because one of the users utilized a total of 2000 kg of fertilizer use last year, which was the highest amount, in comparison to 400kg being the highest amount among the non-users. As a result, the range value for users is 1912.5 kg and 350 kg for non-users.

These results suggest that the e-voucher system increases the total amount of fertilizer used annually. While the reduced prices of subsidized fertilizer may increase affordability and subsequently lead to increased usage on farms, the data suggests that farm size could also play a significant role in fertilizer utilization. Indeed, although the modal value of farm size is 1 acre for both users and non-users, users have an average farm size of 2.1 acres compared to 1.3 acres for non-users. The most notable indicator is the range value, which is 5.75 acres for users, as the three users with largest farm sizes are all users. On the other hand, the range for non-users is 2.75 acres, which is less than half of the users' value.

Other Actors' Perceptions:

Although the main focus of this study is based on the perceptions of farmers in regard to the e-voucher system, we identified other relevant stakeholders that also shared their perspective on the system.

Agro-dealers

We conducted semi-structured interviews with agro-dealers, including two from Embu town and one from Kibugu village. The Embu town agro-dealers, both part of the initial 2020 pilot project, shared similar experiences. They noted increased customer traffic and business profitability as the main benefits of the system at that time. However, challenges for them included insufficient farmer sensitization by the government and technical issues like system breakdowns and payment delays.

On the other hand, the agro-dealer from Kibugu, who was not involved in the 2020 pilot project, observed a nearly 50% reduction in customer traffic since the implementation of the current e-voucher system. Consequently, he opted to reduce the price of fertilizer per kilogram to keep customers. Despite this, he asserts that some farmers continue to buy from his store due to the perceived inferior quality of subsidized fertilizer available at the NCPB and the preference of some farmers for smaller quantities rather than 50-kilogram bags. Lastly, the respondent clearly expressed his unwillingness to participate in the current system if the government was to involve agro-dealers, mentioning mistrust and not wanting to be involved with the government at all as the main reasons.

Officials

Resulting from semi-structured interviews, in this section we delve into the perspectives of official stakeholders (the village chief, the agriculture extension officer, and the managers of the NCPB and the CCS) regarding the e-voucher program, shedding light on their insights and impressions about how the program is being received and its impact from a broader viewpoint.

Overall, the stakeholders unanimously view the system as a successful government initiative, appreciating its role in reducing costs for farmers and making a significant positive impact on their income.

Nevertheless, all the actors also mentioned significant challenges faced by the farmers and arising in the system's planning and execution. It is important to mention that the manager of the CCS, the chief as well as the extension officer do not speak as individuals but for the institution they represent. The chief, with the dual role as both government representative and farmer, underscored systemic flaws: delayed notifications and a tight 30-day deadline for voucher redemption present a challenge for farmers to accumulate their portion of the funds. Both the chief and the NCPB manager highlighted IT setbacks, including network issues or phone malfunctions, as significant challenges. Specifically, delays in M-PESA transaction messages compel farmers to travel long distances to obtain statements from M-PESA agents. The chief, the AEO and the CCS manager highlighted the logistical challenges and associated costs of traveling to the NCPB depot, further compounded by the extended waiting times in long queues, a situation corroborated by participant observations. Furthermore, the CCS manager mentioned encountering stock shortages when making collective purchases from the NCPB, receiving only 2,000 bags of fertilizer instead of the 6,000 needed to meet the demands of their farmers.

All stakeholders emphasized key recommendations for improving the system. The Chief and the CCS manager suggested expanding the subsidy to include crucial farm inputs like pesticides, seeds, and fungicides, noting that productivity was significantly hampered by pests last year. Meanwhile, the NCPB highlighted the need for better coordination among enrolled farmers, enhancements in IT systems, and improved storage capabilities for fertilizers.

It's important to note that while some stakeholders had direct governmental ties, those closest to the farmers (the CCS and chief) provided insights into the local challenges and issues faced by the community. Conversely, the NCPB and the AEO primarily offered perspectives on the program's broader implementation and administrative aspects.

Discussion

E-voucher System's Partial Success

One of the key findings of this study is how the system works in practice currently. On the one hand, the current system fails to address the two main challenges mentioned by farmers: accessibility and cash availability. Previously, the 2020 pilot project aimed to rectify past subsidy program inefficiencies by tracking vouchers and agro-dealer revenues better. It also addressed criticisms of favoritism and accessibility issues to the NCPB depots, intending to help one million households and small-scale farmers with fairer distribution of inputs (eVuna, 2020). However, agro-dealers are not involved in the current system and the NCPB is, once again, the unique selling point for farmers on an individual level and in a cash-only context.

In face of this top-down core functionality of the system, Njagi et al. (2024), recommend that the government involve the private sector in the distribution of subsidized fertilizer, to improve accessibility. This perspective is aligned with the demand of the interviewed Embu agro-dealers to be part of the system, viewing the government's sale of subsidized fertilizer at the NCPB depot as a competitive measure rather than a supportive business facilitation.

Another key finding regarding the system in practice functionality is the CCS as a collective solution by and for farmers. Despite the system failing to work for individual farmers, the involvement of the CCS as a unified actor distributing inputs makes the system somehow viable and beneficial for farmers by solving the original system's flaws. Indeed, the credit system helps farmers to "purchase" subsidized fertilizer without the need of cash liquidity. Moreover, the five coffee factories in the Kibugu area become a more accessible location for farmers. However, there is a discrepancy between farmers' perceptions of being non-users of the system and the reality that they may already be indirect users through their purchase of CCS fertilizer.

Assessment of the E-voucher System

Most of the existing literature suggests that the system's implementation has been successful, leading to enhanced productivity and income for smallholder farmers, thereby improving food security (Nguyen et al. 2023; FAO 2022; Malimi 2023; Nhlengethwa et al., 2023). However, our case study conducted in Kathakwa village reveals a set of results that diverge from this prevailing view.

According to the Kathakwa coffee production data, there was a 22.8% reduction in coffee yield by 2022-2023, when the e-voucher was in effect, compared to the period of 2018-2019 prior to its implementation. Furthermore, t-test analysis demonstrates that the yields between e-voucher users and non-users show no significant difference. Nevertheless, agro-dealer interviewed in Kibugu and farmers interviewed by Kenyan media, Nation (Bii, 2023) also raised the question about quality of the subsidized fertilizer. Furthermore, research by Rickert-Gilbert et al. (2009), suggested that farmers purchasing commercial fertilizers achieve higher yields compared to those using subsidized fertilizers.

However, despite the observed decrease in productivity over the past few years, fluctuation in coffee yield is subject to disease prevalence, as highlighted by the CCS manager. Therefore, it is important to consider other factors influencing productivity such as pests, environmental or economic constraints as suggested by Marinus. et al. (2023).

While for both production and income, over half of the respondents (respectively 75% and 58%) perceive that their productivity and income have been positively affected by the e-voucher program, they observe no significant improvement in living standards or household amenities. This outcome prompts a re-evaluation of the system's effectiveness in achieving food security. Considering coffee as the main agricultural product and income source in the region, questions about the program's ability to support both cash crop and staple crop farmers equitably emerge. Staple crop growers typically have easier access to food, thereby reducing their vulnerability to food insecurity. On the other hand, cash crop producers may face greater financial risks, such as increased food prices, which in turn can affect their food security (Anderman et al., 2014).

Based on interviews, despite income increases, numerous farmers find themselves reinvesting a significant amount back into their farms to procure non-subsidized inputs. This situation highlights the challenges smallholder farmers, particularly those with 1 to 2 acres, face in affording these inputs. Moreover, continuous reliance on fertilization without supplementary support risks soil degradation, consequently, reduces productivity. Ricker et al. (2012) reports fertilizer subsidies for small-scale farmers with limited resources may not yield significant benefits due to poor soil quality and limited farming skills, and therefore additional measures and subsidies are needed for the program to succeed its goals.

Observing that the e-voucher system initially focused solely on subsidizing fertilizer for coffee and tea farmers in Embu county, it promotes a transition from staple crop-oriented methods to commercial crop-oriented practices. However, considering the state-control nature of the e-voucher system, the push toward commercial crops raise concerns about its impact on ensuring food security.

Power Relations

The Kenya ISP received support from a wide range of stakeholders, including multilateral donors, countries, and international organizations, through various forms of assistance such as funding, loans, and consultancy program support (World Bank 2020). However, the involvement of international actors introduces varied agendas, particularly the WB's emphasis on integrating agro-dealers as key intermediaries, thereby reducing direct state involvement with beneficiaries, as reported by the AEO and the Embu agro-dealer.

Significantly, the dynamics of the fertilizer market are changing, with fertilizer importers exerting

considerable influence on government subsidy policies (OECD 2011). This is particularly interesting as most of the fertilizer used in Kenya is imported (Njagi et al. 2024), meaning that the global fertilizer value chain plays a key role in Kenya's national economy. Similarly, the private sector's role in the supply chain was marked by Apollo Agriculture Limited's entry, at the end of 2023. The Nairobi-based firm that permits farmers to purchase fertilizers and other inputs on credit. This company received a \$2 million credit guarantee and a \$219,000 grant from a fund managed by the ADB and will supply over 7,000 tonnes of fertilizers to 100,000 smallholder farmers (ADB 2023). This development prompts a re-evaluation of cooperatives', NCPB's, and local agro-dealers' role, while the private sector is growing influence in agriculture. Moreover, despite being registered, agro-dealers in Embu town await government updates to rejoin the system, with one viewing government fertilizer sales as competition rather than support. Although the credit system is occasionally preferred by the farmers, the question arises about the involvement of large private companies in the credit system and their influence on the functionality of cooperatives.

Moreover, the decline in sales volume reported by the Kibugu agro-dealer, corroborated by findings in Njagi et al. (2024) and Mather and Jane (2018), indicates that many farmers have reduced their probability of purchasing commercial fertilizer as well as its quantity due to the distribution of subsidized fertilizer. Additionally, the political implications and potential influences on the program need further investigation, given that substantial modifications often occur after electoral changes. Following the 2022 presidential elections, there was a change in the participation of various actors, including the exclusion of previously registered agro-dealers from the scheme. This was also mentioned as a reason, by a previously registered agro-dealer. In instances observed in Malawi and Zambia, the distribution of subsidized inputs was influenced after elections, favoring certain counties as a means of rewarding patronage (Mason et al 2012).

Over nine years, the Kenyan Government has dedicated approximately KES 29.6 billion (~US\$310 million annually) to fertilizer subsidies (Njagi et al., 2023). This significant investment highlights the government's commitment to agriculture, underscoring the urgent need for clearly defined roles within the agricultural value chain. Such clarity would enhance collaboration between small enterprises and key stakeholders, while effectively addressing the system's challenges (Ibid). Concurrently, the e-voucher system, aimed at supporting smallholders over three years with potential additional assistance from the Commodities Fund and the Agricultural Finance Corporation (AFC), raises concerns about the government's long-term support strategy (OECD 2011). The potential farmer's dependency on government aid for agricultural productivity improvements poses a significant issue.

Challenges & Implications

The e-voucher system, while beneficial in price, poses significant challenges for farmers. Operating in two modes - individual procurement from the NCPB and collective purchases through the CCS - it encounters obstacles in accessibility and financial viability, as reported by farmers and the chief.

Specifically, the obstacles such as the distance to the NCPB and the need for immediate cash are significant enough to discourage individual users. Additionally, farmers contend with issues like storage shortages in the NCPB or the unavailability of their preferred type, as well as the time and cost involved in long queues and transit. Consequently, these challenges lead farmers to show a marked preference for the CCS option. This preference is driven by the fact that the fertilizer is closer, and they don't need immediate cash, with 80% of survey respondents indicating that the credit system offered by CCS is a key benefit.

Enforcing agricultural cooperatives' participation in the subsidy program could potentially offer a solution to the main challenges of distance, time consumption, cash availability, and transport costs. However, it also introduces existing challenges and potential constraints within the agricultural value chain. Firstly, the CCS occasionally struggles to acquire the necessary amount of fertilizers. This happens due to stock storage issues in the NCPB, but also because of financial difficulties faced by the society, as reported by the manager. Secondly, while the credit system is favored by many farmers, some avoid it, as deducting the credit during the payment period feels like a burden to them. Compared to the risk of annual productivity fluctuations and crops diseases this could result in severe financial losses, ultimately leading to diminished living standards. Moreover, the cooperative's first-come-first-served approach to subsidy distribution, risks disproportionately benefiting larger-scale farmers, as presented in the results. In contrast, many small-scale farmers mentioned that they acquire the fertilizer from CCS at a non-subsidized price, which indicates the challenges of this approach. It remains unanswered, how the impact of such a system works on other crops, due to the fact that the CCS only operates on coffee.

Although the issues above raised concerns, in Kibugu the majority of - if not all - the coffee farmers are members of the cooperative, and most of them are satisfied by the credit system. They recommended that the fertilizer distribution should be brought closer to their homes, preferably to the cooperative factory in Kathakwa village. This would ensure that the subsidized fertilizer is available in both, sufficient quantities and a variety of types to suit their needs. Thus, it is important to recognize the substantial role of the cooperative in the region, which in many phases of the coffee cycle provides solutions to the farmers, where the individual subsidy program has failed. Therefore, it is crucial for the government to reinforce the role of cooperatives in the value chain, recognizing the significance of farmers' associations.

Mentioning a further aspect, according to both farmers and officials, it is essential to support the individual procurement of subsidized fertilizer, including local agro-dealers into the system. Their participation can address three primary challenges: distance, quantity, and financial difficulties. Engaging multiple suppliers can improve storage issues and help reduce long queues at the NCPB. Additionally, based on feedback from various stakeholders, quantities of fertilizer available for purchase should be reassessed. By allowing smaller amounts the system would benefit especially farmers, with less than an acre. Another recommendation is to include other agricultural inputs to get subsidized, a need underscored by recent pest and disease outbreaks. Moreover, according to Agyemang et al. (2022) subsidized input products, not only fertilizers but also especially improved seeds can improve productivity of smallholder farmers (Agyemang et al. 2022). As previously mentioned, productivity is influenced not just by soil fertility but also by farming and managerial skills. Research by Nguyen et al. (2023) and Marinus et al. (2023) underscores the effective combination of agricultural input subsidies with extension services such as training and marketing. They discovered that using co-learning approaches alongside input subsidies fosters crop diversification and advances in farm management. Furthermore, farmers have called for lower fertilizer prices to improve affordability and access for all.

By following the above recommendations, the system would not suffer a loss of participants, as the research showed that 77.8% of the survey respondents stated a willingness of further participation in the system if the problems mentioned were resolved.

Reflections on Methods

In this section, we assess our research methodologies, implementation approaches, and the challenges faced during fieldwork and analysis.

Questionnaire

The survey constituted a crucial component of our research, conducted primarily during the initial half of the field research period. It posed two significant challenges; the absence of a comprehensive understanding of the system from the start and, consequently, the initial lack of critical questions, such as the current fertilizer prices, which were incorporated later on. The main problem we faced was understanding the role of the CCS as a beneficiary within the e-voucher system, rather than as an independent commercial supplier. Therefore, to differentiate between users and non-users of the system, we had to triangulate data from various sections of the questionnaire, including registration status, actual fertilizer use, fertilizer supplier, and the current fertilizer price. The realization that farmers did not recognize purchasing fertilizer at 2500 KES from the CCS as a subsidy, prompted further investigation into this actor's role. However, our initial failure to recognize the various ways in which farmers could be users meant that we did not collect data on their perceptions, as they were initially categorized as non-users.

On the other hand, the survey effectively facilitated a deep comprehension of the local context regarding farming activities, crop cultivation, buyers, and fertilizer suppliers. This variety of data enabled us to engage in both, descriptive statistics and further statistical analysis, allowing for a nuanced examination of these aspects.

Semi-Structured Interviews

A key objective was understanding the e-voucher system's functioning in practice, stakeholders, and implementation. Early semi-structured interviews with the chief and the AEO offered insights into the system's framework. However, the initial research phase limited our exploration of its complexities and challenges, particularly given the governmental ties of our informants. A pivotal interview in our research was with the CCS manager, who clarified the role of the CCS beyond being a supplier of subsidized fertilizer, highlighting its critical position within the coffee value chain. Interviewing the NCPB manager clarified the fertilizer purchase process and its challenges from their perspective. However, the NCPB's governmental role limited our insights into more critical aspects.

Despite intending to interview more farmers initially, we determined that four farmers could sufficiently inform us about their perceptions. Reflecting on this approach, we acknowledge a missed opportunity in diversifying our interviewees, particularly by including more non-users, to enrich our perspective. Additionally, we recognize our shortfall in adjusting the questions to avoid repetition from the questionnaire and within the interviewees' responses. While we did achieve additional insights, this aspect of our research could have been improved. Interviews with agro-dealers were conducted to deepen our understanding of the system's implementation and their views on future participation. However, given our research's emphasis on farmers, these subjects were not examined thoroughly.

Focus Group Discussion (FGD)

Overall, the FGD successfully met its goal of exploring dynamic interactions and deepening our understanding of farmers' perceptions. The initial challenge was scheduling a day that suited most farmers and identifying reliable participants. This was particularly challenging because the activity was scheduled at the end of the research period. In review, proactive planning and extending invitations to more farmers could have mitigated low attendance issues. The participatory map was carried out seamlessly, allowing participants to reveal all their interactions with various stakeholders. The discussions exposed diverse status dynamics among farmers, unveiling varied perspectives on farming strategies that were not discernible through other methods. It would be intriguing to delve deeper into this aspect of our research in the future.

Reflections on Group Work

Our team collaboration, both within Copenhagen and with our counterparts, was smooth and conflict-free. We aligned on our research questions in a meeting about a week before the fieldwork. Before and after the fieldwork, we held regular meetings to analyze our results, set the next steps, and reflect on the work done. Areas for improvement include better preparation the day before field research and enhancing post-research organization and task distribution among editors within the KU team.

Limitations

The recent implementation of the e-voucher system in 2023 presents a considerable limitation to our research due to the restricted time frame for observing its long-term effects and mature local perceptions. A further significant constraint was the limited time available for our fieldwork. While this did not prevent the application of our planned methods, it restricted our ability to conduct thorough investigations or utilize larger samples for surveys and interviews.

Despite receiving information from the CCS about the presence of 700 farmers in Kathakwa, with the help of our guides, we were only able to identify a smaller subset of approximately 35 households, ultimately resulting in 27 participants for our survey. Throughout various sections of our survey on e-voucher users, we encountered inconsistencies in our sample sizes. This was attributed to the initial challenges in identifying and categorizing users and non-users. Consequently, the number of respondents offering insights into the challenges and impacts of the subsidized fertilizer was reduced, with 11-18 participants addressing the former and 8-11 discussing the latter. Moreover, as the survey progressed and we identified gaps in our data, we introduced new questions concerning additional occupations and the current price of fertilizer. Consequently, early respondents did not provide data on these topics.

The limitation in the t-test analysis concerns the relation between coffee yield and land area dedicated to coffee cultivation. In the area all crops were intercropped, so defining exact acre of the coffee crops was not an option. However, for the 92.59% of our sample, coffee is the crop occupying the most area in their farm.

Conclusions

The overall strategy of the e-voucher is to achieve food security in Kenya by strengthening the agricultural economic sector, focusing on supporting smallholder farmers. This research aimed to assess the functioning and the performance of the e-voucher system in Kathakwa, Kibugu in Kenya, as well

as to understand the perceptions of farmers and present an overview of the recommendations provided by different stakeholders. This study applies three indicators to evaluate livelihood as factors influencing food security: productivity, income, and living standards, with a focus on the effectiveness of the system in terms of productivity.

Although the e-voucher program enables farmers to purchase the subsidized fertilizer for a cheaper price than before, its effect on farmers' livelihoods in terms productivity, income and living standards is not evident. For the farmer's view, the productivity and income has somewhat improved, but our statistical results do not prove this. In terms of living standards, results on farmers' perceptions are inconclusive as there is no general agreement. Moreover, findings highlight that cash availability and distance accessibility are the main challenges for farmers to purchase subsidized fertilizer at the NCPB depot. As a result, the community is indirectly benefiting from the subsidized fertilizer prices through the CCS as a new actor in the subsidy program. Most farmers prefer to purchase fertilizer at the CCS due to the credit system and local distribution of the fertilizer, although some may not be aware of CCS indirectly acting as a subsidy supplier. Additionally, dynamics in the value chain are not as expected, with NCPB acting as the only direct supplier and agro-dealers being excluded from it. Lastly, the current system only subsidizes fertilizer and not other inputs.

Despite the farmers' perceptions about the e-voucher system being diverse, the majority of participants would be willing to use the system as long as the main challenges are addressed. In the long term, results indicate that the government should design the system in a more inclusive way, incorporating other private stakeholders such as agro-dealers. The current system has its flaws and gaps, which could be addressed by improving especially logistical and economical accessibility to subsidized fertilizer.

Hence, further research that evaluates the system's effectiveness while expanding the investigation's scope - in terms of sample size, larger research areas, and time frame - would undoubtedly provide valuable insights for future studies.

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Appendices

#1 - Table of applied methods

| Method | Sample Size and Sampling Structure |
|---------------------------|--|
| Survey | 27 convenience sampled farmers in Kathakwa village |
| Semi-Structured interview | 11 purposively sampled interviews with: <ul style="list-style-type: none"> - 4 farmers (3 users, one non-user) - Kibugu Chief - Agriculture Extension Officer (AEO) - Cooperative Coffee Society (CCS) Manager - National Cereals and Products Board (NCPB) Manager - 2 agro-dealers from Embu town - 1 agrodealer from Kibugu |
| Focus Group | 4 purposively sampled farmers with different farm sizes |
| Participant Observation | |
| Unstructured Interviews | 6 convenience sampled, unstructured interviews with: <ul style="list-style-type: none"> - 3 host families (1 representative each) - 2 guides - 1 elder |
| GPS | <ul style="list-style-type: none"> - Polygon Drawing - Mark setting (users and non-users) |

#2 - Research Matrix

| Group | E-voucher | | | | | | | | |
|--|---|---|-------------------------------|---|--|---|-------------|---|--|
| Overall Objective | To find out how the e-voucher system is working, how it is being used, and how it is affecting the livelihood of the actor in the agricultural sector, especially farmers | | | | | | | | |
| Overall Research Question | How is the subsidized fertilizer e-voucher system affecting the livelihood of the smallholder farmers in Kathakwa, Embu County in Kenya? | | | | | | | | |
| Research questions | Sub-questions | Data required | Data collection method(s) | Sampling | Variables | Data analysis | Timeline | Risks | Hypothetical Conclusions |
| 1. How is the e-voucher system implemented in Kibugu, Embu County for smallholder farmers? | How does it work? | <ul style="list-style-type: none"> - Functionality of the system - Eligibility Criteria for farmers and agrodealers - Economic resource allocation | 1. Survey | 30 participants | Inputs, subsidies, farming type, productivity, income, occupation, gender, crop production system | Coding, data visualization, summary statistics | 02/03-04/03 | Sample size limitation, access to respondents | Crop allocation decisions based on subsidized input benefits |
| | | | 2. Participant observation | 2-3 participants | | Coding, across-methods triangulation, process visualization diagram | 05/03 | No use of e-voucher due to seasonality, unwillingness of participants to show us the process, unrealistic/partial behavior of participants | |
| | What are the actors involved directly and indirectly and their incentives for their participation in the e-voucher system? | <ul style="list-style-type: none"> - Stakeholder Analysis - Value chain actors | 4. Unstructured Interviews | 2-3 Participants (gate openers: elder, host families) | Composition of livelihood | Fieldnotes coding, across-methods triangulation | 01/03-02/03 | Participant bias, availability of respondents, time constraints | |
| | | | 1. Survey | 30 participants | power relations, livelihood dynamics, governance | Stakeholder relations map, value chain mapping | 02/03-04/03 | Classification of groups | Main groups will be: farmers, agro-dealers, government officials |
| | | | 3. PRA: Participatory Mapping | 6 participants | | | 11/03/ | Unwillingness of participants to share information about "higher spheres" (government, private companies), no access to government information | |
| 2. What are the perceptions of the farmers and other agriculture actors about the e-voucher system in the Kibugu region? | How is the e-voucher system perceived by the local coffee and tea farmers and what challenges do they face? | Opinions and perceptions of users, non-users | 5. Semi-structured interviews | 5 participants (users) 5 participants (non-users) | <ul style="list-style-type: none"> - farming type - e-voucher access - willingness to use e-voucher (perception) - socio-economic conditions | Coding, transcription, within-method triangulation, across-method triangulation | 06/03-08/03 | Difficulty to find an equal ration of users and non-users to generate representative conclusions Sensitivity of sharing economical situation | Technical issues |
| | | | 1. Survey | 30 participants | | | 02/03-04/03 | Classification of groups | |
| | How is the e-voucher system perceived by the agro-dealers and what challenges do they face? | Opinions and perceptions of agro-dealers | 5. Semi-structured interviews | 5 participants | <ul style="list-style-type: none"> - monetary regards (income, change in price, margin benefits) - value chain opinion | | 09/03 | Unwillingness of respondents to share details, possible conflicts of the system - timescale of payment | Technical issues Payment delays |
| | How is the e-voucher system perceived by the governmental actors (local county government: chief and local extension) and what challenges do they face? | Opinions and perceptions of governmental actors | 5. Semi-structured interviews | 1-2 participants | <ul style="list-style-type: none"> - Acceptance rate - Subsidy (taxation?) details - Responsibilities - Challenges faced by the community | | 10/03 | Unwillingness to share detailed information, avoid to mention arising conflicts | Lack of transparency |
| | How do farmers perceive the e-voucher system and what are their decisions for using it based on? | Opinions and perceptions of all actors | 3. Focus Group: Discussion | 6 participants (farmers: users & non-users) | <ul style="list-style-type: none"> - common challenges - recommendations - implementation process - access to resources - interaction with agro-dealers | | 11/03 | Unwillingness to share detailed information, avoid to mention arising conflicts | Identification of some challenges will lead to a focus on their recommendation |
| 3. How effective is the E-voucher system for | Are there any differences in soil fertility between e-voucher users and non-e-voucher users? | Soil samples | 6. Soil sampling | | Soil fertility (pH, organic matter, nutrient content) | Labwork with soil samples | 05/03 | Unavailability to take soil samples from both types (users & non-users) to make a comparison | |

#3 - Survey Questions

IMPACT OF E-VOUCHER SYSTEM ON LIVELIHOOD OF SMALLHOLDER FARMERS IN KATHAKWA, EMBU COUNTY

Thank you for participating in this survey. Your feedback will be used to assess the impact of the E-voucher system in the Kathakwa area.

The researchers are committed to upholding ethical standards during data collection, ensuring the confidentiality of the information you provide. Your responses will be kept anonymous, and we sincerely appreciate your valuable contribution to this research.

(Purpose of this survey, what is this survey about, how the result will be used, how their data will be processed, ethical concerns)

Ethical Questions

1. Do you agree on taking this survey?
 - Yes
 - No

Please provide your contact information

It could be email, phone, and so on. Please answer depending on available method that you would use.

Background information

2. What is your name?
3. What is your gender?
 - Male
 - Female
4. How many people are living in your household?
5. What is your age?
 - 20-30
 - 31-40
 - 41-50
 - 51-60
 - 61 and above
6. What is your highest level of education?
 - Primary School
 - Secondary School
 - College
 - University

7. Do you have other occupation rather than farming?
 - No
8. If you have other occupation, which occupation makes the biggest income?

Farms

1. What is the size of your farm? (in Acres)
2. What types of crops does the farmer grow, and specify the purpose of the crop
 - Coffee
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Tea
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Maize
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Macadamia
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Beans
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Bananas
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Avocados
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Potato
 - Cash Crop
 - Staple Crop (subsistence)

- Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Napier grass
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
 - Others (please specify)
 - Cash Crop
 - Staple Crop (subsistence)
 - Usage of fertilizer (mineral)
 - Usage of organic fertilizer (manure)
3. Which type of fertilizer do you use for each crop?
(Crops)-(fertilizer) e.g. DAP, NPK 23:23:0, Baraka & Mavuno
4. Where do you get your fertilizers for each crop?
- Coffee
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Tea
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Maize
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Macadamia
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Beans
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Bananas

- Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Avocados
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Potato
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Napier grass
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Others (please specify)
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
5. How much fertilizer do you use per crop? Please answer per year.
6. Where do you go first to get the fertilizer?
- Coffee
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Tea
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
 - Maize
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)

- Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
- Macadamia
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
- Beans
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
- Bananas
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
- Avocados
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
- Potato
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
- Napier grass
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers
- Others (please specify)
 - Agro-dealers
 - Coffee factory (Used to act as agro-dealers)
 - Tea factory (Used to act as agro-dealers)
 - NCPB (National Cereals and Produce Board)
 - Other farmers

7. Do you sell fertilizer to other farmers?

8. For the crops you sell, who do you sell to?

- Coffee
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives
- Tea
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives
- Maize
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives
- Macadamia
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives
- Beans
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives
- Bananas
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives
- Avocados
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives
- Potato
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors

- Cooperatives
- Napier grass
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives
- Others (please specify)
 - Directly to consumers
 - Supplier company
 - Factories
 - Intermediate actors
 - Cooperatives

9. In terms of area, what are the three main crops that you grow?

- 1
 - Coffee
 - Tea
 - Maize
 - Macadamia
 - Beans
 - Avocado
 - Bananas
 - Potato
 - Napier grass (livestock)
- 2
 - Coffee
 - Tea
 - Maize
 - Macadamia
 - Beans
 - Avocado
 - Bananas
 - Potato
 - Napier grass (livestock)
- 3
 - Coffee
 - Tea
 - Maize
 - Macadamia
 - Beans
 - Avocado
 - Bananas
 - Potato
 - Napier grass (livestock)

10. From which crops do you earn the most income?

- 1
 - Coffee
 - Tea
 - Maize
 - Macadamia
 - Beans
 - Avocado
 - Bananas
 - Potato
 - Napier grass (livestock)
 - Others
- 2
 - Coffee
 - Tea
 - Maize
 - Macadamia
 - Beans
 - Avocado
 - Bananas
 - Potato
 - Napier grass (livestock)
 - Others
- 3
 - Coffee
 - Tea
 - Maize
 - Macadamia
 - Beans
 - Avocado
 - Bananas
 - Potato
 - Napier grass (livestock)
 - Others

11. For the 3 main crops, how many kilos did you produce last year? (kilos or bags)

E-Voucher: Effects of Agricultural input voucher programme on the livelihoods of smallholder farmers in Kathakwa, Embu County.

1. Are you registered with the government subsidy (E-voucher) system?

- Yes

- No

2. If yes, have you got any messages from NCPB to collect subsidized fertilizer?
3. If yes, do you acquire fertilizer through the governmental subsidization program?

- Yes

- No

4. If yes, why did you decide to use E voucher system?
5. If yes when did you start using E voucher system?
6. If no, why are you not registered in the E voucher system?
 - Did not receive any information
 - Did not sound like a beneficial policy
7. If no (registered but not using the govt subsidy program), why did you decide not to use it?
8. On a scale from 1 to 5, how easy is it for you to access the subsidized fertilizer?

1 being "very difficult" and 5 "Very easy".

- Distance (transportation)
 - 1 (Very difficult)
 - 2 (Difficult)
 - 3 (Neutral)
 - 4 (Easy)
 - 5 (Very easy)
- Finance
 - 1 (Very difficult)
 - 2 (Difficult)
 - 3 (Neutral)
 - 4 (Easy)
 - 5 (Very easy)
- Availability of preferred fertilizer
 - 1 (Very difficult)
 - 2 (Difficult)
 - 3 (Neutral)
 - 4 (Easy)
 - 5 (Very easy)
- Stock
 - 1 (Very difficult)
 - 2 (Difficult)
 - 3 (Neutral)
 - 4 (Easy)
 - 5 (Very easy)
- Queue
 - 1 (Very difficult)
 - 2 (Difficult)

- 3 (Neutral)
- 4 (Easy)
- 5 (Very easy)

9. (Access) Which factor hinders your decision to use the subsidized fertilizer?

Please select the biggest problem factor to smallest problem factor that effects your access to the subsidized fertilizer

- Distance (transportation)
 - 1 (the hardest)
 - 2
 - 3
 - 4
 - 5 (least hard)
- Finance
 - 1 (the hardest)
 - 2
 - 3
 - 4
 - 5 (least hard)
- Availability of preferred fertilizer
 - 1 (the hardest)
 - 2
 - 3
 - 4
 - 5 (least hard)
- Stock
 - 1 (the hardest)
 - 2
 - 3
 - 4
 - 5 (least hard)
- Queue
 - 1 (the hardest)
 - 2
 - 3
 - 4
 - 5 (least hard)

10. How did you learn about the E voucher system?

- Chief
- Extension Officer
- App (Yourself)
- Friend/Neighbour
- Clerks
- Had no sensitization nor training
- Media (radio, etc.)

11. How much did you pay for the fertilizer per 50kg bag before the e voucher system was initiated?
12. How much do you pay now in your preferred store?
13. How much kilogram fertilizer do you use per acre?
14. If the distance of depot got closer and if you can buy it on credit, on a scale of 1 to 5, how willing are you to use the E voucher system in the future?
 - 1: Not willing
 - 2: Somewhat not willing
 - 3: Undecided
 - 4: Somewhat willing
 - 5: Willing

Impact of the E voucher system in income generation for the smallholder farmers in Kathakwa

1. On a scale of 1 to 5 how much do you think the subsidized fertilizer has helped to increase farm productivity?
 - 1 (Disagree)
 - 2 (Somewhat disagree)
 - 3 (Neutral)
 - 4 (Somewhat agree)
 - 5 (Strongly agree)
2. On a scale of 1 -5 how has E voucher system influenced the income generation in your household?
 - 1 (Disagree)
 - 2 (Somewhat disagree)
 - 3 (Neutral)
 - 4 (Somewhat agree)
 - 5 (Strongly agree)
3. Did the quality of housing, material comfort, and wealth experienced by an individual or group improved?

e.g. Did it help you to afford your children's education?

 - 1 (Disagree)
 - 2 (Somewhat disagree)
 - 3 (Neutral)
 - 4 (Somewhat agree)
 - 5 (Strongly agree)

#4 - Interview Questions

Farmers

Registered non-users

Background Information

- How long have you been a farmer?
- What type of property rights do you have over the land? (Owner, user, etc)

Experience with the E-Voucher System

- How did you learn about the existence of the e-voucher system? When was the first time that you heard about this system? Whom did you hear this information from?
- Did you get any introduction (sensitization and training) about how it works, what are the requirements, the benefits and so on?
- What was your initial reaction to the introduction of the e-voucher system for purchasing agricultural inputs?
- Can you walk me through the process of registration? What did the clerks tell you?
- After the registration happened, when did you receive the first message?
- Where do you buy the fertilizer?

Perception and un-willingness to use

- Why do you not use the e-voucher?
- Has your perception of the e-voucher system changed over time? If so, how?
- What alternatives do you use instead of e-voucher? How do you currently purchase your agricultural inputs, and what has been your experience with this method?

Challenges and Suggestions for Improvement

- Under what conditions might you consider using the e-voucher system in the future?

General Feedback

- Do you want to share any other feedback or comments about your experience with the e-voucher system?

Registered users

Background Information

- How long have you been a farmer?
- What type of property rights do you have over the land?

Experience with the E-Voucher System

- When was the first time that you heard about this system? Whom did you hear this information from?
- Did you get any introduction (sensitization and training) about how it works, what are the requirements, the benefits and so on?
- Who registered you into the E-voucher system?

- What was your initial reaction to the introduction of the e-voucher system for purchasing agricultural inputs?
- Can you walk me through the process of registration? What did the clerks tell you?
- After the registration happened, when did you receive the first message?
- Can you walk us through the process of buying the fertilizer using the government-subsidized program?
- Where did you go to buy it?
- How did you get there?
- What was the cost of the transportation to the store in regards to time and money?
- How frequently do you use e-vouchers for purchasing inputs?
- How important to you is the e-voucher in purchasing fertilizers?

Perception and Willingness to Use

- Has your perception of the government subsidized fertilizer changed over time? If so, how?
- What do you see as the main advantages of using government subsidized fertilizer?
- Why did you decide to go to NCPB from your original preferred source?
- Are there any disadvantages/challenges or concerns you have regarding the e-voucher system?
- Do you think the government subsidized fertilizer system has influenced the living standard (better house, more money to pay school fees, better and more food) of your households?
- In your opinion, what could be done to improve the e-voucher system for farmers?

Perception and Willingness to Use

- Has your perception of the government subsidized fertilizer system changed over time? If so, how?
- What do you see as the main advantages of using government subsidized fertilizer?
- Why did you decide to go to NCPB from your original preferred source (agrovets)?
- Are there any disadvantages/challenges or concerns you have regarding the e-voucher system?
- Do you think the government subsidized fertilizer system has influenced the living standard (better house, more money to pay school fees, better and more food) of your households?
- In your opinion, what could be done to improve the e-voucher system for farmers?

Chief

- What is your role in the community and what's your involvement with the e-voucher system?
- How does the e-voucher system work?
- What were the steps towards e-voucher implementation?
- How many farmers are using e-voucher approximately?
- Are there control on inputs that are being used for different target crops?
- Who are the actors involved?
- Are agro-dealers from Kibugu region registered in the e-voucher system?
- Are the coffee and tea factories involved in the e-voucher system?
- How is the extension officer connected into the system? What is their role?
- How did you communicate the e-voucher system strategy to the local community? How was the sensitization carried out to the farmers?
- What was the main reason for the E voucher system to be implemented? What is the main objective?

- What are the main benefits of the system?
- Did you face any difficulties during the implementation of the e-voucher system?
- What are the challenges of the system?
- What is the main challenge to farmers?
- What specific changes or improvements do you believe are necessary in the e-voucher system to better serve the needs of farmers and the local community?
- How did the pilot project work?

Agriculture Extension Officer (AEO)

- What is the e-voucher? What is the purpose of the e-voucher?
- How did you participate in this process as an extension officer in terms of training and sensitization?
- How does the current e-voucher system work?
- How did the pilot project work?
- How many farmers are registered in the system?
- What information did you give to the farmers about the e-voucher during the sensitization?
- How did they react? What was their first reaction?
- What is the perception on e-voucher now? After two years of implementation?
- Can you map what type and brand of fertilizer is sold in the market(agro dealers) and what types of fertilizers are sold by the government?
- Which brand/type of fertilizers are farmers buying according to each crop?

National Cereals Products Board (NCPB) Manager

- How do you collaborate with the government in the implementation of the e-voucher system?
- For how many sub-counties do you provide the fertilizers?
- How many farmers visit the depot during the season and how many can you supply for?
- Can you take us through the process of purchasing subsidized fertilizer from the moment the farmers enter your depot until they leave?
- Which brand/type of fertilizer do you sell?
- What's the price of the subsidized fertilizer that you sell?
- Do you give subsidized fertilizers on credit? and If yes to whom?
- Do you always have the amount and the type of fertilizers the farmers need?
- How often do you run out of stock?
- What are the reasons of running out of stock?
- Do you supply coffee/ Tea factories with subsidized fertilizer?

Coffee Cooperative Society (CCS) Manager

- How is the cooperative structured, by whom, how it operates, can you explain the relation between the cooperative society and factories?
- What does the factory do? How long have you been operating?
- From whom and how do you get the coffee?
- What is the procedure of processing the coffee?
- What happens after you sell the coffee? How do you distribute the profits?
- What inputs do you provide to farmers?
- What types of fertilizer do you provide?

- How do you provide fertilizer to the farmers?
- Can you explain to us the credit system? how does it work?
- Where do you source the fertilizer stock to issue to the farmers?
- Do you get government subsidized fertilizer?
- Are there any systems for price differentiation based on certain criteria?
- How much do you sell per bag of fertilizer?
- How is providing fertilizers to farmers beneficial to the factory?
- How many farmers in Kathakwa are using the fertilizer from the factory?
- Did the number of farmers using the factory for fertilizer change after the e-voucher system was introduced?
- When the e-voucher system was introduced, how did the factory perceive it? Did you perceive it positively, neutral or negatively?
- How did the e-voucher system affect the factory's income? Have you noticed any difference in income?
- What do you think about the farmer's perception after the e-voucher was introduced? Did you see any changes or preferences of the farmers?
- Have you noticed any difference of farmer's productivity after the e-voucher system was introduced?

Agro-dealers

Embu town agro-dealers

- Which brand/type of fertilizer do you sell?
- Are you registered in the government subsidy program?
- When did you register?
- How did you register?
- What is the percentage of customers that are using e-voucher?
- What inputs are subsidized now? Have there been other inputs apart from fertilizer that were subsidized before?
- What's the price of the subsidized fertilizer and what's the price of the non-subsidised?
- Can you take us through the process of purchasing subsidized fertilizer from the moment the farmers enter your store until they leave?
- How did you learn about the e-voucher system in the first place?
- Did you receive training before implementing the system?
- Did the government provide IT equipment to implement it?
- Did the government offer any incentives for you to be part of the system?
- What benefits does the e-voucher system provide for your enterprise?
- What challenges do you face by using the e-voucher system?
- What is the current situation?

Kibugu village agro-dealer

- Which brand/type of fertilizer do you sell?
- How many inputs do you sell?
- Where do you get your fertilizer? Who is your supplier?
- Are you registered in the government subsidy program?
- Do you have any idea about what the government is subsidizing?

- Do you feel your income went down because of the E-voucher system?
- Have you worked with the county government with any other agricultural program?
- Would you be interested in working with the government?
- Do you see that as a chance for you that the government system is not working well?
- What do your customers mostly grow?
- How long have you run the business?
- What was your occupation before then?
- Who do you see as a competitor?
- How do you see the future?
- Which brand/type of fertilizer do you sell?

#5 - Synopsis

The Livelihood of Smallholder Farmers in Kibugu, Impacted by the E-voucher System

Introduction to the study

Agriculture in Embu County

Agriculture is the cornerstone of Kenya's economy, underpinning the livelihoods of its residents and serving as a key national development pillar. One of the counties in Kenya, Embu, where this research will be conducted, demonstrates great relevance to this fact. In Embu, about 70.1% of the population works in agriculture, with nearly 88% of households engaged in farming activities, focusing on cash crops like coffee, tea, macadamia, and miraa, alongside food crops such as maize, beans, and bananas (1). This sector's significance is mirrored nationwide, where it employs 40% of the total population and accounts for over a third of Kenya's GDP (3). Given its critical role, the government is actively implementing measures to bolster agriculture, aiming to enhance food security by supporting smallholder farmers (1).

E-voucher system in Embu, Kenya

The role of International actors in the agricultural sector

Kenya's agricultural sector strategy is supported by substantial aid from global donors such as the World Bank, African Development Bank, the EU, member state agencies like DANIDA and GIZ, and UN bodies FAO and IFAD. These initiatives aim to enhance productivity and sustainability (19). Building on this strategy, the World Bank has allocated \$250 million from the International Development Association (IDA) credit for the National Agricultural Value Chain Development Project (NAVCDP), designed to improve market access and value addition for 500,000 small-scale farmers positioning them as key contributors to agricultural development across 26 counties. It concentrates on enhancing nine critical value chains, providing specialized support for fundamental agricultural sectors such as coffee, and tea (20). Moreover, UN international organizations FAO and IFAD, as well as OECD promote recommendations and policies on Digital Agricultural solutions for succeeding self-sustainable farming (23). One of the policy recommendations is the implementation of an e-voucher system, depicting the influence of these big actors in the decision-making of Kenya.

Increase of input costs and the launch of E-voucher system

In 2020, disruptions in fertilizer supplies due to COVID-19 supply chain issues, high input costs, diminished European production, and Chinese export restrictions led to a global surge in prices (21). In Kenya, this situation saw fertilizer prices soaring by 50–60% during 2020-2021 (ibid), exacerbating the trend of rising agricultural input costs in the past decade.

To combat rising agricultural input costs, the Kenyan government introduced the idea of an e-voucher system in 2015, a digital subsidy program for fertilizers, seeds, and pesticides, under the National Value Chain Support Programme and the Post-Covid-19 Economic Stimulus Programme, which was fully implemented in 2020 (4). Through this system, farmers are responsible for covering 60% of input costs, with the government subsidizing the remaining 40%. The e-voucher scheme, aiming to alleviate

farmers' financial burdens and enhance their socio-economic status, uses a mobile app to facilitate transaction verification between farmers and agro-dealers.

Furthermore, implemented to enhance tracking of vouchers and agro-dealer revenues, the e-voucher system also aims to rectify past subsidy program inefficiencies. Addressing criticisms of favoring intermediaries and accessibility issues for those far from the National Cereals and Produce Board (NCPB), it seeks to support one million households and small-scale farmers, particularly in the long rain season, by ensuring a fairer distribution of farming inputs(5).

Despite its objectives, the effectiveness of the e-voucher system in significantly improving smallholder livelihoods remains under scrutiny amidst the continuing rise in global fertilizer prices.

Functionality of the system and actors involved

For the implementation of the system, a Private-Public Partnership was conducted with the involvement of some of the biggest private corporations in Kenya and Africa in general. This collaboration included Safaricom, Kenya's top telecommunications provider; Kenya Commercial Bank (KCB), the country's largest commercial bank; Mezzanine Ltd, a digital solutions company serving 800,000 users across Africa; and the Alliance for a Green Revolution in Africa (AGRA), supported by the Bill and Melinda Gates Foundation. AGRA's mission is to transform the livelihoods of 30 million smallholder farmers by promoting high-yield agricultural practices and modern inputs, with the goal of doubling their productivity and incomes by 2020.

The e-voucher system is powered by Mezzanine (5). First of all the agro-dealers must register at the Ministry of Agriculture in order to use the app. For that they need different requirements like the provision of a certificate of incorporation or business registration as well as different certifications from the Kenya Plant Health Inspectorate Services and Pest Control Products Board. Compliance with the Kenya Revenue Authority (KRA) is also mandatory. The second included actor, the farmer does not need any app for using the voucher, as they receive an SMS with the voucher based on their value chain. The vouchers are received by the farmers depending on what crops they intend to grow and the county they are doing this. Currently, the system includes the value chains Maize in Traps Nzoia, Uasin, Gishu, Nandi and Bungoma counties, the Irish potato chain in Nyandarua and Elgeyo-Marakwet, and thirdly Rice in Kisumu and Kirinyaga. The fourth value chain, which is covered is Coffee and tea in Nyeri, Embu, Meru and Kericho, while this research takes place in Embu county. For the verification of the voucher, the agro-dealer can use any phone, which receives SMS. When the process is conducted, the farmer pays 60% of the market price while the last 40% are covered by the government. Afterwards a message with the transaction details are sent to the ministry, in order to keep control of the number of vouchers disbursed and the amount paid to the agro-dealers (5).

Assessing the e-voucher system

The e-voucher system presents advantages such as streamlined registration, direct management of subsidies, enhanced fraud detection, and bolstered income growth for farmers. Nevertheless, its effect on smallholder farmers, particularly in the context of Kibugu village, warrants further investigation.

According to the Nation newspaper, through the e-voucher system implementation “the plan by the government is to graduate small farmers into commercial farming” (6). This raises the question of whether this transition towards export-oriented production is creating tension for smallholder farmers,

as they no longer grow for subsistence, and how this might affect their livelihood in terms of food security and living standards.

Nguyen et al. (2023) found that agricultural input subsidies significantly boost yield, income, living standards, and food security. Supporting this, the 2014 Mozambique E-voucher project showed that increased input access enhanced productivity, expanded cultivation areas, and uplifted incomes, leading to a virtuous cycle of investment in equipment and infrastructure. Concerns emerge over the sustainability of these gains beyond the subsidy period (22). In Kenya, the e-voucher system, designed to assist smallholders for three years with potential extra support from the Commodities Fund and the Agricultural Finance Corporation (AFC) (6), prompts questions about how the government is willing to support the farmers after the program is finished. Furthermore it is questioned whether this system generates a dependency for the farmers on the government regarding their economic freedom.

Questions also revolve around farmers' acceptance of the e-voucher system and whether the incentives provided could lead to shifts in agricultural practices and crop **selection**. These shifts, potentially influenced by the push for increased export production, may not necessarily reflect the best interests of smallholder farmers, highlighting worries about their autonomy and decision-making in adopting new agricultural strategies.

Moreover, Nguyen et al. (2023) study found an effective complementarity between the agricultural input subsidy schemes and other interventions and extension services such as training and marketing strategies (7). Nevertheless, it remains uncertain whether the e-voucher system in Kenya is effectively integrated with complementary interventions and extension services to maximize its positive impact on the region's livelihoods.

Research and sub-research questions

Our research stands as a critical inquiry into the above-mentioned concerns and raises aiming to dig deeper into the functioning of the e-voucher system in reality, the power dynamics that may arise, the possible conflict of interests of the different stakeholders involved, whether it fulfills its objective of helping farmers to increase productivity and, therefore, assumingly their living standards, with a special focus on farmers of the Embu County, more specifically from the area of Kibugu.

As a result, we aim to answer the following research question: **How is the input e-voucher system influencing the livelihood of the smallholder farmers growing coffee and tea in Kibugu, Embu County in Kenya?**

1. The first sub-research question: "How is the e-voucher system implemented in Embu County for coffee and tea farming?" explores the implementation of the e-voucher system in Embu County, specifically for coffee and tea farming. It aims to clarify the process, identify the key participants, and understand their motivations for engaging with the e-voucher system.
2. The second sub-research question explores: "What is the local community's perception of the e-voucher system in the Kibugu region?" This inquiry extends beyond farmers to include stakeholders like agro-dealers and government officials, offering a comprehensive view of the system's impact and the interactions among these groups.
3. The final sub-research question addresses: "How effective is the e-voucher system for farmers in enhancing soil fertility and productivity?" This aspect focuses on objectively evaluating the system's influence by comparing changes in soil fertility and agricultural productivity.

Methodology

To delve into the research question posed above, this research will use both qualitative and quantitative research methods. The research methods used are as follows: Survey, Participant Observation, Unstructured interviews, Semi-structured Interviews, Focus groups using the Participatory Rural Appraisal method, and Soil Sampling.

Survey

Survey is the basic pillar of the research question as its purpose is to look up the demographics, occupation, and usage of E-voucher. This information leads to basic understanding of the situation and reinforces the foundation of the survey, it should be carried out in the early stage of the field work. Therefore, it is expected to be carried out within a few days of the researchers' arrival, probably from March 3rd to March 4th. Furthermore, the survey will be carried out with 30 participants, using a random sampling strategy.

Starting from basic information, the survey will be used to find the details of the e-voucher system. The questionnaires will contain the questions regarding functionality of the system, eligibility criteria, mainly focusing on farmers, and economic source allocation. Questions about inputs, subsidies, farming type, productivity, and crop production system will be asked.

As its characteristic is quantitative, data analysis will be carried out through coding, and it will be presented as summary statistics. However, due to the size of the research area and cultural differences, limitations in sample size and access to respondents might occur and be a risk factor for the study.

Participant Observation

Participant observation will also mainly be used to conduct the first research question, researching how the E-voucher works. As the plan and how it is carried out in reality could be different, this research method will have significance in showing how the E-voucher works in reality. The researchers will follow 2-3 participants to see how they use E-vouchers and record details. As researchers need information about who is using the E-voucher, this method will be carried out after the survey is done, therefore planned to be carried out on March 5th.

As participant observation is watching the participant's behavior and tracing their usage of the E-voucher, it shows the qualitative approach. Therefore, this method will be coded, using field notes and then be analyzed using across-methods triangulation with surveys trying to reinforce the data and the result on how E-voucher works.

However, this method has two major risks; seasonality and limitation on participant's behavior. Since the e-voucher system provides inputs that are subjected to seasonality, there is a chance that usage of E-vouchers by farmers is limited. Furthermore, participants could be unwilling to show researchers the process or may show unrealistic or partial behavior when the third party gets involved.

Interviews

a. Unstructured interviews

To gain an in-depth understanding of the current and historical conditions affecting livelihoods, farming activities, and the dynamics between various actors within the community, this study will employ unstructured interviews as a foundational methodology. These interviews, designed to capture a rich tapestry of experiences, perceptions, and changes over time, will involve 3-to 4 key participants from the community. The selection will include an elder, who can provide historical insights and continuity, as well as members from the hosting families, to ensure a broad spectrum of perspectives, and they will contribute to our research as gate-openers. This approach allows for a flexible and open-ended exploration of topics, facilitating a deep dive into the intricate details of the community's agricultural practices, socio-economic conditions, and the evolving interactions within the e-voucher system's network of participants. Through this method, the research aims to construct a preliminary framework of understanding, laying the groundwork for subsequent, more focused investigations.

b. Semi-structured interviews

The qualitative methodology that will be employed in this research is meticulously designed to explore the multifaceted impacts of the e-voucher system on the agricultural practices and livelihoods of farmers in Kathakwa, Embu County, Kenya. Through a series of structured yet open-ended interviews, the research aims to delve into the personal experiences, challenges, and perceptions of farmers regarding the e-voucher system.

Focusing on users and non-users among farmers (approximately 5 participants from each target group) is critical by using a quota stratification sampling strategy after conducting the survey and the participant's observation. Examining users will highlight the system's direct benefits and operational issues, offering insights into its effectiveness and areas for improvement. Conversely, non-users' perspectives will reveal barriers to adoption, providing a comprehensive view of the system's reach and limitations. This dual focus is essential for identifying strategies to enhance inclusivity and impact.

Agrodealers, as vital links in the agricultural value chain, will be studied to understand how the e-voucher system affects their business operations and the broader economic dynamics. This is important for the study to understand their role between the government and the smallholder farmers, as well as their own perceptions of the voucher. Their experiences will shed light on the system's market implications and potential for scaling.

Governmental actors, including village chiefs and extension officers, will be interviewed to explore the institutional and policy frameworks surrounding the e-voucher system. Their insights will help uncover the governance challenges and successes in implementing and promoting the system, offering a view of the interplay between policy objectives and on-the-ground realities.

Focus Groups

The last qualitative method to be employed in this research will be a focus group session, comprising approximately six participants, users and non-users. The primary goal is to explore the interactive dynamics of actors involved in the e-voucher system, identifying both direct and indirect participants and understanding their motivations for engaging with the system. Additionally, the discussion will delve into how farmers interact with other stakeholders within the e-voucher system and the basis of their decision-making processes.

Employing Participatory Rural Appraisal (PRA) techniques, such as participatory stakeholder mapping, the focus group will facilitate an in-depth discussion on these topics. This approach encourages active participation, enabling farmers to visually map out the network of actors involved and discuss their experiences and observations. This method is particularly effective in uncovering the complex web of interactions and incentives that drive the e-voucher system, providing valuable insights into its operation and the dynamics between different stakeholders. Through this focused dialogue, the research aims to identify key areas for enhancing stakeholder engagement and improving the system's design and implementation for the benefit of the farming community. However, it is important to acknowledge potential risks, such as the reluctance of participants to share detailed information, especially concerning sensitive topics or conflicts between farmers and the government.

Soil Sampling

Another quantitative method to be utilized in this study is soil sampling, to investigate whether there are observable differences in soil fertility between e-voucher users and non-e-voucher users. This approach will involve collecting and analyzing soil samples from the fields of both groups and assessing key indicators of soil productivity and fertility such as the nutrient availability of Nitrogen and Phosphorus. By employing quantitative analysis, this method aims to empirically determine the impact of the e-voucher system's adoption on soil quality, providing measurable and statistically significant data on the system's effect on agricultural practices.

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