

**EVALUATION OF THE INFLUENCE OF INPUT SUBSIDY ON POTATO
PRODUCTION, PRODUCTIVITY AND TECHNOLOGY ADOPTION
AMONG SMALLHOLDER FARMERS IN MARAKWET WEST SUB-
COUNTY, ELGEYO MARAKWET COUNTY, KENYA**

BEN KIBOR

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DECLARATION

Declaration by the Candidate

This thesis is my original work and has never been presented for the award of an academic degree in any other university and should not be copied, or reproduced in any format without written authority from the author and/or University of Eldoret.

Ben Kibor

Date _____

SAGR/AGE/M/2007/16

Approval by the Supervisors

This thesis is submitted with our approval as the university supervisors.

Date _____

Prof. Linnet Gohole

School of Agriculture & Biotechnology

Department of Seed, Crop & Horticultural Sciences

University of Eldoret, Kenya

Date _____

Dr. Chemwok Philip

School of Agriculture & Biotechnology

Department of Agricultural Economics & Rural Development

University of Eldoret, Kenya

DEDICATION

I would like to dedicate this achievement to my beloved family members, mother and father for your love, support, encouragement and prayers.

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ABSTRACT

Agricultural input subsidies are widely promoted to improve access to critical farm inputs such as fertilizers and certified seeds, especially among resource-constrained smallholder farmers in developing countries. However, limited empirical evidence exists on the extent to which such subsidies impact productivity, profitability, and technology adoption among Potato farmers in Kenya. This study evaluated the influence of agricultural input subsidies on the livelihoods of smallholder Potato farmers in Marakwet West Sub-county. Specifically, the study sought to assess the effect of subsidies on Potato yields, determine their influence on profitability, and examine their role in the adoption of improved production technologies. The study was guided by the Theory of Production and the Cobb-Douglas production function, applying both descriptive and explanatory research designs. A multistage sampling technique was used to select 372 smallholder farmers from a target population of 5,499, from whom data were collected using structured questionnaires. Analytical methods included descriptive statistics, multiple linear regression, the Cobb-Douglas model, and binary logistic regression. The results revealed that 58.0% of farmers received subsidized fertilizers, averaging 537 kg per household, while 83.1% received subsidized Potato seeds, averaging 1,600 kg. Most farmers received fertilizer and seed subsidies once per year, indicating limited seasonal coverage. The average yield of Potato was 9.8 t/ha without subsidies, increasing to 17.1 t/ha with fertilizer subsidy, 12.9 t/ha with seed subsidy, and 21.8 t/ha when both subsidies were received. Profitability also followed a similar trend, with net returns above total variable cost increasing from Kshs 145,764 (31%) without subsidies to Kshs 458,439 (56%) with fertilizer subsidy, Kshs 291,364 (47%) with seed subsidy, and Kshs 718,564 (69%) with both. However, only 32.2% of farmers adopted certified potato production technologies despite the availability of subsidies. Regression analysis showed that agricultural subsidies significantly influenced potato yield ($R^2 = 0.714$, $P < 0.01$), profitability, and technology adoption. Fertilizer quantity ($\beta = 0.679$, $P < 0.001$), seed quantity ($\beta = 0.481$, $P = 0.012$), and combined subsidy access ($\beta = 1.315$, $P < 0.001$) were the most influential predictors driving observed improvements. The study concludes that fertilizer and seed subsidies are effective in improving yields, profitability, and the uptake of certified agricultural technologies, thereby contributing positively to farmer livelihoods. Based on these findings, it is recommended that the government enhance the reach, targeting, and consistency of input subsidy programs, including increasing access to both fertilizers and certified potato seeds. There is also a need to support research on high-yielding, drought- and disease-resistant potato varieties, and strengthen market access through the elimination of brokers and improved farm-to-market linkages. For future research, longitudinal studies are suggested to evaluate the long-term livelihood effects of input subsidies, particularly on income stability and food security. Further studies should examine gender-disaggregated impacts of subsidies and assess the efficiency of digital delivery systems such as e-vouchers in enhancing transparency and accountability in subsidy distribution.

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LIST OF ABBREVIATIONS AND ACRONYMS

AAA:	Agricultural Adjustment Administration Act
CAP:	Common Agricultural Policy
IMF:	International Monetary Fund
IPA:	Importance Performance Analysis
ISPs:	Input Subsidy programmes
NAAIAP:	National Accelerated Agricultural Input Programme
NACOSTI:	National Commission for Science, Technology and Innovation
NCPB:	National Cereal Produce Board
SDG:	Sustainable Development Goal
SPSS:	Statistical Package for Social Sciences
SSA:	Sub Saharan Africa
USA:	United States of America

OPERATIONAL DEFINITION OF TERMS

This section defines various terms and terminologies as used in this study. The following terms were operationalized as shown.

Agricultural inputs: Materials or substances aimed at boosting agricultural productivity. In the current study fertilizers, seeds, herbicides are the most important in the study area

Agricultural subsidy: It is a government incentive paid to agribusiness, agricultural organizations and farmers to purchase inputs toward agricultural production

Beneficiary farmers: Potato farmers who have benefited from the agricultural input-subsidy programme by the government from 2015 to 2022.

Crop yield: Quantity of crops harvested by a farmer

Food Security: Having the ability to have food to meet the nutritional needs in the household.

Free inputs: Farm inputs provided to farmers without any cost attachment

Inputs: Seeds and fertilizers used by the farmers for production

Production: The average total yield of crop over a period of time

Provision of farm inputs: The distribution of agricultural resources needed for farm production, such as fertilizer and seeds.

Social change: Observable differences in any sociological phenomena over any period of time

Subsidized Cost: Price of inputs after government waive part of its cost to lower its market cost.

Vulnerable farmers: Mainly potato farmers who are relatively poor and unable to purchase inputs though they own a piece of land

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter presents the background, statement of the problem, objectives, hypotheses, significance, justification, scope, limitations and assumptions of the study.

1.2 Background of the Study

Agricultural input subsidy interventions by governments aim to incentivize agricultural production by reducing the price of particular inputs like fertilizers, herbicides, machinery, fuel and seeds to prices below what the farmer would have paid in the normal market price (Yi *et al.*, 2025, Nguyen *et al.*, 2023; Tang *et al.*, 2023). Globally, such subsidies have long been used from the European Union's Common Agricultural Policy to Asia's fertilizer and seed support schemes and OECD members' decoupled payments as instruments to stabilize yields, manage risk, and steer technology adoption, even as debates persist over fiscal efficiency, market distortions, and environmental targeting (Nguyen *et al.*, 2023; Tang *et al.*, 2023). The proponents of subsidy programmes content that reduction of the costs of agricultural inputs will result in farmers having more money at their disposal to buy the inputs at the right quantity and have more disposable income to purchase other factors of production such as labour, necessary to drive agricultural production (Kumbhakar *et al.*, 2023). Utilizing agricultural subsidies in crops production may ultimately lead to optimistic effects such as increased production or yields which has a direct effects on food production and income owing to the crop sales; higher market participation and share by the farmers manifested in increased farmers sales and income (Ye *et al.*,

2023). The subsidy programme will also increase crop yields, reduce food therefore tackling the problem of food insecurity in the population.

In Sub-Saharan Africa (SSA), agricultural input subsidies were initially implemented by national governments such as Malawi, Zambia, Kenya, Nigeria, and Ghana, as policy in the 1960s and 1970s, with the aim of enhancing food security and increasing smallholder productivity. However, these programs were later abandoned in the 1990s due to structural adjustment policies from the International Monetary Fund, World Bank, and other Bretton Woods institutions (Bjornlund *et al.*, 2020; Ricker-Gilbert, 2020). In the new millennium, starting from 2000, there was renewed policy momentum leading to reintroduction of subsidies in SSA. This resurgence began with Input Subsidy Programmes (ISPs), which have been widely accepted to promote smallholder production (Kanyamuka *et al.*, 2022). Subsidies were enacted to reduce the cost of acquiring farm inputs for vulnerable farmers who had low financial capacity (Camara & Savard, 2023; Muzangwa, 2022). In the SSA, up to twenty-two countries had working subsidy programmes by the year 2023 (Nguyen *et al.*, 2023). Nevertheless, agricultural input use, as well as subsidies to enhance the use of high inputs in agriculture within the SSA, remains considerably low compared to global standards (Mapanje *et al.*, 2023; Jayne & Rashid, 2013).

In Kenya, subsidies have a long and winding history, having been introduced in the 1960s but later abandoned in the 1990s due to fiscal constraints and structural adjustment reforms (Jayne & Rashid, 2013; Mason *et al.*, 2017). In 2007, the Kenyan government implemented the National Accelerated Agricultural Input Access Programme (NAAIAP) to promote agricultural input use and enhance crop productivity (Njogu, 2011). In addition, the 'Kilimo Plus' input subsidy was rolled

out by the Ministry of Agriculture and Livestock, with the objective of increasing crop yields and household income, which led to a substantial increase in cereal crop production (Tegemeo Institute of Agricultural Policy and Development, 2024). The initial plan was to provide fertilizer and maize seed subsidies to a limited number of districts but was later expanded to cover approximately 2.5 million farmers nationwide. More recently, the government introduced policy measures, including fertilizer subsidy programs aimed at lowering fertilizer prices, increasing usage, and ultimately enhancing national food production (Ariga & Jayne, 2011; Nduati *et al.*, 2015). Over the years, these efforts have significantly increased fertilizer use among farmers through both subsidies and a favorable policy environment that fosters private-sector investments in the fertilizer supply chain (Ariga & Jayne, 2009; Smale & Olwande, 2014). Fertilizer consumption in Kenya rose by 80% between the 1999/2000 and 2021/22 periods, reflecting the impact of these initiatives (Kirimi *et al.*, 2023; Breisinger *et al.*, 2024). According to data from the Kenya National Trading Corporation (KNTC, 2023), over three million farmers from 34 counties had received subsidized fertilizer by June 2023. This indicates widespread national reach, with nearly all agriculturally productive counties benefiting from the program.

In Kenya, there has been limited or no subsidized inputs for most cultivated crops apart from maize farming (Mulupi, 2022). However, some farmers have been known to divert maize-targeted subsidies particularly fertilizers for use in crops such as potatoes, beans, and vegetables, especially in mixed farming systems (Kirimi *et al.*, 2023). This informal reallocation highlights the unmet input needs in other non-maize subsectors like potato production. The cultivation of the potato is concentrated in areas with altitude ranging from 1,600 to 3,200 m asl, which are predominantly found

in counties that also engage in maize farming and thus share infrastructure and input distribution channels. This connection between the crops provides a contextual link between the subsidy focus on maize and the spillover relevance to potato farming. Most production of potatoes occurs around the slopes of Mt. Kenya in regions such as Embu, Nyandarua, Meru, and Kirinyaga and extends to Laikipia. The crop also grows within the Mau Escarpment zones of Mau Narok and Molo, as well as in the Rift Valley Region, notably Nandi, Uasin Gishu, Trans-Nzoia, and Elgeyo-Marakwet Counties (Momanyi & Karanja, 2019). However, the crop is cultivated in many of these areas with limited or no access to targeted input subsidies. Crops do not need subsidies to grow biologically; rather, subsidies improve access to essential inputs like fertilizers and certified seeds, which enhance productivity and economic viability for farmers. Therefore, the average production of potato in Kenya over the last five years was 1.3 to 1.5 million metric tonnes (MMT) (Andati *et al.*, 2023), within a land area of approximately 108,000 hectares (Mwakidoshi *et al.*, 2023). The current yields have been quite low, at only 8–10 tons/ha (64 to 80 50-kg bags) (Momanyi, 2021; Korir *et al.*, 2020; Ndegwa *et al.*, 2020), against a prospective potential of 50–60 tons/ha, which can be achieved under optimal agronomic and climatic conditions (Caliskan *et al.*, 2022).

In Elgeyo-Marakwet County, a subsidy programme was introduced to help increase crop and livestock production, enhance farm incomes, and improve the overall livelihoods of small-scale farmers. Under this programme, the county government has supplied one million tea seedlings, 200,000 coffee seedlings, 500,000 avocado seedlings, 158,000 fingerlings, 14,000 poultry chicks, 214 heifers, 65 Doper rams, and achieved 19,000 artificial inseminations (AI) to date (Ministry of Agriculture,

Livestock and Fisheries, 2018). Currently, the Ministry is also providing fertilizer input subsidies priced at Ksh 3,500 for basal and Ksh 2,000 for top-dressing fertilizers through local National Cereal Produce Board (NCPB) depots, whereas the same fertilizers retail at Ksh 6,500 and Ksh 4,000 respectively at local agrovet outlets. The conundrum surrounding these subsidies lies in the fact that they were primarily intended for maize, coffee, avocado, and livestock producers, without a well-defined framework for supporting other emerging crops such as potatoes, which have recently gained economic importance and expanded in acreage across the county. This lack of targeted support for potato farming limits its productivity potential despite increasing demand and farmer interest in the crop.

1.3 Statement of the Problem

Agriculture remains the primary source of employment for over 70% of Kenya's rural population and contributes approximately 20–33% to the national Gross Domestic Product (GDP). However, the sector's role in ensuring food security, income stability, and improved livelihoods is at risk due to decline in productivity among crops. Among these, potatoes ranked as the second most important staple after maize are critically affected, particularly in the highland regions of Marakwet West Sub-County. Potato farming in the region continues to record low yields and declining profitability. Smallholder farmers face multiple constraints, including high input costs, limited access to certified seed and fertilizers, inadequate extension services, and volatile market prices. These structural and institutional barriers have not only hindered the adoption of improved technologies but have also suppressed productivity growth, keeping most potato farmers trapped in low-input, low-output production cycles. Empirical studies show that average potato yields in Kenya range between 7 and 9 tons per hectare (Seurey, 2020), which is far below the potential yields of 30–40 tons

per hectare under optimal management, and drastically lower than the 120–150 tons per hectare achieved in leading global producers such as the Netherlands and Belgium (Goffart *et al.*, 2022). This wide yield gap illustrates the urgent need for interventions that enhance farmers' access to quality inputs, modern agronomic practices, and effective market linkages. To address these challenges, the Government of Kenya introduced an agricultural input subsidy program designed to increase farmers' access to fertilizers, certified seeds, and agrochemicals. While the initiative sought to enhance crop productivity and rural incomes, its actual impact on smallholder potato farmers in Marakwet West Sub-County remains unknown. Preliminary evidence points to mixed outcomes: some farmers report improved access to inputs and modest yield gains, while others face delayed disbursement, inequitable targeting, and continued yield stagnation. Moreover, there is limited empirical evidence on whether input subsidies have translated into broader livelihood improvements, such as increased household income, enhanced market participation, or food security resilience. The absence of such evidence has created a major knowledge gap, leaving policymakers and county governments unable to make informed decisions regarding the efficiency, equity, and sustainability of subsidy interventions. Therefore, the problem this study addresses is the absence of empirical understanding of how agricultural input subsidies influence potato productivity, profitability, and technology adoption among smallholder farmers in Marakwet West Sub-County. Without such evidence, the potential of subsidy programs to transform rural livelihoods and strengthen Kenya's food security architecture remains largely unrealized. This study thus seeks to fill this gap by empirically evaluating the effects of agricultural input subsidies on smallholder potato farming performance and livelihood outcomes in Marakwet West Sub-County, Kenya.

1.4 Objective of the Study

1.4.1 General Objective

To evaluate the influence of potato input subsidy on potato productivity among smallholder potato farmers in Marakwet West Sub-County.

1.4.2 Specific Objectives

The following were the specific objectives of the study

- i. To evaluate the influence of agricultural input subsidy on potato yield among smallholder farmers in Marakwet West Sub-county.
- ii. To assess the influence of agricultural input subsidy on the profitability of potato farming among smallholder farmers in Marakwet West Sub-county.
- iii. To determine the effect of agricultural input subsidy in enhancing adoption of agricultural technology among smallholder potato farmers in Marakwet West Sub-county.

1.5 Hypotheses

The hypotheses identified for the study include;

H₀₁: Use of Agricultural input subsidies will lead to higher potato yields among smallholder farmers in Marakwet West Sub-county

H₀₂: use of agricultural input subsidies will lead to higher profitability potato among smallholder farmers

H₀₃: Use of Agricultural input subsidies will lead to higher adoption of agricultural technology among smallholder potato farmers in Marakwet West Sub-county

1.6 Significance of the Study

Understanding the influence of potato input subsidy on crop yields is an important policy intervention inquest when such resources have to allocate to such programs or attempt to reform existing programs. In various counties in Kenya, agricultural input subsidy program for smallholder farmers has been ongoing with the government giving farmers subsidized certified potato seed and fertilizers (Mather *et al.*, 2022). The Department of Agriculture and Livestock Report (2022) indicates that there is a huge disparity in production, profitability and adoption of agricultural technologies that enhance agricultural production among smallholder potato farmers. These disparities have seen farmers get between 34-40% of the total potential of peak harvest and income from the sales of the potatoes. Therefore, there is a need to determine the reasons for such large variations in the production of potatoes, and adoption of beneficial technologies among smallholder potato farmers. It is against this backdrop that the current study was undertaken in order to evaluate the influence of agricultural input subsidy on potato production and changing livelihoods among smallholder potato farmers in the study area.

The findings from the study will be used by relevant government ministries, institutions, stakeholders and departments to make decisions on agricultural input subsidy policies and programmes. Also it may help government, Non-Governmental Organizations (NGOs) and the private sector to redefine and redesign their existing agricultural subsidy strategies to increase agricultural productivity, farm profitability, and adoption of agricultural modern technologies among smallholder poor farmers.

There is need to find answers relevant to policy. This attempts to define such by answering the question how subsidy policy may be beneficial to the citizens, in the

process emphasizing the significance of subsidy programmes in improving agricultural crop production.

1.7 Scope of the Study

The study analyzed the influence of agricultural input subsidies (independent variable) on potato production, profitability and adoption of technology among smallholder potato farmers (dependent variables) and its effect on changing farmer livelihoods. The study was carried out in Marakwet West Sub-County. Time scope of the study was production of potato seven months from January to July 2024 but data covered a period of 2020 to 2022.

1.8 Limitations of the Study

This research was limited by scope since the study covered Marakwet West Sub-county and not the entire Elgeyo-Marakwet County. Secondly, the landscape in Marakwet West Sub-county hilly and contain rough patches and some parts had poor road network making it difficult to access some sections of the study area. The use of motorcycle was used to navigate the terrain of the study area. Thirdly, data collection coincided with farming activities or long rainy season making it difficult to collect data from some of the farmers who claimed that they are busy in their farms while some farmers were inaccessible. In cases where data collection coincided with farming activities, or long rainy season, the researcher rescheduled data collection exercise.

1.9 Assumptions of the Study

During the study, the following were the assumptions:

- i. The population of farmers targeted in the study area understood the eligibility criteria for agricultural input subsidies and recognized their importance, making them more likely to participate in the subsidy program.
- ii. The formal distribution mechanisms and channels for accessing agricultural input subsidies by potato farmers were assumed to be operational and accessible during the study period.
- iii. While acknowledging natural variability in soil fertility and topography, it was assumed that such variations were randomly distributed across the sample and did not systematically bias the results.
- iv. The study assumed that any differences in agronomic practices (e.g., spacing, irrigation, pest control) were not significant enough to confound the observed influence of input subsidies on yield, profitability, or adoption of technology.
- v. Farmers used common potato varieties prevalent in the region, and differences in seed variety were not expected to systematically influence the overall findings.

Overall, the study assumed that non-selected external factors such as weather fluctuations, pest outbreaks, or off-farm income were randomly distributed and did not significantly distort the relationships being investigated. These assumptions were necessary to isolate the influence of input subsidies on the key study outcomes.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter reviews literature on agricultural input subsidies with a specific focus on smallholder Potato production. It begins with the global, Sub-Saharan African, and Kenyan context of subsidy programmes and their design features, then synthesizes empirical evidence on three outcome domains central to this study: potato yield (production), farm profitability, and adoption of improved technologies (e.g., certified seed, input use practices). The review then outlines the theoretical foundations Production Theory and the Cobb-Douglas production function that inform the study's specification of relationships between inputs and outputs. A conceptual framework is developed to link input subsidies to production, income, and technology adoption pathways under relevant contextual factors. Finally, the chapter identifies the knowledge gap concerning the effect of input subsidies on potato farming outcomes in Marakwet West Sub-County, thereby motivating the study's empirical models (multiple linear regression/Cobb-Douglas and binary logistic regression) and hypotheses.

2.2 Background of Agricultural Subsidies Programmes

A subsidy entails a financial benefit or assistance, most often from the government, to help businesses, organizations, or individuals (Barbosa, 2024). The role of the government is to offset part of the input cost by purchasing inputs at the market price and selling them to farmers at a subsidized rate (Firasta-Vastani & Sheth, 2025). Subsidies may also take the form of direct financial support paid to farmers through a voucher system, enabling them to purchase inputs at the prevailing market price

(Ahmed, 2024). The global aim of such subsidies is to improve agricultural production by reducing input costs for farmers, thus enabling them to apply optimal input levels (Alta *et al.*, 2021). This approach is based on the hypothesis that when small-scale farmers who typically lack the financial capacity are able to access adequate inputs, their productivity will increase. This theoretical assumption forms the basis for many empirical studies, including the current one, which tests whether subsidies do in fact enhance yield, profitability, and technology adoption among resource-constrained farmers. Agricultural subsidies can take the form of free provision of goods (e.g., fertilizers and seeds) or through redeemable vouchers (Kim *et al.*, 2021). In some countries, subsidies are also extended to cover electricity, fuel, and farm machinery (Barbosa, 2024). While the intention is to empower financially disadvantaged farmers, evidence suggests that in practice, subsidies often disproportionately benefit wealthier farmers who have greater access to distribution channels and purchasing power (Dorward & Chirwa, 2014).

Agricultural subsidy programs began in the late 1960s and 1970s in rural economies, although some countries began subsidizing agricultural production as early as the 1920s (Ciaian *et al.*, 2021). In most developed countries, agricultural subsidies were provided to 70–85% of farmers during the 1970s and 1980s, but the practice stalled in the mid-1990s (Amaglobeli *et al.*, 2024). This decline was largely driven by policy reforms influenced by the World Bank and the International Monetary Fund (IMF), which viewed subsidies as fiscally unsustainable and market-distorting. As a result, many countries scaled back or eliminated subsidies during the 1980s and 1990s (Barbosa, 2024). However, in recent years, there has been a resurgence of interest in the use of subsidies to support agriculture. The United States of America, for example, introduced subsidies in 1933 through the Agricultural Adjustment Act,

which was later replaced by the U.S. Agricultural Act of 1949 (Coppess, 2022). By 2023, the U.S. was providing up to US\$40 billion in agricultural subsidies. Meanwhile, the European Union began its major subsidy programs in the 1960s under the Common Agricultural Policy (CAP), aimed at improving productivity, and remains one of the most heavily subsidized blocs spending approximately US\$100 billion annually to support farmer incomes and productivity (Saman, 2021). In Asia, the use of agricultural subsidies is also well established, with countries such as Japan, Korea, Malaysia, and Thailand receiving substantial government support, mainly in the form of fertilizer and seed subsidies, amounting to over US\$80 billion annually (Prabhakar, 2021). China alone provided an estimated US\$212 billion in subsidies to support its farmers (Jha & Yeros, 2023). In contrast, New Zealand provided subsidies until the mid-1980s, after which the policy was completely phased out (Hawke, 2020).

In Africa, agricultural input subsidies were a common policy in the 1960s, and have been a controversial topic ever since. Countries such as Malawi, Kenya, Zimbabwe, Tanzania, Mozambique, Nigeria, Senegal, Mali, Ghana, Burkina Faso and Zambia, approved the subsidy programmes in 1960s through the 1980s with a sole aim of increasing agricultural productivity and spurring economic growth, especially in poor rural economies (Jellason *et al.*, 2021). In as much as emphasis has been put on countries in Sub-Saharan Africa to implement smart subsidy programmes, it appears that the extent to which these programmes were actually pursuing smart subsidy objectives is quite contentious and limited. However, the subsidies proved to be expensive thus strained the government budgets which led to structural adjustments reforms in the 1980s–1990s (Branca *et al.*, 2022). However, from the 2000s to the

present time, several African governments reestablished subsidies to address low agricultural productivity, food insecurity and rural poverty (Mgomezulu *et al.*, 2024). Currently, the agricultural subsidies have remained low in the continent forcing smallholder farmers in most of these countries to rely on family resources for agricultural investment (Makore & Osode, 2025).

In Kenya, subsidy programmes started in the 1960s under the Ministry of Agriculture and Livestock (Gichobi & Kungu, 2024). In the past, policy analysts believed that subsidies were ineffective and inefficient because they contributed to over-spending and fiscal imbalances. Coupled with the pressure of structural adjustment programmes, the subsidy system was subsequently scrapped in Kenya in the 1990s (Samoei *et al.*, 2025). However, beginning in 2010, under the aegis of the Economic Stimulus Programme (ESP), Kenya reestablished input subsidies to address low agricultural productivity, food insecurity, and rural poverty. By 2023, the government had allocated approximately US\$1.1 billion towards agricultural subsidies primarily for fertilizer procurement and distribution to improve national food production and reduce farmer input costs (Ayalew *et al.*, 2025).

Potato (*Solanum tuberosum* L) is grown in Kenya where it is the second most important food crop after maize. The sector employs over 3.5 million people where over Kshs. 50 billion is obtained from the crop. Growing of potato has been included in the Big 4 Agenda in food nutrition and security. The main potato producing counties include: Baringo, Bomet, Bungoma, Elgeyo-Marakwet, Muranga, Kiambu, Kirinyaga, Kisii, Laikipia, Meru, Nakuru, Nandi, Narok, Nyamira, Nyandarua, Nyeri, Trans-Nzoia, Uasin-Gishu and West Pokot (Thujo and Maina, 2024). While input

subsidy for potato farming may go along in improving productivity of the crops, there is currently no policy on provision of subsidies for potatoes. However, farmers can take advantage of the subsidy programs for other crops like maize to use the same input for potato farming.

One of the most significant aspects in agricultural subsidies is the proportion of farmers receiving the subsidies. Surveys have been conducted, and the results show a variable number of farmers benefiting from subsidized fertilizers and other inputs (Barasa *et al.*, 2018). In 2016, the imported subsidized fertilizers benefited between 400,000 and 650,000 farmers, and a majority of these fertilizers were distributed within the North Rift region (Makau, 2016). Meanwhile, between 2018 and 2023, several farmers across the country received subsidies (Njagi *et al.*, 2024; Kirimi *et al.*, 2023). However, it remains unclear what proportion of farmers from Elgeyo Marakwet County or more specifically Marakwet West Sub-county benefited from these subsidy programmes, as disaggregated data by county or sub-county was not provided in the available national reports.

The average quantity of agricultural subsidies remains one of the most important factors in ensuring adequate production of agricultural crops. This is because the level of subsidization often determines whether farmers can afford to apply optimal quantities of inputs. The quantity of fertilizer required annually is driven by demand from farmers. Although the volume of fertilizers and seeds imported into Kenya is well documented (Kirimi *et al.*, 2023), the actual on-farm demand for these inputs remains poorly established, especially at regional and crop-specific levels. Furthermore, in the case of fertilizers, there are distinct recommendations for planting

and top-dressing applications. These vary by crop, soil type, and season, causing annual fluctuations in national demand that are not consistently monitored or forecasted. The price of inputs is also a significant factor influencing farmers' purchasing decisions, particularly for smallholders with limited financial resources. In Kenya, the market price of fertilizers ranges between Kshs 4,500 and Kshs 6,500 per 50-kg bag (Awuor, 2023). The gap between this market price and the subsidized price defines the extent of financial relief offered to farmers, thereby influencing uptake. However, due to fluctuating market dynamics, logistical costs, and international price volatility, the actual market price of fertilizer can vary widely across time and location making it difficult to define a stable reference point for policy and subsidy calculations.

2.3 Influence of Agricultural Subsidies

The enactments of agricultural subsidies policies have affected potato across the world. These impacts are manifested in the form of influence on crop production, profitability and adoption of agricultural technologies as outlined in this sub-section.

2.3.1 Influence of Agricultural Subsidies on Crop Production

The debate concerning what should constitute agricultural input subsidies and how they influence crop production has occupied literature since the 1960s. One school of thought suggests that subsidies should only be given in the form of fertilizers and seeds (Xhen *et al.*, 2021). Meanwhile, in Asia, subsidies were extended to include farm machinery, irrigation equipment, and other critical inputs that farmers may not readily access but are essential for driving productivity (Wang *et al.*, 2019). In the United States and Canada, subsidy programmes also included government-provided extension services, crop insurance, and mechanization support (Gregory *et al.*, 2023).

In Asia and other Western countries where such comprehensive subsidies are provided, farmers have consistently reported increased production compared to their counterparts without access to subsidies (Johnson *et al.*, 2023; Murray *et al.*, 2024; Tadros *et al.*, 2025). There are a few exceptions, however, where subsidies did not lead to increased production. For example, Harrison *et al.* (2023) found that in parts of South Asia, the distribution of subsidies was poorly timed, inputs arrived after the planting season, and corruption in voucher allocation limited access to intended beneficiaries. In other cases, subsidies were misallocated to wealthier farmers who already had sufficient resources, thereby failing to reach those most in need. These programmatic failures significantly undermined the effectiveness of subsidies in enhancing productivity.

In the SSA, the small-holder farmers are regarded as poor and hence in dire need of agricultural inputs subsidies (Ambitho *et al.*, 2021). Therefore, many countries are providing agricultural inputs through initiatives focusing on fertilizers, and seeds, (Murunga, 2024). In the SSA, Mali, Nigeria, Senegal, Rwanda and Zambia provided agricultural input subsidies longer than other countries (Maseka *et al.*, 2022). There are remarkable success stories of input subsidies increasing agricultural production in these countries, notably maize in Malawi (Chirwa & Dorward 2023), rice in Tanzania (Mshote *et al.*, 2021) and subsistence crops in Senegal (Konate *et al.*, 2021). In Zambia, the success of agricultural subsidies through the voucher system in enhancing food production is clear (Nzola *et al.*, 2024; Mwale *et al.*, 2024). In most of these countries that have long history of subsidies, the agricultural input subsidies improved efficiency, efficacy, and distribution networks of subsidies and reduced the cost of farming (Chirwa & Dorward, 2011).

Countries in SSA were slow in implementing policies for subsidies, which lagged yield compared to other countries of the world where subsidies are utilized (Carter *et al.*, 2023). In the 1990, agricultural subsidies were introduced by various African governments in Malawi, Kenya, Ghana, Zambia and Tanzania targeting production. In Malawi, fertilizer subsidy for maize and tobacco crops were introduced in 2006-2007 season to increase crop productivity. In Malawi, Chibwana, *et al.*, (2024), and Dorward *et al.*, (2013), reported that farm input subsidies increased crop production. An additional kilogram of subsidized fertilizer improved maize production by 1.82 kg and 2.16 kg/ha. in subsequent years. For maize, Chibwana, *et al.*, (2024) reported that subsidized fertilizer increased the yields of the crop 249 kg per hectare, and subsidized certified maize seeds provided simultaneously with fertilizer boosted yield by 447 kg/ha. Meanwhile, Dorward *et al.*, (2013) reported full subsidies programmes increased maize production by 500 kg/ha. Similar results were obtained in Zambia by Mason *et al.*, (2013) found that additional kg of subsidized fertilizer increased the maize yield by 1.88 kg/ha. In Ghana, Wiredu *et al.*, (2015) demonstrated that fertilizer subsidy increased yields of rice by 29 kg/ha. There are however some contradiction in the effects of subsidies on crop yield. The study by Holden and Lunduka, (2024) in Malawi provided contradictory outcomes where the former established positive influence of agricultural subsidies while the later found no influence. In another study within the same region, Chibwana *et al.*, (2012) find increased crop production, while Holden and Lunduka (2024) established reduced impacts of input subsidies.

Subsidies have also been found to improve efficiency in agricultural production (Bojnec & Latruffe, 2013; Sipiläinen *et al.*, 2014; Latruffe *et al.*, 2017; Zhu & Oude Lansink, 2024). Using the Malmquist Productivity Growth Index, studies have shown

that farm subsidies enhanced crop performance in Dutch farms over the period 1990–1999. Fogarasi & Latruffe (2023) further established that technical efficiency and overall productivity in French farms increased significantly following the implementation of subsidy programmes.

2.3.2 Influence of Agricultural Subsidies on Agricultural Profitability

Agricultural profitability refers to the financial returns a farmer earns from agricultural activities after accounting for all input costs, including seeds, fertilizers, labor, land preparation, and other operational expenses. It is commonly measured as net income or return per hectare and reflects the efficiency and sustainability of farm enterprises. Several studies have also found mixed and context-specific results on the relationship between subsidies and farm profitability. In Zambia, Chirwa *et al.* (2023) established that farmers recorded improved profitability following access to fertilizer subsidies. Similarly, a study by Ricker-Gilbert & Jayne (2024) reported that an additional kilogram of subsidized fertilizer improved farm profitability by US\$116 per hectare. However, in a related study, Ricker-Gilbert & Jayne (2022), using a quantile regression model to analyze the effects of subsidized fertilizer on crop income, found that subsidies increased profitability for poor farmers, but no significant effect was observed among wealthier farmers in the United States. In Ethiopia, Maseret *et al.* (2024) found that the quantity of farm input subsidies was a significant predictor of farm household productivity and profitability among potato farmers in the Tigray Region. In Eswatini, Mathemo *et al.* (2025) discovered a significant positive influence of subsidy programmes on the profitability of rye farmers, particularly when coupled with extension services and timely input distribution.

The profitability of farm production has also been examined by several authors who found that they have no influence or negative effects on farm profitability. Sipiläinen *et al.*, (2014) examined profitability of farms in Finland and Norway during the period 1991 to 2008 and found a significant negative association between profitability and subsidies. Another finding in Finland (Hoijsland *et al.*, 2023) found that agricultural subsidies did not affect profitability of Finnish farmers. In Ghana, Assebo *et al.* (2024) found no evidence of increased profits among farmers who used subsidies even though they reported increased crop production.

The above studies highlight the indirect effects of subsidies on crop profitability. In one hand, other authors content that agricultural subsidies increase profitability while there are also evidence that the impacts of subsidies are negligible or negative. Therefore there is need to conduct more studies to establish how subsidies affect profitability in various farmers for diverse number of crops.

2.3.3 Effects of Agricultural Subsidies on Technology Adoption

The conceptualization of adoption of technologically improved potato technologies varies among experts. In the adoption of improved crops, there is tendency to classify farmers as adopters if they are quick to use improved crop technology (Mendoza, 2020; Ortiz-Monasterio & Menab, 2024). Analysis of adoption of technologically improved potato technologies are nevertheless few to make any meaningful conclusions on how subsidies drive technology adoption. It has also proved to be complicated in defining technologically improved potato adoption by the farmers, considering whether one just acquire a set of seeds or not (Kharumnuid *et al.*, 2018).

One of the aim of subsidies is to ensure that farmer adopt new technologies useful for smallholder agricultural production through the use of modern inputs (Osieko *et al.*, 2024). However, whether this has been achieved for many crops remains speculative. Reports suggest that in the SSA where the programmes were being promoted to benefit the poor farmers, the uptake of agricultural technologies such as improved seed has remained lethargic due to a plethora of factors such that hinder farmers use of inputs and lack of capital to invest in farm infrastructure (Oyetunde-Usman, 2022). The campaign and increasing interest in adopting improved potato among smallholder farmers seems to lag behind due to absence of subsidies on such inputs (Fleming *et al.*, 2019; Simelton *et al.*, 2017). The interest in adopting certified potato cultivars among smallholder farmers in developing countries also suffers due to lack of input subsidies in Sub-Saharan Africa (SSA) (Owombo *et al.*, 2018; Garrity, 2004; Sereke *et al.*, 2016). This limited adoption is often attributed to financial constraints, poor extension services, and weak input supply chains, even where subsidy programmes exist. The underlying factors behind low technology adoption in the wake of subsidies are currently being explored, with scholars offering a broad spectrum of explanations, including delayed input delivery, limited awareness, elite capture of subsidy benefits, and inconsistent government support. One research frontier, therefore, concerns the role of input subsidies in promoting the adoption of agricultural technologies such as certified potato seeds to enhance productivity and improve farmer livelihoods (Smith & Dressler, 2017).

2.4 Theoretical Framework

The current study used production theory and Cobb Douglass production theory.

2.4.1 Production Theory

Production process are activities aims at creating goods and services to satisfy human wants (Sui *et al.*, 2021). Based on Adam-Smith theory of economies, production facilitates the conversion of inputs to outputs through the use of a resource (Inoua & Smith, 2023). Measurement of production relies on understanding the rate of output within a given period. Production process is therefore defined by quantity of commodity produced, the form of the goods created and spatio-temporal distribution of the produced good (Chase, 2023). Production theory contemplates that inputs/resources such as the raw material, labour input, machinery, land and enterprise form the factors of production. Demand for production is a function of on its marginal products (Becker, 2017). Marginal products is the change in total product due to the increase of the marginal unit of the factor of production.

The theory of production is an expression of the relationship between the factors of production and the output of goods and services. Mathematically the production function is typically denoted as follows: $Q = f(L, K, N, E)$

Where:

- Q represents the quantity of output produced (goods or services).
- L stands for labour input.
- K represents capital input.
- N denotes land (natural resources) input.
- E represents entrepreneurship input.

Output (Q) is a function of inputs in the study were; fertilizers (f), potato seed(s), agrochemicals(c), land acreage (a), labour (l) and technology use (te). The potato production function was expressed as: $Q_y = f(x_1, x_2, x_3, x_4 \dots x_n)$

Where; $x_1 = f, x_2 = s, x_3 = c, x_4 = a, x_5 = l$ and $x_6 = t$

$$Q_y = \beta_0 + \beta_1 f + \beta_2 s + \beta_3 c + \beta_4 a + \beta_5 l + \dots \beta_6 t + \varepsilon$$

2.4.2 Cobb-Douglass Production Function

A Cobb-Douglas production models the relationship between input and output factors of production. Inputs include labour (L) and capital (K). An Economist by the name Paul Douglas collaborating with a Mathematician Charles Cobs developed the function in 1920s, in the form of: $Q = AK^\alpha L^\beta$ where $\alpha + \beta = 1$

Where K, is the capital which they described as the monetary value of physical assets needed for production, L, productive effort of the workforce. The exponent α measures the responsiveness or elasticity of output with respect to capital. For example, an elasticity of $\alpha=0.5$, or 50%, means that every dollar of capital investment translates to an increase in production valued at \$0.50. The two elasticities are complementary percentages which add up to 100%, reflecting the relative contributions of each factor to any increase in output. Other factors of production can be added to the formula. Each factor is simply multiplied in succession, with the exponents of each factor being required to sum to exactly 1. For example, a Cobb-Douglas model with three factors X_1, X_2, X_3 takes the form $Q = AX_1^\alpha X_2^\beta X_3^\gamma, \alpha + \beta + \gamma = 1$.

2.5 Conceptual Framework

The conceptual framework below indicates the relationship between the input subsidies, technology adoption, agrochemical use, labour and land acreage that enable potato farmers in the target area do farming and output (potato yield) while government policies, cultural beliefs, political environment and weather conditions act as the intervening variables. The relationship between agricultural subsidies, farm production, farmers' income and technology adoption is shown in Figure 2.1.

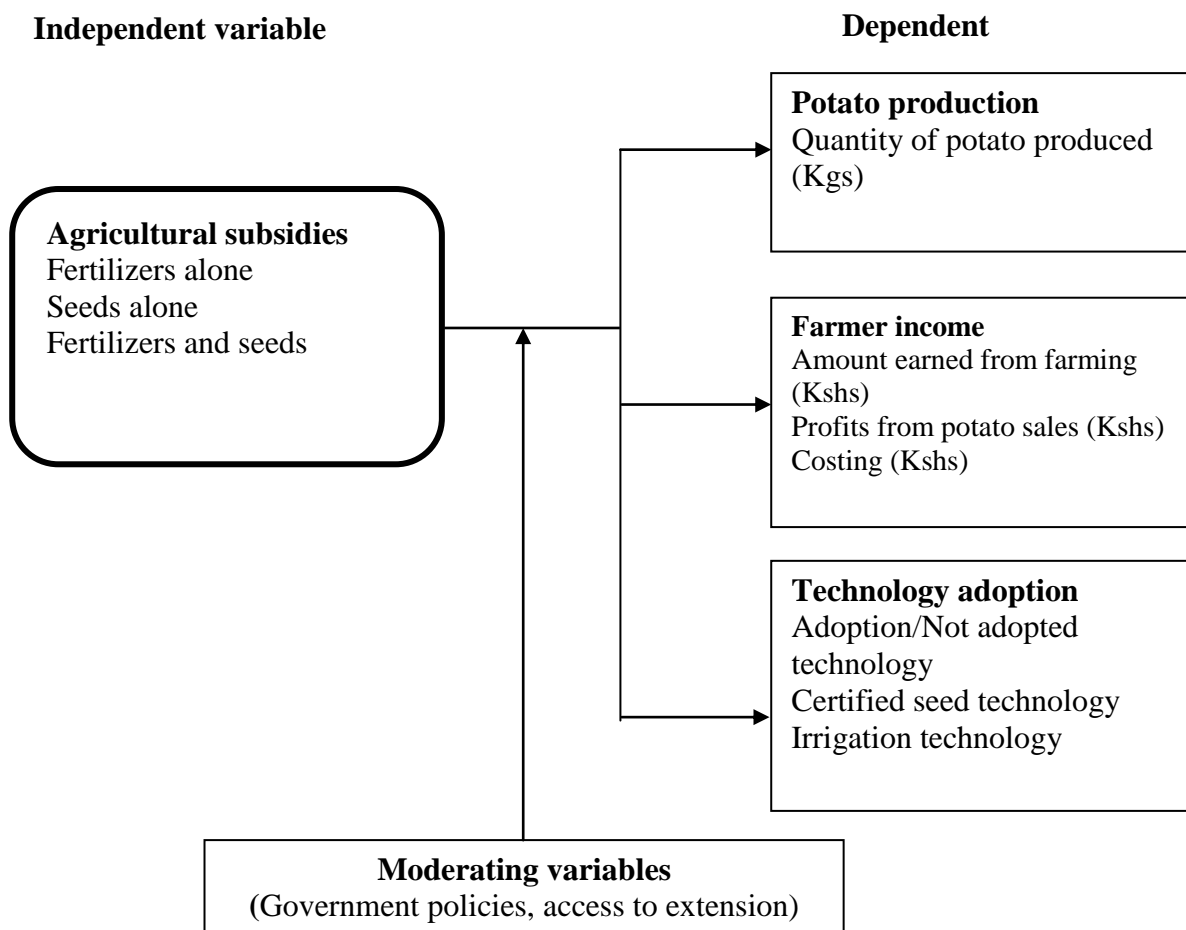


Figure 2.1: Conceptual framework agricultural subsidies, farm production, farmer income and technology adoption

2.6 Identification of Knowledge Gap

A global-based study was conducted with an objective to examine and compare the effects of input and output farm subsidy programs, but lacked any discernable problem statement and conceptual framework (Tang *et al.*, 2024). Data were collected through a review of literature data used in published papers. The model preliminaries were analyzed using multiplicative yield uncertainty. The conclusion derived from the mixed empirical evidence developed a unified modeling framework established that input subsidy increased yields, reduced the farmers' input costs, aggregate income inequality and income gap among farmers. The underlying mechanisms of the two subsidies differed and affected farmers invariably. The model assumed that the mean yield rate $\mu(r)$ of farmer r is exogenous, but can be affected by climate change, thereby affecting overall yields over a longer period. Second, is the assumption that government has full information about the farmers' cost parameters which may be erroneous due to poor information technology infrastructures in developing countries. The study recommended that the issue of risk aversion should be explored in a future study. The study suffers from several gaps such as inability to identify the exact nature of the input subsidies, quantity of subsidies provided, crop that was under cultivation from the subsidies as well as the yields obtained due to subsidies. Moreover, the study failed to look at the influence of input subsidies on farmer income and adoption behavior of new agricultural technologies.

A study on fertilizer subsidy in North-Eastern Ghana by Andani *et al.* (2020) aimed to examine maize productivity response to Ghana's fertilizer subsidy policy in the Tempane District. The variables measured included maize productivity (kg/ha), marital status, age, gender of the farmer, education level, household size, farm size, fertilizer application per hectare, use of improved seeds, access to credit, non-farm

activity, extension services, farm-to-market distance, place of residence, community influence, and media exposure. Although no explicit problem statement was provided, it could be inferred from the background that farmers in Ghana were unable to optimize fertilizer use due to high costs and limited availability. The authors noted that in Sub-Saharan Africa (SSA), fertilizer use remains very low at only 7 kg/ha, compared to over 150 kg/ha in Asia (Fearon *et al.*, 2015). This disparity justified the introduction of agricultural input subsidies to correct market failures and support smallholder productivity. Yet, there are still relatively few studies in SSA that have comprehensively examined the influence of input subsidies on agricultural production outcomes. The study was modeled on the Expected Utility Maximization Theory, which posits that farmers will adopt or use subsidized fertilizers when the anticipated utility (benefits) of doing so outweighs the utility of not using them. Thus, farmers' decisions are influenced by their perception of increased yields, cost savings, and overall improved economic returns associated with the subsidized inputs.

In another study in Tempane District the respondents were purposely selected from five communities to include farmers benefiting from subsidized fertilizers. Data was collected using a semi-structured questionnaire and analyzed using Endogenous Switching Regression (ESR). The results depicted education, area and media access to influence probability of fertilizer subsidy participation. Participation in subsidized fertilizer policy was found to be significantly associated with maize productivity positively. Fertilizer use rate and type of seeds enhanced maize yield. The study showed positive influence of fertilizer subsidy on maize yield. Other socio-economic factors like age and non-farm work also influence maize yield, which made a major recommendation of targeting farmer through field demonstrations.

In Africa, a study by Dorward & Chirwa (2013) had an objective of summarizing field data from nine fertilizer subsidy programmes which were enacted to boost input use to enhance crop production. Data were selected from published work from nine countries where subsidy programmes are available. The review looks at agricultural input subsidies in Ghana, Mali, Nigeria, Rwanda, Senegal, Tanzania, and Zambia. Among these countries there is varying rates of fertilizers subsidies programmes. The results indicated that many African countries are currently seeing a growing interest in agricultural input subsidies focusing particularly on fertilizers but not seeds. However, in Nigeria, the subsidy programme does not reach intended beneficiaries due to diversion. While general increase in crop production was reported among farmers receiving fertilizers, there are no quantitative values provided, and there were no attempts made to discuss profitability of farming as well as adoption of improved agricultural technology due to subsidies. That study reported that none of the countries in Africa had subsidies for potato farming most of them just focusing on fertilizers subsidies for maize farming.

In a study conducted in the Lapai communities of Niger State, Nigeria, Alfa & Sheshi-Tsado (2022) aimed to determine the impact of fertilizer subsidy on rural farmers' productivity. The variables examined in the study included gender, age, education, farm productivity, fertilizer subsidy, farm size, labor, seed, technology, and microcredit. The problem statement identified gaps in previous research, particularly the limited empirical evidence on the effect of fertilizer subsidies on agricultural productivity. A sample size of 142 farmers was selected from a population of 310 registered members of the All Farmers Association of Nigeria (AFAN), using cross-sectional data. Data analysis was conducted using the Ordinary Least Squares (OLS) regression method. The study showed that fertilizer subsidy, in combination with

access to microcredit, positively influenced farmers' productivity particularly in rice production more than maize. Based on these findings, the authors recommended an expansion of the fertilizer subsidy program with an emphasis on reducing input costs for smallholder farmers. However, the study did not provide empirical estimates of the influence of subsidies on crop profitability or the adoption of agricultural technologies, which limited the depth of policy insights that could be drawn from the findings.

In Siaya County, a study was conducted by Ambajo *et al.* (2021) with the objective of evaluating how farm input subsidies affect agricultural yields among small-scale farmers in Alego Usonga Sub-County. The study used a sample size of 317 farmers who were recipients of government-provided subsidies. Data were collected using conventional survey methods, and several analytical techniques were applied, including frequency distribution, percentages, chi-square test, Spearman rank correlation, and logistic regression. The results suggested that the use of input subsidies increased crop yields, profitability, and technology adoption among the smallholder farmers. However, the study was largely qualitative and did not report data on the actual quantities of input subsidies received, nor did it provide quantitative measurements of yield or profitability. Moreover, the study failed to specify which crops were under investigation, limiting the applicability of its findings. The use of binary logistic regression was methodologically flawed, as crop yield is a continuous variable and cannot be accurately modeled using a binary outcome. This may have compromised the validity of the results. Although seed subsidy was mentioned, the study did not report whether farmers received seed subsidies or identify the crop types involved. While the study made the general conclusion that subsidies enhance yield, profitability, and adoption of technologies, this conclusion lacks empirical robustness

and should be validated through an independent, well-designed study focused on a specific crop with quantifiable metrics.

To study fertilizer subsidy as a solution to low maize productivity in Kakamega, Mulupi *et al.* (2021) set the objective of determining the effects of the subsidized fertilizer program on maize productivity. The variables measured included: farm size (area under maize production in ha), manure quantities (kg/ha), household size (number), seed quantities (kg/ha), age (years), schooling (years), gender (1 = Male, 2 = Female), occupation (Farming, Business, and Student), amount of credit (Kshs), distance to market (km), distance to agriculture office (km), and group membership (1 = Yes, 0 = No). The problem statement identified low maize productivity arising from declining soil fertility and limited use of fertilizers as the core challenge. The research used a descriptive survey design, employing semi-structured, personally administered questionnaires. Rational Choice Theory and the Theory of Production were adopted to underpin the analytical framework for estimating maize grain yields. The Tobit regression model was applied due to the censored nature of yield data. The authors demonstrated that fertilizer subsidies resulted in higher usage of fertilizers among beneficiary farmers. Maize productivity was significantly influenced by farm size, household size, certified seed use, age of the farmer, and initial credit accessed. When these factors were considered alongside subsidies, the Tobit model revealed that maize production increased by 32.3% after controlling for other independent variables. Average maize yields were 2.46 t/ha among farmers who received subsidies and 1.97 t/ha among non-beneficiaries. However, even with the subsidy program, the yields did not approach the optimal potential of 5.5 t/ha. The study attributed this yield gap to inadequate extension support, poor agronomic practices, and untimely access or disbursement of subsidized inputs. As a result, the study concluded that

while subsidies are a viable strategy to boost fertilizer use and marginally improve yields, they must be complemented by broader structural reforms such as capacity-building, better timing of input distribution, and access to improved technologies to achieve optimal productivity.

Another study on maize production was conducted by Njurai (2011) at Itabua (Embu County) and looked at the national accelerated agricultural inputs aiming to answer to the objectives of how access to inputs, information and extension services influence maize production. The problem identified low maize production owing to lack of specific inputs like seeds and fertilizers. The solution by the Kenyan government was to implement NAAIAP in various part of the country. The Systems theory was used as the theoretical framework. The descriptive study was limited to a population of 300 farmers from where a sample size of 30 was selected among farmers benefiting from the programme. Structured and semi-structured questionnaires were used to collect data. The study findings showed a positive influence of seeds and fertilizer subsidies increasing maize production by 24%. The report however indicated that there is need to strengthen the programme to achieve long terms success on maize production. This study had some glaring gaps such as presenting the quantity of certified seeds, fertilizers and yield in bags rather than tons/ha.

In study done conducted by Kimoso *et al.* (2022) in Malava and Mumias East Sub-counties, objective centered on the influence of subsidy program on fertilizer usage and maize-grain productivity. The variables measured were: Farm size, manure quantities (Kgha^{-1}), family size (number), seed quantities (kg), age (years), and gender, occupation, amount of credit (Kshs), distance to market (km), distance to agriculture office (km) and group membership (Yes, No). It was shown that up to

59.4% of farmers benefited from the subsidies, with variation in fertilizer usage where those with subsidies used 85.6 kg/ha while those who did not benefit from the programme used 74.9 kg/ha. When Tobit model was applied in analysis, there was noticeable increase in maize production by 32.3%. The result translated to maize productivity of 2.46t/ha. when subsidies were used 1.97t/ha in absence of subsidies. While the outcome of this study was more interesting after good study design, the gaps identified indicate that the study failed to account for influence of quantity and price of the input on maize yield, the study failed to determine the influence of both fertilizer and seeds on yield and study did not look at profitability.

In summary, the reviewed literature highlights the potential of input subsidies to improve agricultural productivity, profitability, and technology adoption among smallholder farmers. While global and regional studies from Ghana, Nigeria, Ethiopia, Zambia to various parts of Kenya have demonstrated varying degrees of success, many have lacked specificity in crop focus, employed flawed methodologies, or failed to provide empirical measurements of yield, profit margins, or input quantities. Particularly in Kenya, most subsidy programs have historically targeted staple crops like maize, with limited attention given to other high-potential crops such as potatoes. Moreover, few studies have offered conclusive evidence on how subsidies translate into improved livelihoods beyond yield gains, such as income diversification or market access.

In Elgeyo Marakwet County, although the government has implemented notable agricultural interventions including distribution of subsidized fertilizers and seedlings for crops like tea, coffee, and avocado these programs have largely bypassed potato farmers, despite the crop's growing economic relevance in the region. No study to

date has systematically evaluated the influence of agricultural input subsidies on potato production, profitability, or the adoption of modern farming technologies in this area. This lack of evidence presents a critical gap in policy planning and resource allocation.

The current study therefore seeks to fill this gap by empirically assessing the influence of agricultural input subsidies on potato productivity, profitability, and technology adoption among smallholder farmers in Marakwet West Sub-County. By focusing on a specific crop within a defined geographical context and employing robust analytical methods, the study aims to generate actionable insights to inform future subsidy design, enhance smallholder resilience, and guide equitable agricultural development strategies in Elgeyo Marakwet and similar highland regions.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter presents the study area, research design, target population, sample size, sampling procedure, instruments of data collection, validity and reliability of instruments, data collection procedures, data analysis, and ethical considerations.

3.2 Study Area

This study was conducted in Marakwet West Sub-County, one of the four sub-counties of Elgeyo-Marakwet County in Kenya's Rift Valley region. Elgeyo-Marakwet County has a population of 454,480, while Marakwet West accounts for 137,513 people in 29,523 households (Kenya National Bureau of Statistics [KNBS], 2019). Administratively, the sub-county comprises six wards Kapsowar, Lelan, Sengwer, Cherang'any/Chebororwa, Moiben/Kuserwo, and Arror. The landscape transitions sharply from the Kerio Valley escarpment to the Cherang'any highlands.

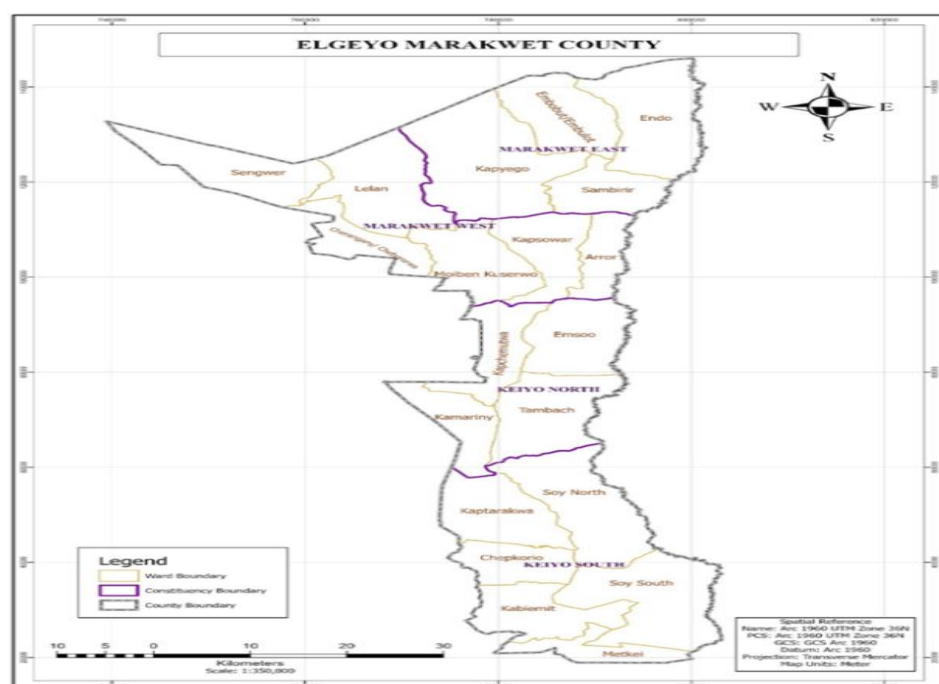


Figure 3.1: Location of the study area

Agro-ecologically, the sub-county spans Lower Midland (LM), Upper Midland (UM), and Upper Highland (UH) zones. Mean temperatures range from about 14°C in the highlands to 24°C in the valley, with annual rainfall between roughly 400 mm in the valley and 1,400 mm on the windward highlands (Ministry of Agriculture and Livestock, 2023). Potato is cultivated in all wards except Arror, which lies in the hotter, drier Lower Midland zone of the Kerio Valley; the cooler UM and UH belts in Lelan, Kapsowar, Sengwer, Cherang'any/Chebororwa, and Moiben/Kuserwo provide suitable altitude and rainfall for ware and seed potato production.

The local economy is predominantly agrarian. Smallholder mixed farming is the main livelihood, combining food and cash crops with livestock. Potatoes, maize, beans, garden peas, and assorted horticultural crops (e.g., cabbages, carrots) dominate in the highland and upper-midland zones, while valley households emphasize drought-tolerant crops, fruit trees, beekeeping, and small ruminants. Dairy (zero-grazing and semi-intensive systems) is an important income source in the cooler highland wards, complemented by poultry and sheep/goat rearing across the sub-county. Off-farm activities retail trade, agro-produce aggregation, transport services, artisanal carpentry/metalwork, and seasonal wage labour in nearby towns provide additional earnings, particularly near market centres such as Kapsowar and along feeder corridors linking to Iten and Eldoret.

Agricultural marketing revolves around periodic markets and farmer groups/cooperatives that facilitate bulking of potatoes and milk, access to certified seed and agro-inputs, and linkage to traders serving Eldoret, Iten, and Kapcherop. Public and faith-based facilities (schools, health centres, mission hospital) and an

expanding rural road network support service employment and market access, though road accessibility in rainy seasons and input price volatility remain binding constraints. Within this setting, potato production is a cornerstone of food security and cash income for highland households, making Marakwet West an appropriate site for analyzing technology-innovation–management practices (TIMPs), institutional support, and their effects on yield and profitability.

3.3 Research Design

This study adopted an explanatory research design because it aimed to establish cause-and-effect relationships between different study variables. In the study, the independent variable was agricultural input subsidies, whereas the dependent variables were three aspects: potato production, income, and adoption of agricultural technology. Correlation analysis, which is one of the methods of analysis used in explanatory research design, was employed to explore the cause-effect relationship between two or more quantitative variables (Rahi, 2017). The suitability of the design lies in the fact that the current study was focused on examining how input-related factors accessed through subsidies influence yields, profitability, and technology adoption.

3.4 Target Population

The target population was smallholder potato farmers who benefited from the subsidy programme in Marakwet West Sub-county. The number of smallholder potato farmers who benefited from the subsidy programme Marakwet West Sub-county during the study was 5,499 (Elgeyo-Marakwet Agriculture Annual Report, 2023). The potato farmer's population distribution per ward is as shown in Table 3.1.

Table 3.1: Population of smallholder potato farmers per ward in Marakwet West Sub-County in 2023

Ward	The target population
Cherang'any/Chebororwa	850
Moiben/Kuserwo	1400
Kapsowar	760
Lelan	1545
Sengwer	944
Total	5,499

Source: Elgeyo-Marakwet Agriculture Annual Report (2023).

3.5 Sample Size

The sample size of the study was calculated by using the Slovincs formula (Tejada & Punzalan, 2012) with a 95% confidence level as:

$$n = \frac{N}{1 + Ne^2} = \frac{5499}{1 + 5499 * 0.05^2} = 372.87 \approx 372$$

Where: n = Sample size required

N = Number of people in the population

e = Allowable error (5%) 0.05 for population 1,000 to 10,000

Therefore, the sample size for this study was 372 potato farmers.

3.6 Sampling Procedure

The sampling procedure adopted in this study was proportional stratified random sampling, designed to ensure fair representation of smallholder potato farmers across Marakwet West Sub-County. The sub-county comprises five administrative wards

Sengwer, Moiben/Kuserwo, Lelan, Kapsowar, and Cherang'any/Chebororwa which served as the strata for this sampling approach. Stratification was based on the understanding that different wards may exhibit varied characteristics in terms of farmer demographics, agro-ecological conditions, and farming practices. By dividing the population into these distinct subgroups, the study aimed to capture this diversity effectively (Makwana *et al.*, 2023).

To begin with, the total number of smallholder potato farmers in each ward was established using records obtained from the respective Ward Agricultural Offices. This data allowed for the determination of the proportion of farmers in each ward relative to the total number of smallholder potato farmers across all five wards. These proportions were then applied to the overall sample size of 372 respondents to calculate the number of participants to be drawn from each ward. For example, if a particular ward accounted for 25% of the total population of farmers, then 25% of the 372 respondents (i.e., approximately 93 farmers) were sampled from that ward.

Once the number of respondents required from each ward was determined, simple random sampling was employed within each stratum. A complete list of registered smallholder potato farmers in each ward was used as the sampling frame. Each farmer was assigned a unique identification number, and a random number generator or lottery method was used to select participants. This ensured that every farmer within a given ward had an equal chance of being selected, thereby minimizing selection bias (Etikan & Bala, 2017).

The first respondent in each ward was selected using the same simple random method. A number was randomly drawn or generated, and the farmer corresponding to that number on the list became the first participant for that particular ward. Subsequent respondents were also selected randomly from the remaining list until the required sample size for the ward was achieved. This procedure allowed for a representative and unbiased sample that reflected the distribution and characteristics of smallholder potato farmers in Marakwet West Sub-County.

Table 3.2: Population, proportion and sample size of smallholder potato farmers per ward in Marakwet West Sub-County in 2023

Ward	Target population	Proportion	Sample
Cherang'any/Chebororwa	850	15.5	58
Moiben/Kuserwo	1400	25.5	95
Kapsowar	760	13.8	51
Lelan	1545	28.1	105
Sengwer	944	17.2	64
Total	5,499	100.0	372

Source: Author's (2023)

3.7 Data Type and Sources

The data collected for this study was primary data. Primary data was collected directly from the 372 potato farmers through structured questionnaires in the five wards of Marakwet West Sub-County. This data collected provided specific information about the subsidy inputs, potato farm production, and profitability and technology adoption.

3.8 Data Collection Instruments

For this study, the data collection instruments were; questionnaire, interview guide and observation checklist. The questionnaire was used to gather information from potato farmers regarding their subsidy inputs, farm production, profitability and technology adoption (Smith, 2019). The interview guide was utilized to conduct in-depth interviews with key stakeholders, such as extension service providers, to explore their perspectives on the logistic of subsidies (Jones *et al.*, 2020). Additionally, an observation checklist was employed during on-site visits to document the status of potatoes production among farmers.

3.8.1 Validity of Instruments

To establish validity, multiple measures were implemented. Firstly, content validity was ensured through expert opinions (Jones, 2019). Content validity was done through discussion with ministry of agriculture officials from Marakwet County. Suggestions were incorporated in the final instruments. Additionally, criterion validity was established by comparing the instrument results with established measures or indicators (Garcia *et al.*, 2016).

3.8.2 Reliability of the Instruments

Reliability was measured using Cronbach's Coefficient (Taber, 2018) as shown below:

$$\alpha = \frac{N\bar{c}}{\bar{v} + (n-1)\bar{c}}$$

Where: α is the Cronbach's Alpha coefficient, \bar{c} is covariance among the items, \bar{v} is the average variance and N is the number of items. Score for Cronbach's Alpha was

obtained during piloting, where a sample of 37 (10% of the sample population) of potato smallholder farmers in Keiyo North Sub-County, Kapchemutwa ward were provided with test questionnaires. Cronbach's alpha coefficient of 0.7 and above was acceptable to validate the study.

3.9 Data Collection Procedures

Before data collection, the researcher applied for research permit from the National Commission for Science Technology and Innovation (NACOSTI), a legally mandated body for research in Kenya. The researcher sought approval from County Government of Elgeyo-Marakwet in the Ministry of Agriculture, Livestock and Fisheries to conduct interviews. Data collection took place from March to June 2024.

3.10 Definition, Measurement of Variables and Expected Signs

In this study, each variable was selected based on its expected influence on potato productivity, profitability, or technology adoption. The variables were operationalized with appropriate units of measurement, and their hypothesized directions of influence were indicated using positive (+) or negative (-) signs. A positive sign (+) suggests that an increase in the variable was expected to lead to an increase in output, while a negative sign (-) implies that an increase in the variable was likely to reduce the output. Table 3.3 presents a summary of the variables used in the study and their respective measurements.

Table 3.3: Descriptions and Measurement of Variables

Variables	Description	Units	Expected sign
Dependent Variables			
potato production (output)	Continuous	Kgs	+
Profits earned from potato farming	Continuous	Kshs	+
Technology adoption	Categorical	Adopted technology: 1=Yes;2=No	+/-
Independent Variables (Agricultural subsidies)			
Access to subsidized fertilizers	Categorical	Has access to subsidized fertilizers: 1=Yes; 2=No	+/-
Access to subsidized seeds	Categorical	Has access to subsidized seeds: 1=Yes; 2=No	+/-
Quantity of subsidized fertilizers	Continuous	50-kg bags	+
Quantity of subsidized seeds	Continuous	50-kg bags	+
Ease of acquiring subsidized fertilizers	Categorical	It is easy to access subsidized fertilizers: 1. Strongly Disagree, 2. Disagree 3 Not sure, 4. Agree 5. Strongly Agree	+
Ease of acquiring subsidized seeds	Categorical	It is easy to access subsidized seeds: 1. Strongly Disagree, 2. Disagree 3 Not sure, 4. Agree 5. Strongly Agree	+

Source: Author (2024)

3.11 Data Analysis and Presentation

Filled questionnaires were screened; coded and entered in IBM Statistical Packages for Social Sciences (SPSS) version 26.0. The collected data was analyzed using appropriate statistical methods to address the research objectives. The analysis involved both descriptive and inferential statistics. Descriptive statistics were used to summarize the characteristics of the variables. Frequency distributions (%) were used for categorical variables. The following are the models that were used to analyze the research objectives.

3.11.1 Cobbs Douglass-Multiple Regression Model

Linearized Cobbs-Douglass production function followed by Multiple linear regression was used to test the strength and direction of the relationship between a single dependent variable measured in this study and three independent variables. The coefficient of each factor showed their relative contribution to the overall prediction of the dependent variables as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_n X_n \dots + \varepsilon_i \dots \dots \dots \text{Eq.1}$$

Where Y is the dependent variable, and $X_1 \dots X_n$ are the n independent variables.

The relationship between production and input factors is usually modeled using Cobbs-Douglass production function in the form: $Q = AK^\alpha L^\beta$. Where Q = output, A is a constant, K and L are combinations of inputs/factors used to produce Q. To linearize the relationship, it takes the form $\ln(Y) = \ln[f(X_i)]$. To evaluate the first objective on the influence of agricultural input subsidy on potato yield among smallholder potato farmers. The Cobb Douglass double log equation was equation used was:

$$\ln(Y) = \ln(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} \dots + \varepsilon_i) \dots \text{Eq 2}$$

Where

$\ln(Y)$ is yield of potato

$\ln(X_1)$ = Received fertilizer subsidies

$\ln(X_2)$ = Frequency of receiving fertilizer subsidies

$\ln(X_3)$ = Price of fertilizer subsidies

$\ln(X_4)$ = Types of subsidized fertilizers

$\ln(X_5)$ = Quantity of subsidized fertilizers received

$\ln(X_6)$ = Received seed subsidies

$\ln(X_7)$ = Frequency of seeds subsidies

$\ln(X_8)$ = Price of seeds subsidies

$\ln(X_9)$ = Types of subsidized seeds

$\ln(X_{10})$ = Quantity of subsidized potato received

$\ln(X_{11})$ = Received fertilizer and seed subsidies

3.11.2 Multiple Regression Model

To evaluate the second objective on the influence of agricultural input subsidy on potato production among smallholder potato farmers. The equation used was:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} \dots + \varepsilon_i \dots \text{Eq 2}$$

Where

Y is Profitability of potato

X₁ = Received fertilizer subsidies

X₂ = Frequency of receiving fertilizer subsidies

X₃ = Price of fertilizer subsidies

X₄ = Types of subsidized fertilizers

X₅ = Quantity of subsidized fertilizers received

X₆ = Received seed subsidies

X₇ = Frequency of seeds subsidies

X₈ = Price of seeds subsidies

X₉ = Types of subsidized seeds

X₁₀ = Quantity of subsidized potato received

X₁₁ = Received fertilizer and seed subsidies

Diagnostic tests were conducted on the regression results obtained from the analytical approach, specifically the SPSS output. These tests aim to assess the assumptions underlying the chosen analytical model, which in this study is multiple linear regression using ordinary least squares. Multicollinearity, which refers to the correlation between independent variables, was assessed using the Variance Inflation Factor (VIF) in SPSS. The VIF measures the extent to which the variance of an estimated regression coefficient is inflated due to multicollinearity. A VIF of 1 indicates no correlation, while values between 1 and 5 suggest moderate correlation that does not require corrective measures. VIFs greater than 5 indicate severe multicollinearity, which can lead to unreliable coefficient estimates and questionable p-values (Snee & Marquardt, 1984).

3.11.3 Binary Logistic Regression Model

The analysis of the third objective, to determine the effect of agricultural input subsidy on adoption of agricultural technology among smallholder potato farmers was

analyzed using binary logistic regression model. This model is used to analyze predictors of outcomes when the output is a binary outcome.

The model used was: $Y_t = f(\beta_0 X_i \dots X_n) + \varepsilon_t$ Eq 3

Where, $\varepsilon \sim N(0, 1)$; β = maximum likelihood; ε = error term; X = set of independent variables included in the model.

The overall binary logistic equation used was

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} \dots \text{Eq 3}$$

Where

Y_t is technology (0 if not adopted and 1 if adopted)

X_1 = Received fertilizer subsidies

X_2 = Frequency of receiving fertilizer subsidies

X_3 = Price of fertilizer subsidies

X_4 = Types of subsidized fertilizers

X_5 = Quantity of subsidized fertilizers received

X_6 = Received seed subsidies

X_7 = Frequency of seeds subsidies

X_8 = Price of seeds subsidies

X_9 = Types of subsidized seeds

X_{10} = Quantity of subsidized potato received

X_{11} = Received fertilizer and seed subsidies

3.12 Ethical Considerations

The main ethical consideration emphasized in the study were those that ensure subject protection during research (Pietilä *et al.*, 2020; Mustajoki and Mustajoki, 2017). Ethical considerations to protect respondents' rights, dignity, and welfare and included: confidentiality, objectivity, openness, and intellectual property rights. The researcher maintained confidentiality through ensuring anonymity of participants' details. The researcher also ensured objectivity by delinking the study from personal interest and group prejudice. The researcher maintained openness by: promoting the study progress through publication and data sharing. The researcher respected the respondents by avoiding gender-based discrimination, as well as biasness through

religion. All intellectual property including copyrights were respected and plagiarism avoided.

CHAPTER FOUR

RESULTS

4.1 Response Rate and Reliability of the Questionnaire

Out of 372 questionnaires that were distributed to smallholder Potato farmers, 326 were successfully returned and deemed usable for analysis. This resulted in a high response rate of 87.6%, which falls within acceptable thresholds for survey-based research.

Additionally, the internal consistency of the instrument was tested using Cronbach's alpha and yielded a coefficient of 0.87. This surpasses the threshold of 0.6, confirming the reliability and validity of the instrument for further analysis.

4.2 Socio-economic Status of Smallholder Potato Farmers

This section provides the results of the socio-economic profiles of the smallholder Potato farmers including age, household size, gender, level of education, and occupation.

A summary statistics showing the mean age and household size is shown in Table 4.1.

Table 4.1: Socio-demographic characteristics of the small-holder potato farmers

	Mean	Std. Dev.	Minimum	Maximum
Age	36.5	10.3	21	63
Household size	4.76	1.87	1	9

The average household size in Marakwet West Sub-County was 4.76 ± 1.87 members in each family, where the minimum number was 1 and maximum of 9 members.

Further results on household size indicate that there were 4.76 ± 1.87 members in each family, where the minimum number was 1 and maximum of 9 members (Table 4.1).

Results of the gender, level of education and main economic activities in the household of the small-holder Potato farmers in Marakwet West Sub-county is shown in Table 4.2.

Summary statistics results on gender of the household head of the small-holder Potato farmers show that 63.8% of farmers were males while 36.2% were females showing the male headed households are aggressive in Potato production (Table 4.2). In terms of education, a significant portion (44.2%) had only primary-level education, followed by 36.8% with secondary education, 16.6% with tertiary qualifications, and a small minority (2.5%) with university-level education. This suggests a relatively low overall education level among the farmers. The farmers also reported engaging in multiple livelihood activities: 80.4% practiced cattle keeping, 73.6% were involved in crop farming (including potatoes), 41.1% in trading, and 27.0% in formal employment. The overlap in economic activities indicates a diversified livelihood strategy aimed at mitigating agricultural risks and enhancing household resilience. These characteristics are crucial in understanding how different farmer profiles may interact with and benefit from agricultural subsidy programs, especially in terms of technology adoption and maximizing returns from potato farming.

Table 4.2: Gender, level of education and position in the household of the smallholder Potato farmers in Marakwet West Sub-county

Attribute	Frequency	%
Gender		
Male	208	63.8
Female	118	36.2
Total	326	100
Level of education		
Primary	144	44.2
Secondary	120	36.8
Tertiary	54	16.6
University	8	2.5
Total	326	100
Main economic activities		
Crop farming	240	73.6
Keeping cattle	262	80.4
Trading activities	134	41.1
Formal employment	88	27.0
Total	724/326*	-

*Number is over 326 due to overlapping activities.

Results on farm sizes indicate that smallholder potato farmers owned an average of 3.24 ± 1.13 acres of land. Out of this, an average of 2.04 ± 0.70 acres, equivalent to $62.9 \pm 12.6\%$, was allocated specifically to potato farming (Figure 4.1). Notably, 1.80 acres, representing 56.5% of the land under potato cultivation, was leased by the farmers, highlighting a strong dependence on hired land for potato production. This trend indicates that while land ownership is limited, farmers often seek to expand their production through seasonal leasing of land to meet the demands of Potato farming.

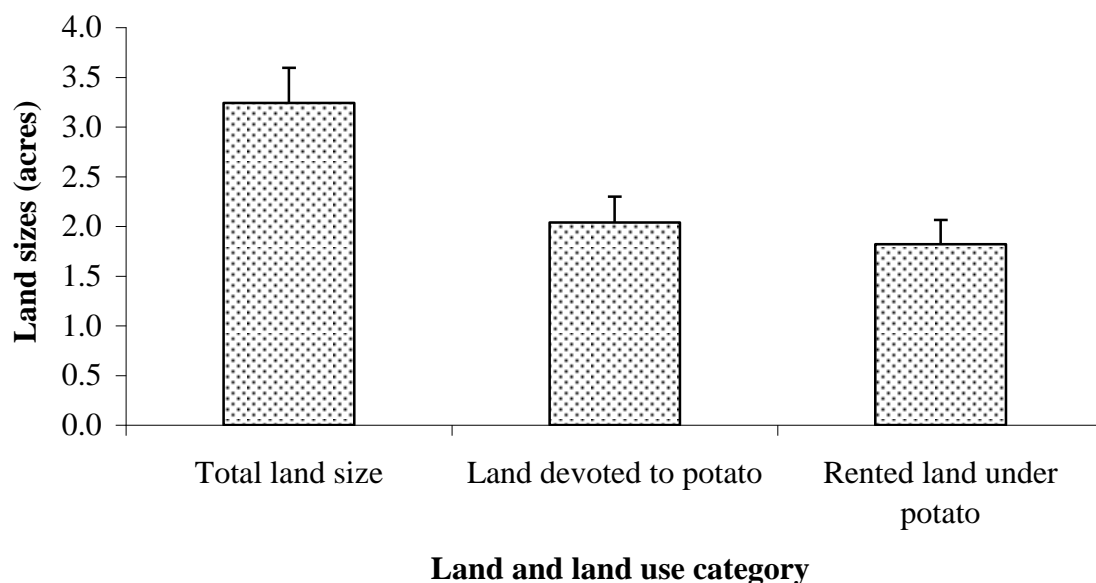


Figure 4.1: Attributes of land sizes among respondents

4.3 Attributes for Fertilizer and Seeds Subsidies

4.3.1 Fertilizer Subsidy Attributes

The findings on fertilizer subsidy revealed that a majority of smallholder farmers in Marakwet West Sub-county (58.0%) received subsidized fertilizers during the planting seasons, while 42.0% reported receiving none. Notably, 48.8% of farmers accessed subsidized fertilizer once per year, and only 9.2% received it twice, despite the region having two planting seasons annually (Table 4.3).

Table 4.3: Percentage of farmers receiving subsidized fertilizers per year among the small-holder farmers

Percentage of farmers receiving subsidized fertilizers	Frequency	%
None	137	42.0
Once	159	48.8
Twice	30	9.2
Total	326	100.0

Analysis of fertilizer quantities used and received across three planting seasons (2020–2022) shows that farmers used an average of 584.8 ± 204.5 kg per year and received an average of 537.4 ± 138.5 kg per year. This translates to 91% coverage of subsidized fertilizer relative to total fertilizer used (Table 4.4).

Table 4.4: Quantities of fertilizer (kgs) used and received by small-holder farmers in 2020, 2021 and 2022 planting seasons

Year	Quantity of fertilizer used	Quantity of fertilizer received
2020	596.8 ± 166.7	544.3 ± 149.5
2021	587.1 ± 164.6	536.0 ± 138.7
2022	570 ± 224.7	530.8 ± 204.5
Average	584.8 ± 204.5	537.4 ± 138.5

The price of subsidized fertilizers was also consistently lower than retail market prices. The average price of subsidized fertilizer dropped from Kshs 4,395 in 2020 to Kshs 3,520 in 2022, while the equivalent market price remained above Kshs 6,200 throughout. On average, subsidized fertilizer cost 36% less than retail market fertilizer over the three years (Table 4.5).

Table 4.5: Subsidized and retail market prices of subsidized and retail market fertilizers in 2020, 2021 and 2022 planting seasons

Year	Average price of subsidized fertilizer	Retail market price of fertilizer
2020	$4,395 \pm 176$	$6,273 \pm 242$
2021	$4,380 \pm 183$	$6,211 \pm 241$
2022	$3,520 \pm 152$	$6,556 \pm 227$
Average	$4,098 \pm 145$	$6,347 \pm 233$

With regard to the type of fertilizer received, the majority of farmers (94.2%) obtained NPK, while a small proportion received both NPK and Urea (4.2%), and only 1.6% received Urea only (Table 4.6).

Table 4.6: Attributes of the subsidized fertilizers received small holder farmers in Marakwet West sub-county.

Attributes	Frequency	Percent
NPK	178	94.2
Urea	3	1.6
Both NPK and urea	8	4.2
Total	189	100.0

4.3.2 Seed Subsidy Attributes

The results indicate that 83.1% of farmers received subsidized Potato seeds, while 16.9% did not. Most respondents (62.6%) received subsidized seed once a year, and 20.6% received them twice, pointing to relatively better access to seed subsidies compared to fertilizer subsidies (Table 4.7).

Table 4.7: Frequency of receiving subsidized seeds among the small holder farmers

Percentage farmers receiving subsidized seeds	Frequency	Percent
None	55	16.9
Once	204	62.6
Twice	67	20.6
Total	326	100.0

Over the three years, farmers used an average of $2,553.1 \pm 261.9$ kg of seed annually but received only $1,600 \pm 106.5$ kg, indicating that the subsidy covered approximately 72% of their seed needs (Table 4.8).

Table 4.8: Quantities of seeds (kgs) demand, received and used by small-holder farmers in 2020, 2021 and 2022 planting seasons

Year	Quantity of seeds used	Quantity of seeds received
2020	2257.4 ± 145.2	1617.5 ± 264.6
2021	2756.3 ± 224.5	1561.7 ± 274.3
2022	2645.5 ± 235.3	1620.8 ± 302.3
Average	2553.1 ± 261.9	1600 ± 106.5

The average price of subsidized ~~Potato~~ seeds was Kshs 3,131 over the three years, compared to an average market price of Kshs 4,556. This shows that the subsidized seeds were sold at 68% of the market value, making them 32% cheaper than retail alternatives (Table 4.9).

Table 4.9: Average price of subsidized and retail market Potato seeds in the 2020, 2021 and 2022 planting seasons

Year	Average price of seed received	Retail market price of fertilizer
2020	3,097 ± 514	4,554 ± 177
2021	3,112 ± 354	4,780 ± 277
2022	3,184 ± 234	4,333 ± 182
Average	3,131 ± 385	4,556 ± 224

In terms of seed type received as subsidized seed, results indicate that majority of smallholder farmers (77%) received certified seeds. A smaller portion used local varieties (12.6%), and 10.4% reported receiving apical cuttings (Table 4.10).

Table 4.10: Type of subsidized potato seed subsidies among the small holder farmers

Attribute	Frequency	%
Certified seeds	251	77.0
Apical cuttings	34	10.4
Local variety	41	12.6
Total	326	100.0

Regarding the variety of Potato planted, Shangi was overwhelmingly the most popular, planted by 89.6% of the farmers. Tigoni and Alka were each grown by only 5.2% of the respondents (Table 4.11).

Table 4.11: Types of subsidized potato seed among the small holder farmers

Potato variety grown	Frequency	%
Shangi	292	89.6
Tigoni	17	5.2
Alka	17	5.2
Total	326	100.0

4.4 Production

The study revealed substantial variation in potato yield based on the type of agricultural subsidy accessed by smallholder farmers in Marakwet West Sub-county. Farmers who operated without any form of subsidy achieved an average yield of 9.8 t/ha. Those who accessed fertilizer subsidies attained a markedly higher average yield of 17.1 t/ha, while those who benefited from seed subsidies alone achieved 12.9 t/ha. The highest average yield was observed among farmers who accessed both fertilizer and seed subsidies, reaching 21.8 t/ha over the 2020–2022 seasons (Table 4.12).

Table 4.12: Yield parameters from fertilizer subsidies, seed subsidies and fertilizer + seeds subsidies among small-holder farmers in 2020, 2021 and 2022

Subsidies	Potato yield (t/ha.)			
	2020	2021	2022	Average
No subsidy	9.7 ± 1.7	9.5 ± 2.1	10.4 ± 1.6	9.8 ± 1.5
Fertilizer subsidy	16.7 ± 2.1	17.3 ± 2.2	17.6 ± 2.5	17.1 ± 1.9
Seed subsidy	12.5 ± 1.6	13.4 ± 2.3	12.8 ± 3.8	12.9 ± 3.4
Fertilizer + seed subsidy	21.4 ± 3.3	21.7 ± 3.8	21.4 ± 4.2	21.8 ± 2.5

4.5 Profitability of Potato Production

Enterprise budget analysis showed that revenue from potato farming was lowest among farmers who did not access any subsidy, earning an average of Kshs 473,600 annually. Farmers who received fertilizer subsidies only, earned Kshs 820,800, while those who accessed seed subsidies only, earned Kshs 619,200. The highest revenue, Kshs 1,046,400, was realized by those who accessed both fertilizer and seed subsidies (Table 4.13). In terms of net returns above total variable costs (TVC), farmers without subsidies earned Kshs 145,764, while those with fertilizer and seed subsidies alone earned Kshs 458,439 and Kshs 291,364, respectively. The highest net return above TVC was Kshs 718,564 for those who accessed both subsidy types. Correspondingly, profit margins were 31% without subsidy, 56% with fertilizer subsidies, 47% with seed subsidies, and 69% with combined subsidies.

Table 4.13: Enterprise Budgeting of Potato Production with or without subsidies (2020–2023)

Revenue from potato sales	Without subsidies	Fertilizer subsidy	Seed subsidies	Fertilizer and seed subsidies
Revenue from potato farming				
Average units of potato harvested (t/ha.)	9.8	17.1	12.9	22
Number of planting seasons	2	2	2	2
Unit cost of potato	24	24	24	24
Total revenue	473,600	820,800	619,200	1,046,400
Variable costs				
Cost of potato seeds	157976	17550	157976	157976
Cost of fertilizers	74177	77567	74177	74177
Cost of farm labour	35500	37767	35500	35500
Cost of herbicides	38000	43500	38000	38000
Cost of land cultivation	7233	7667	7233	7233
Weeding costs	10283	20967	10283	10283
Harvesting costs	4667	6000	4667	4667
Total variable cost (TVC)	327,836	362,361	327,836	327,836
Fixed costs				
Land rates	10000	10000	10000	10000
Amortization	2400	2400	2400	2400
Interest on fixed cost	13,392	13,392	13,392	13,392
<i>Total fixed cost</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>
Total cost (TC)	353,628	388,153	353,628	353,628
Profit margin (%)	31	56	47	69

4.6 Adoption of Agricultural Technologies

Assessment of the adoption of improved agricultural technologies among the smallholder Potato farmers revealed a generally low adoption rate. Only 32.2% of respondents reported adopting modern farming technologies like irrigation technology, drought tolerant potato seeds, while a substantial majority of 67.8% had

not adopted any such innovations (Table 4.14). This highlights a potential constraint to optimizing productivity, despite the availability of subsidies.

Table 4.14: Potato Technologies Adoption among the Agricultural Subsidies in Potato Production

Attribute	Frequency	%
Adopted technological improved agricultural technology		
Yes	105	32.2
No	221	67.8
Total	326	100.0

4.7. Regression Analysis on the influence of subsidies on yield, profitability and adoption

4.7.1 Multicollinearity Test Results

Multicollinearity diagnostic was conducted to assess the suitability of predictor variables used in the regression models evaluating the influence of agricultural subsidies on Potato production, profitability, and adoption of agricultural technologies. Tolerance values and Variance Inflation Factors (VIF) were computed for each predictor. According to established thresholds ($VIF < 5$ and tolerance > 0.25), all predictors in the three models were within acceptable limits, indicating an absence of multicollinearity issues.

For the model examining the effect of subsidies on production, VIF values ranged from 1.070 to 1.450 and tolerance values from 0.690 to 0.935. This suggests that variables such as receipt, price, type, and quantity of both fertilizer and seed subsidies were not highly correlated and were suitable for inclusion in the regression model. In the model linking subsidies to profitability, VIF values similarly remained low (1.305–1.483) with corresponding tolerance values above 0.674, again confirming

that the predictors were independent of each other and would yield reliable coefficient estimates.

In the model examining the influence of subsidies on adoption of technology, slightly higher VIF values were observed (up to 2.365), particularly for variables such as “types of subsidized seeds” and “price of fertilizer subsidies.” However, even the highest VIF remained well below the critical threshold of 10, and all tolerance values exceeded 0.423. These results confirm that multicollinearity was not a concern in this model either.

Table 4.15: Estimates of Multicollinearity Statistics

Model	Multicollinearity statistics	
Model 1: Subsidy against production	Tolerance	VIF
Received fertilizer subsidies	0.935	1.070
Price of fertilizer subsidies	0.813	1.229
Types of subsidized fertilizers	0.789	1.267
Quantity of subsidized fertilizers received	0.935	1.070
Received seed subsidies	0.813	1.229
Frequency of seeds subsidies	0.789	1.267
Price of seeds subsidies	0.935	1.070
Types of subsidized seeds	0.729	1.372
Quantity of subsidized potato received	0.690	1.450
Received fertilizer and seed subsidies	0.789	1.267
Model 2. Subsidy against profitability		
Received fertilizer subsidies	0.755	1.325
Price of fertilizer subsidies	0.705	1.419
Types of subsidized fertilizers	0.766	1.305
Quantity of subsidized fertilizers received	0.729	1.372
Received seed subsidies	0.755	1.325
Frequency of seeds subsidies	0.674	1.483
Price of seeds subsidies	0.705	1.419
Types of subsidized seeds	0.766	1.305
Quantity of subsidized potato received	0.738	1.356
Received fertilizer and seed subsidies	0.695	1.438
Model 3. Subsidy against adoption of technology		
Received fertilizer subsidies	0.498	2.007
Price of fertilizer subsidies	0.455	2.200
Types of subsidized fertilizers	0.508	1.967
Quantity of subsidized fertilizers received	0.498	2.007
Received seed subsidies	0.530	1.886
Frequency of seeds subsidies	0.455	2.200
Price of seeds subsidies	0.616	1.622
Types of subsidized seeds	0.423	2.365
Quantity of subsidized potato received	0.578	1.731
Received fertilizer and seed subsidies	0.596	1.678

4.7.2 Estimates of the Influence of Agricultural Input Subsidy on Potato Production

The multiple linear regression analysis was conducted to determine the influence of agricultural subsidies on Potato production (measured in tons per hectare) among smallholder farmers in Marakwet West Sub-county. Among the predictor variables, several factors had a significant and positive impact on potato yield. Receiving subsidized fertilizers significantly increased yield ($\beta = 0.956$, $p < 0.001$), indicating that access to these inputs contributes substantially to productivity. Similarly, the quantity of subsidized fertilizers received was positively associated with yield ($\beta = 0.679$, $p < 0.05$), emphasizing the importance of adequate fertilizer amounts. The study also found that receiving subsidized seeds had a significant positive effect on the yield? ($\beta = 0.853$, $p < 0.001$), and that the quantity of seeds received contributed positively to yield ($\beta = 0.481$, $p < 0.05$).

The most substantial positive effect was observed when both subsidized fertilizers and seeds were received concurrently ($\beta = 1.315$, $p < 0.001$), highlighting the synergistic impact of integrated subsidy support. However, variables such as the number of times subsidies were received, the prices of subsidized inputs, and the types of fertilizers or seeds did not show significant influence on yield ($p > 0.05$).

Table 4.16: Multiple Linear Regression Model Showing the Relationship between Potato Production (T/Ha.) and Subsidies

	Unstandardized Coefficients		Standardized Coefficients	t Stat	P-value
	Beta	Std. Error	Beta		
(Constant)	2.798	0.899		3.111	0.002
Received subsidized fertilizer	0.956	0.182	0.320	5.246	0.000**
Price of subsidized fertilizer	-0.06	0.000	-0.003	-0.061	0.951
Quantity of subsidized fertilizers	0.679	0.301	0.205	1.769	0.000**
Types of fertilizers	-0.06	0.000	-0.003	-0.061	0.951
Received subsidized seeds	0.853	0.281	0.268	4.461	0.000**
Price of subsidized seeds	0.007	0.005	-0.0204	-3.133	0.343
Quantity of subsidized seeds	0.481	0.201	0.191	2.425	0.000**
Type of subsidized seeds	0.180	0.108	0.076	1.661	0.099
Received subsidized fertilizers and	1.315	0.751	0.345	4.415	0.000**

* = significant at 1% level and **=significant at 5%

4.7.3 Estimates of Influence of Agricultural Input Subsidy on Potato Profitability

The multiple linear regression model presented in Table 4.17 was used to assess the influence of agricultural input subsidies on the profitability of Potato farming among smallholder farmers in Marakwet West Sub-county. The model showed strong explanatory power, with an R Square value of 0.678 and an Adjusted R Square of 0.667, meaning that about 66.7% of the variation in profitability was explained by the subsidy-related variables. The input subsidy factors collectively had a significant impact on profitability (F-statistic value of 34.418 and a p-value less than 0.01).

Several variables emerged as significant predictors. The quantity of subsidized fertilizers received had a positive and significant effect on profitability ($\beta = 0.645$, $p = 0.010$), indicating that higher fertilizer allocations led to increased returns from potato farming. Additionally, receiving subsidized seeds was strongly associated with higher profitability ($\beta = 0.742$, $p < 0.001$), suggesting that access to quality seeds

significantly enhances net farm income. Notably, the combined receipt of both fertilizer and seed subsidies was the most influential variable ($\beta = 1.112$, $p < 0.001$), implying that bundled support programs significantly improve profitability by up to 111.2%.

On the other hand, the price of subsidized seeds showed a significant negative relationship with profitability ($\beta = -0.296$, $p = 0.034$), highlighting that reductions in input costs especially seeds can enhance economic returns. Other variables, such as receipt of subsidized fertilizer alone, price of fertilizer, and type or frequency of input subsidies, were statistically insignificant ($p > 0.05$), indicating that these factors had limited influence in isolation.

Table 4.17: Estimated Results on Influence of Agricultural Input Subsidy on Potato Profitability

	Unstandardized Coefficients		Standardized Coefficients	t Stat	P-value
	Beta	Std. Error	Beta		
(Constant)	2.222	0.149		2.799	0.000
Received subsidized fertilizer	1.102	1.045	-0.096	-1.447	0.150
Price of subsidized fertilizer	-0.843	0.262	-0.003	-0.037	0.971
Quantity of subsidized fertilizers	0.645	0.441	0.284	2.630	0.010*
Types of fertilizers	0.432	0.453	0.057	0.447	0.350
Received subsidized seeds	0.742	0.461	0.332	3.882	0.000**
Price of subsidized seeds	-0.296	0.194	-0.172	2.083	0.0340*
Quantity of subsidized seeds	-0.001	0.000	0.057	0.359	0.868
Type of subsidized seeds	-0.001	0.000	-0.232	-3.339	0.601
Received fertilizers and seed	1.112	0.523	0.460	4.586	0.000**

* = significant at 1% level and **=significant at 5%

4.7.4 Estimates of Agricultural Input Subsidy on Potato Adoption

The influence of agricultural input subsidies on the adoption of certified Potato production technologies was examined using binary logistic regression, with results summarized in Table 4.18. The model demonstrated a good explanatory capacity, as indicated by a Nagelkerke R^2 of 0.4761. This suggests that nearly 47.6% of the variation in adoption behavior among farmers was accounted for by the subsidy-related variables. The overall model fit was statistically significant, confirmed by a high likelihood ratio ($\chi^2 = 110.232$), affirming that the selected variables jointly contributed meaningfully to explaining technology uptake.

Among the variables assessed, receiving subsidized fertilizer significantly increased the likelihood of adopting certified technologies ($B = 0.312$, $p = 0.0012$), with an odds ratio of 1.366. This indicates that farmers who benefited from fertilizer subsidies were 36.6% more likely to adopt certified seed and related technologies compared to those

who did not. Similarly, the quantity of fertilizer received was also a positive and statistically significant predictor ($B = 0.256$, $p = 0.048$), implying that each unit increase in fertilizer quantity raised the probability of adoption by approximately 29.2%. These findings emphasize the role of input availability in removing financial and operational barriers to adoption.

Additionally, farmers who received both fertilizer and seed subsidies exhibited the highest likelihood of technology adoption ($B = 0.846$, $p = 0.002$), with an odds ratio of 2.330, showing they were more than twice as likely to adopt certified potato production technologies. Although other variables such as quantity of subsidized seeds ($B = 0.245$, $p = 0.306$) and type of subsidized seeds ($B = 0.314$, $p = 0.009$) displayed positive influence, only the latter reached statistical significance, suggesting that some specific seed types may be more appealing or effective in motivating adoption.

Table 4.18: Binary Logistic Regression Showing the Influence of the Subsidies on Adoption of Certified Potato Technologies

Variables in the Equation	B	S.E.	Wald	Df	<i>P value</i>	Exp(B)
Received subsidized fertilizer	0.312	0.431	0.575	1	0.0012	1.366
Price of subsidized fertilizer	0.025	0.004	0.036	1	0.095	1.025
Quantity of subsidized	0.256	0.001	1.418	1	0.048	1.292
Types of fertilizers	-0.400	0.284	1.983	1	0.159	.670
Received subsidized seeds	-0.590	0.795	0.550	1	0.458	.554
Price of subsidized seeds	-0.002	0.000	0.194	1	0.659	1.002
Quantity of subsidized seeds	0.245	0.035	1.048	1	0.306	1.278
Type of subsidized seeds	0.314	0.299	0.144	1	0.009	1.369
Received fertilizers and seed	0.846	0.471	3.231	1	0.002	2.330
Constant	1.382	2.273	0.370	1	0.007	3.984

CHAPTER FIVE

DISCUSSION

5.1 Discussion

5.1.1 Fertilizer and Seeds Subsidies

The analysis showed that 58.0% of the farmers received subsidized fertilizer, while 42.0% did not access the support, and half of the farmers (48.8%) received the input only once per year. These findings suggest partial access and seasonal inconsistency in subsidy distribution.

Several factors may explain these findings. First, budgetary constraints and logistical challenges within the national or county-level input subsidy programs may have limited the availability and distribution frequency of subsidized fertilizer. Second, the focus on NPK could reflect national preferences or procurement policies that overlook site-specific soil nutrient needs. Third, targeting inefficiencies may have led to the exclusion of nearly half the farmers, with no clear evidence of targeting based on vulnerability or productivity potential. Lastly, the higher uptake during the long rains season may be driven by farmers' perception of this period as more reliable and productive for Potato cultivation.

These findings align partially with Kirimi *et al.* (2023), who found that approximately 55% of farmers in Kenya's North Rift accessed fertilizer subsidies, albeit primarily once per year. Similarly, a study by Odhiambo *et al.* (2020) reported that fertilizer subsidies in Nakuru County were more accessible during maize planting seasons than for Potatoes, reflecting crop-specific biases in implementation. However, unlike in this study where 91% of farmers' fertilizer needs were met, Njagi *et al.* (2022)

reported coverage rates of below 60% for potato farmers in Embu County, suggesting variability in program intensity across counties.

With regard to seed subsidies, 83.1% of the farmers reported having received subsidized Potato seeds at least once. This proportion is markedly higher than fertilizer access. This is attributed to subsidized cost of fertilizers and seed which was cheaper than the retail market average in agrovet and local shops. These results suggest high adoption of certified seed and a strong varietal preference driven by yield performance or market acceptability.

Several reasons may explain the higher reach of seed subsidies. First, seed interventions have been more actively promoted by both the government and development partners as part of Potato commercialization programs. Second, due to the perishability and high cost of seed potato, farmers may rely more on subsidies to access certified material. Third, the simplicity in handling and distributing seeds compared to fertilizers may have enhanced program efficiency. Finally, Shangi's dominance could be attributed to its short maturity period and market preference, which aligns with findings by Kaguongo *et al.* (2014) that Shangi commands a higher price and is preferred in urban markets.

When compared to other studies, these results support the findings by Mburu *et al.* (2021), who documented that over 75% of potato farmers in Elgeyo Marakwet preferred Shangi and that certified seeds were considered more productive and disease-tolerant. Similarly, a study by Gildemacher *et al.* (2011) across Kenya reported that farmers showed higher willingness to adopt certified seed when

subsidized, particularly when accompanied by extension services. However, this study's relatively high 72% seed coverage contrasts with Waceke *et al.* (2022), who found that less than half the required seed quantities were met through subsidy programs in Nyandarua and Meru counties, indicating local improvements in seed access.

Taken together, the study reveals that farmers received more potato seed subsidies than fertilizers, both inputs contributed significantly to meeting the production needs of smallholder farmers. The subsidy programs effectively reduced input costs, with fertilizer and seed being 36% and 32% cheaper than market prices, respectively. However, coverage gaps and seasonal inconsistency in fertilizer subsidies pose a constraint to maximizing production potential, especially given the two-season production calendar.

The choice of fertilizer (primarily NPK) and seed type (dominantly certified Shangri) further suggests limited varietal and nutritional diversity. This trend may constrain long-term soil health and system resilience. Additionally, the substantial proportion of farmers who only received inputs once or not at all underscores the need for better targeting, program expansion, and consideration of regional agronomic needs. These patterns suggest that while input subsidies have proven valuable, their full potential remains underutilized due to inconsistent access, supply chain challenges, and limited integration with broader extension and market support systems.

In summary, the findings from this study indicate that agricultural input subsidy programme in Marakwet West Sub-county have partially achieved their goal. The

subsidy programs through cost reduction and improved input access play an essential role in supporting smallholder potato production by the farmers. Addressing the gaps in distribution frequency, varietal diversity, and program targeting could significantly enhance their effectiveness in boosting productivity, adoption of certified inputs, and rural farmer welfare.

5.1.2 Influence of subsidies on Potato Production

The study investigated the role of input subsidies specifically fertilizer, seed, and combined fertilizer-seed subsidies on Potato yields among smallholder farmers in Marakwet West Sub-County from 2020 to 2022. The study showed a consistent and substantial increase in potato yields among farmers who received subsidies compared to those who did not. These findings indicate that subsidies especially when provided as a package greatly enhanced Potato productivity.

The study revealed that potato yields among smallholder farmers in Marakwet West Sub-county varied significantly based on access to input subsidies. The average yield among farmers who received fertilizer and seed subsidies were much higher than those who did not receive and use the subsidized inputs standing at an average of 84.23 bags per acre. These yield differences underscore the strong contribution of input subsidies in improving crop productivity in resource-constrained farming systems. These findings indicate that subsidies especially when provided as a package greatly enhanced Potato productivity by increasing soil fertility and access to high quality seed with high vigor thus potato production.

When compared with national and regional averages, these results are striking. According to data from the National Potato Council of Kenya (NPCK, 2022), average potato yields in Kenya range between 50 and 60 bags per acre under rainfed conditions without subsidies. Thus, the yield levels among subsidy recipients in Marakwet West far exceed national averages, demonstrating the potential of targeted input support to bridge yield gaps. Comparable results were observed in Nakuru and Uasin Gishu counties where similar subsidy programs raised yields from 55 bags per acre to over 80 bags (Kirimi *et al.*, 2020). The implication is that input subsidies can bring underperforming regions closer to their productive potential, particularly when accompanied by timely delivery and quality assurance mechanisms.

Internationally, a study by Nabahungu *et al.* (2021) in Rwanda reported a 67% yield increase among smallholders following subsidy access, a pattern mirrored in this study. These comparisons affirm that input subsidies are a proven pathway to yield enhancement in both local and regional contexts, particularly for high-input crops like potatoes.

Regression analysis further clarified the quantitative influence of subsidies on Potato yield. Among the predictors, the most impactful was receiving both seed and fertilizer subsidies, followed by receiving only fertilizer subsidies, and receiving only seed subsidies. This means that not only is access to subsidies important, but the quantity received plays a crucial role in determining productivity levels. These results emphasize that larger volumes of subsidized inputs have stronger yield-enhancing effects, likely due to improved soil nutrition and better crop establishment.

Several factors may explain the observed positive impact of subsidies on yield. First, fertilizers, especially NPK and Urea, directly address soil nutrient deficiencies prevalent in the highland regions of Marakwet West. Many smallholder farmers typically apply sub-optimal fertilizer quantities due to cost constraints; thus, subsidies increase application rates closer to agronomic recommendations. Second, certified seeds contribute to higher yields due to their superior genetic potential, disease resistance, and uniform maturity. The availability of such inputs through subsidy programs ensured better crop vigor and tuber uniformity, leading to improved harvests. Third, receiving both fertilizer and seed subsidies created a synergistic effect where the nutrient-rich environment supported optimal expression of genetic traits in certified seeds. This synergy is critical in breaking the yield barrier often observed when only one input is optimized while the other remains constrained. Fourth, cost reduction from subsidies may have indirectly enabled farmers to invest in complementary practices such as timely planting, weeding, disease control, and even simple irrigation, thereby enhancing the overall production system efficiency.

The observed impact of input subsidies in this study is consistent with findings from other parts of Africa. Marenja *et al.* (2012) found that in Malawi, combining fertilizer subsidies with improved maize seeds increased yields by 47%. Similarly, Wiggins and Brooks (2010) observed that the effectiveness of input subsidy programs in sub-Saharan Africa hinges on the bundling of inputs and their timely delivery. In Kenya, the National Agricultural Input Access Programme (NAAIP) has been shown to improve yields by over 40% in targeted counties (Muyanga *et al.*, 2019). The consistency of these results across studies highlights that well-designed subsidy programs especially those addressing both seed and fertilizer gaps can dramatically

raise productivity in smallholder systems. However, critics like Jayne *et al.* (2018) have raised concerns about the sustainability of subsidies due to elite capture, late distribution, and inefficient targeting. In contrast, the strong positive outcomes in Marakwet West suggest that local implementation was relatively effective, possibly due to better administrative structures, farmer sensitization, and community-level accountability mechanisms.

5.1.3 Influence of Input Subsidies on Potato Profitability

The study provides compelling evidence that agricultural input subsidies significantly enhanced the profitability of Potato farming among smallholder farmers in Marakwet West Sub-county. This relationship was confirmed through a multiple linear regression model which showed 68% of the variation in Potato profitability could be explained by the subsidy-related variables included in the model, signaling a strong association between input support and economic returns from potato farming.

The most influential predictor of profitability was receiving both seed and fertilizer subsidies, which had the highest positive effect on potato profitability. This finding underscores the compounded benefits of integrated support. Farmers who accessed both types of subsidies not only benefitted from enhanced soil fertility through subsidized fertilizers but also leveraged the high-yield potential of certified seeds. These two inputs appear to act synergistically, resulting in not only higher yields but also greater profit margins due to the reduced cost of production.

Receiving subsidized seeds alone also had a strong and significant positive impact on profitability, indicating that access to quality planting materials independently

contributes to higher returns. This is likely due to reduced disease incidence and better genetic performance, leading to improved marketable tuber yields. Similarly, the quantity of subsidized fertilizer received had notable positive effect productivity; supporting the idea that increased application of essential nutrients helps maximize productivity, which in turn enhances income. However, the study also revealed that the price of subsidized seeds had a significant negative effect on profitability. This implies that when subsidized seed prices are relatively high though still lower than market rates they can erode some of the profit margins, especially for resource-constrained farmers who operate on tight input-output budgets. This highlights the delicate balance between affordability and profitability in subsidy programs, especially for inputs like certified seed that already command higher baseline prices. There continued subsidy programs among potato farmers may lead to distortion of market efficiencies, inefficient resource allocation and can be manipulation by political class and this may disadvantage many farmers.

The results of this study are in line with findings from other regions. In Rwanda, for instance, Nabahungu *et al.* (2021) reported that targeted input subsidies led to a 67% increase in profit margins in potato farming. In Ethiopia, Holden and Lunduka (2012) demonstrated that subsidies helped smallholder farmers overcome liquidity constraints and increased their income by improving both input use and output sales. Similarly, in Kenya, Kiriimi *et al.* (2020) found that the National Agricultural Input Access Programme (NAAIP) substantially improved profitability for potato producers in the Rift Valley by reducing input costs and stabilizing farm operations.

Nevertheless, the present findings contrast with those of Kibaara *et al.* (2015), who found that inefficiencies such as late input delivery, unpredictable prices, and elite capture undermined the intended profitability gains of subsidy programs. In this study, however, the consistency and reliability of the subsidy program, as reported by the respondents, likely contributed to its effectiveness in enhancing profitability. The Marakwet West case thus exemplifies how well-coordinated and adequately scaled subsidy programs can yield tangible financial benefits for farmers.

In summary, input subsidies not only contribute to increased potato yields but also serve as powerful instruments for improving household incomes and enhancing the economic viability of small-scale farming. The profitability gains observed in this study affirm the importance of both access and affordability in the design and implementation of subsidy interventions. To sustain these gains, policymakers should ensure timely delivery, fair pricing, and bundling of inputs, while expanding coverage to reach more farmers across multiple growing seasons.

5.1.4 Influence of subsidies on Adoption of Agricultural Technologies

This study examined how access to agricultural input subsidies influenced the adoption of improved Potato farming technologies among smallholder farmers in Marakwet West Sub-County. The results revealed that there was low level of adoption despite the presence of input subsidies, suggesting that financial support alone may not be sufficient to catalyze widespread technology uptake among smallholders. The adoption of agricultural technologies can be further increased through agricultural extension training and on-farm demonstration which may accelerate technology transfer and adoption among potato farmers.

The low adoption rate aligns with studies in similar smallholder settings across sub-Saharan Africa. For instance, Okello *et al.* (2016) reported a 42% adoption rate of improved potato technologies in Central and Eastern Kenya, slightly higher than the current study but still well below majority adoption thresholds. Likewise, Nazziwa-Nviiri *et al.* (2017) found that in Uganda, access to subsidized seeds significantly improved technology uptake, although other enabling factors such as extension services, market access, and farmer training also played crucial roles. These comparisons suggest that while subsidies may reduce cost-related barriers, additional constraints such as knowledge gaps, risk aversion, or lack of institutional support may continue to hinder adoption.

The influence of agricultural input subsidies on the adoption of improved farming technologies among smallholder Potato farmers in Marakwet West Sub-county was notable and multifaceted. The study findings revealed that access to subsidized inputs specifically fertilizers and certified potato seeds played a catalytic role in encouraging farmers to embrace modern agricultural practices that they might otherwise have found financially or logistically inaccessible.

Farmers who benefited from input subsidies reported a significantly higher inclination to adopt improved technologies such as certified seed use, precision fertilizer application, pest and disease management techniques, and modern planting methods. In particular, the provision of certified seeds acted as a gateway to improved agricultural performance by exposing farmers to new cultivars like Shangi, Tigoni, and Alka varieties known for better yield potential and disease resistance. Among

these, Shangi emerged as the dominant choice, used by over 89% of recipients, which suggests a diffusion pattern stimulated by subsidy-driven exposure.

Subsidies also encouraged the uptake of complementary practices. Farmers receiving subsidized inputs were more likely to seek agronomic training, attend extension sessions, or use agrochemicals in tandem with certified seeds and fertilizers. This reflects the synergistic effect of subsidies as both an economic lever and an educational nudge. By lowering the initial cost burden, subsidies reduced perceived risk and uncertainty often associated with the adoption of new technologies, especially in subsistence-based systems where resource allocation is a critical constraint.

The results align with previous literature emphasizing the link between subsidies and technology uptake. For instance, Duflo *et al.* (2008) reported that even modest subsidies significantly increased fertilizer use among Kenyan farmers. Similarly, in Rwanda, input support programs were found to double the adoption rate of improved potato varieties within five years (Bizimana *et al.*, 2014). In Ethiopia, subsidized seed access was shown to accelerate uptake of certified cultivars in wheat farming (Spielman *et al.*, 2010). These findings corroborate the current study's evidence that subsidy programs function not merely as economic relief mechanisms but as accelerators of behavioral change and innovation adoption.

Several factors explain this relationship. First, cost reduction lowers the entry barrier for initial adoption. Second, farmers perceive subsidized inputs as endorsements of quality by the government, thus increasing their trust in these technologies. Third, the

increased yield and profitability realized from earlier adoption cycles create a positive feedback loop, reinforcing continued use and experimentation with other complementary technologies. Lastly, extension services linked to subsidy distribution help improve knowledge and confidence, further enhancing uptake. Nevertheless, the sustainability of adoption post-subsidy remains a concern. Some farmers indicated that without continued support, they might revert to traditional practices due to unaffordability of retail inputs. This underscores the need to couple subsidies with financial inclusion initiatives such as farmer cooperatives, input credit schemes, and market access guarantees to ensure long-term adoption.

Input subsidies have a transformative effect on technology adoption among smallholder farmers. Beyond mere access to inputs, they stimulate a broader behavioral shift towards modern, science-based farming. For such transformations to persist beyond the life of subsidy programs, the enabling environment markets, training, credit, and extension must evolve alongside. The findings affirm that when properly structured, subsidies are not just cost-reduction tools but levers for accelerating agricultural modernization.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Overview

The chapter presents a summary of the findings based on research objectives and hypotheses, conclusions, recommendations and suggestions for further study.

6.2. Conclusions

This study sought to examine the role of agricultural input subsidies specifically fertilizer and certified seed subsidies on Potato yield, profitability, and technology adoption among smallholder farmers in Marakwet West Sub-county. The following conclusions are drawn based on the results of the three research objectives:

- Input subsidies played a pivotal role in enhancing agricultural production. Farmers who received subsidized inputs, particularly those farmers using combined fertilizer and seed, recorded significantly higher potato yields compared to those who did not access any form of subsidy.
- In assessing the influence of agricultural input subsidies on potato profitability, the results show that farmers who received both seed and fertilizer subsidies achieved the highest net returns and profit margins. The enterprise budget and regression analyses consistently confirmed that fertilizer and seed subsidies had a statistically significant and positive effect on farm-level economic performance.

- In determining the effect of agricultural input subsidies in enhancing adoption of agricultural technologies, the study found that farmers who accessed subsidized inputs were more likely to adopt improved practices such as certified seed use and modern agronomic methods. Although overall adoption remained relatively low, the data revealed that receipt and quantity of subsidized inputs significantly influenced farmers' likelihood to embrace new technologies.

6.3 Recommendations

Based on the findings of the study, the following recommendations are proposed to enhance Potato yield, profitability, and adoption of agricultural technologies through improved input subsidy programs among smallholder farmers in Marakwet West Sub-County.

- I. To improve the reach and effectiveness of fertilizer and seed subsidies, the government through the Ministry of Agriculture and county-level departments should enhance the timeliness, frequency, and quantity of input delivery. The current practice where most farmers receive inputs only once annually, despite having two cropping seasons, limits potential gains.
- II. Public policy should shift from disbursing singular inputs to promoting synergistic input combinations tailored to local agronomic needs.
- III. It is recommended that input pricing be reviewed periodically to remain in line with farmers' purchasing power and that subsidies be accompanied by interventions that facilitate access to stable markets, improve post-harvest handling, and minimize input price volatility. Introducing input credit facilities and warehouse receipt systems could further help farmers to smooth costs and maximize margins over time.

- IV. To improve long-term agricultural transformation, input subsidies should be strategically used to catalyze the adoption of modern technologies by incorporating training modules, demonstration plots, and farmer field schools to build awareness and capacity around modern practices.
- V. A graduation strategy should also be considered where farmers gradually transition from subsidy dependency to commercial input access, ensuring sustainability and resilience.

6.4 Suggestions for Further Research

In order to enhance the effectiveness of agricultural input subsidies and support increased production of certified potato seeds in similar agro-ecological contexts, the following areas are recommended for further research:

1. Future studies should investigate the long-term effects of varying levels of agricultural input subsidies on the stability of potato yields across different agro-ecological zones. This would provide insights into the sustainability of subsidy-supported production systems.
2. Longitudinal research is recommended to assess the long-term implications of agricultural input subsidies on smallholder farmers' livelihoods, particularly focusing on income stability and food security. Such studies can help determine whether short-term gains translate into sustainable development outcomes.
3. Further research should explore the gender-disaggregated impacts of input subsidies. Understanding how subsidies affect male and female farmers differently can inform the design of more equitable and inclusive agricultural support programs

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APPENDICES

Appendix I. Letter of Transmittal

Ben Kibor,
P.O Box 220-30700
Iten.
Dear Sir/Madam,

REF: REQUEST FOR PARTICIPATION IN RESEARCH STUDY

I am Ben Kibor, a student at the University of Eldoret pursuing a Master's Degree in Agricultural Extension. I am conducting a research study on "**Evaluation of The Influence of Input Subsidy on Potato Production, Productivity and Technology Adoption among Smallholder Farmers in Marakwet West Sub-County, Elgeyo Marakwet County, Kenya**".

You have been selected to participate in this study as a respondent. I therefore request you respond to the questions in this questionnaire. The information collected from you was kept confidential and used purely for this academic work.
Thank you for your cooperation.

Yours faithfully,
Ben Kibor
Reg No" **SAGR/AGE/M/2007/16**
Tel. No. +254 725622898

Appendix II. Questionnaire for Small-Holder Potato Farmers

I am Mr. Ben Kibor, a student at University of Eldoret undertaking Master's Degree in Agricultural Education and Extension. I am carrying out research on **Evaluation of The influence of Input Subsidy on Potato Production, Productivity and Technology Adoption among Smallholder Farmers in Marakwet West Sub-County, Elgeyo Marakwet County, Kenya.**

Your responses will help me to analyse and generate report for my studies. The information given will be treated with utmost confidentiality. If you will have any question(s) kindly contact me through this mobile number 0725622898. Thank you. I request that you respond to the following questions and where you are uncomfortable you can skip the question. The responses will be anonymous. Do not write your name or telephone number or any identifier.

General Information

Date of interview: Day-----Month-----Year-----

Interviewed by----- Ward-----

Personal information and household characteristics

1. Gender of the respondent: Male _____ Female _____
2. Position in the household: Head of the household Spouse of head of the household
 Child Relative Other (Specify)-----
3. Age of the respondent (in years)
4. Total size of the family.....
5. Highest level of formal education attained by the respondent Tick where applicable below
 Primary level
 Secondary level.
 College level
 University level.
6. Primary activity of the respondentTick where applicable below
 Crop cultivation Cattle rearing Other off-farm activities(specify)-----

7. Reason for doing the primary activity.Tick where applicable below
 It generates good income
 I prefer doing it because I like it
 I do it because it is easier to do this activity as compared to other activities
 I do it because my father, grandfather have been doing it
 I do it because I don't have any other choice.
8. Secondary activity of the respondent
 Crop cultivation Keeping cattle Other off-farm activities
9. What is the total land size (in acres) you have for farming potato crop (i.e both owned and rented)? OwnedRented farm..... Government land (eg forest) ----- Acres
Total acres-----

Section B: Subsidy**i) Subsidized fertilizers**

1. Are you aware that the government is giving out fertilizers (subsidy) at a reduced cost?

Yes [] No []

2. How many times have you received fertilizer subsidy?

Three times [] Twice [] Once [] Not received []

3. How would you rate the subsidized fertilizers in terms of price?

Still high [] Moderate [] Cheap []

4. How do you rate the subsidized fertilizer in terms of quality?

Poor in quality [] Normal quality [] Good quality []

5. Which kind of fertilizer did you get in the last 3 years?

NPK [] Ammonia [] Urea []

b. Comment whether the type of fertilizers provided are the types you needed for potato production

.....

6. a. Did the subsidized fertilizer result in increased potato yields?

Yes [] No []

b. If yes, what was the increase in potato yield in 50 kg bags/acre in the last three seasons? -----

7. Kindly rate the level to which you agree with the following statements on fertilizer subsidies in potato farming

	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
PARAMETERS TO BE MEASURED	1	2	3	4	5
F1. I am happy with the fertilizer subsidy programme for potato growing					
F2. The subsidized fertilizer has proved good for potato farming					
F3. Due to subsidy programme, I have access good quality fertilizers for potato farming					
F4. It is easy to enrol and obtain the fertilizers subsidy					
F5. Fertilizer subsidy improved crop production					

8. Please complete the table below based on the last 3 planting season

PARAMETERS TO BE MEASURED	Year		
	2020	2021	2022
Quantity of fertilizer needed/applied for			
Quantity of fertilizer received			
Quantity of fertilizer used			
Price of fertilizer received			
Equivalent market price of fertilizer			

ii) Subsidized potato seeds

9. Are you aware that the government is giving out seed subsidy?

Yes [] No []

10. How many times have you received potato seed subsidy?

Three times [] Twice [] Once []

11. How would you rate the subsidized seeds in terms of price?

Still high [] Moderate [] Cheap []

12. How do you rate the subsidized seed in terms of quality?

Poor in quality [] Normal quality [] Good quality []

13. Which kind of seeds did you get in the last 3 years?

Certified [] Genetically improved [] Local variety []

b. Comment these are the types of seeds you needed for potato production

.....

.....

.....

.....

14. Did the subsidized seeds result in increased potato yields?

Yes [] No []

15. Kindly rate the level to which you agree with the following statements on seeds subsidies in potato farming

	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
PARAMETERS TO BE MEASURED	1	2	3	4	5
S1. I am happy with the seed subsidy programme for potato growing					
S2. The subsidized seed has proved good for potato farming					
S3. Due to subsidy programme, I have access good quality seeds for potato farming					
S4. It is easy to enrol and obtain the subsidized seeds					
S5. Seeds subsidy improved crop production					

15. Please complete the table below based on the last 3 planting season

PARAMETERS TO BE MEASURED	Year		
	2020	2021	2022
Quantity of seed needed/applied for			
Quantity of seeds received			
Quantity of seeds planted			
Price of seeds received			
Equivalent market price of seeds			

Section C: Potato production

1. What is the gross Potato output (kgs) in the following years

Year	Quantity planted	Total land size	Land area under crop	Yield	Fertilizer input	Seed quantity
2020						
2021						
2022						

2. Which month did you plant the potato.....

3. Is the weather conditions favourable for production of potato? Yes [] No []

4. Is there adequate labour for potato farming? Yes [] No []

5. Do you have access to capital for potato farming? Yes [] No []

6. What potato varieties cultivated:

.....

7. What farming system was employed?

Traditional [] Modern []

8. What land tenure system for potato farming:

Privately-owned [] Leased [] Family [] Communal/community-owned []
 State-owned [] Other (Specify) _____

9. Are you a member of in agricultural groups or cooperative societies?

Yes [] No []

Section D: Profitability of the farming enterprise

1. Kindly provide the following statistics for the last 3 years.

Year	2020	2021	2022
Units of potato harvested (50 Kg bag)			
Price per unit of potato (50kg bag)			
Cost of potato seeds (Ksh/50kg)			
Cost of fertilizers (Ksh/50kg)			
Cost of farm labour			
Cost of irrigation			
Cost of agrochemicals			
Cost of land cultivation			
Weeding costs			
Cost of machinery used			
Harvesting costs			
Government taxes			

2. Do you use own parcel of land or hire for potato production?

Hire [] Self [] Hybrid []

3. Do you have access to capital for potato farming?

Yes [] No []

4. Access to marketing services for potato produce:

Yes [] No []

5. Did you pay taxes when selling the produces?

Yes [] No []

Section E: Adoption of agricultural technologies

Kindly respond to the following questions concerning technology adoption in relation to the subsidy programme you obtained.

1 Are you aware of the modern potato farming techniques?

Yes [] No []

2. List the potato farming modern potato farming techniques you have adopted.

i.

ii.

iii.

3. Do you have access to the best quality potato seeds for farming?

Yes [] No []

4. Do you know the fertilizer application rates for potato farming?

Yes [] No []

What are your:-

i. DAP/NPK application rate per acre?.....

ii. CAN/urea application per acre?.....

5. Do you use the modern methods of irrigation methods for potato farming?

Yes [] No []

6. Do you use mechanized farming equipment for potato farming?

Yes [] No []

7. Do you use digital technologies for information in for potato farming?

Yes [] No []

If yes, list them

.....

8. Kindly rate the level to which you agree with the following statements on technology adoption in potato farming

Level of knowledge about technology adoption	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
PARAMETERS TO BE MEASURED	1	2	3	4	5
T1. Due to subsidy programme, I am fully aware of the modern potato farming techniques					
T2. Due to subsidy programme, I have adopted the modern potato farming techniques					
T3. Due to subsidy programme, I have access to the best quality potato seeds for farming					
T4. Due to subsidy programme, I know the fertilizer application rates for potato farming					
T5. Due to subsidy programme, I use the modern methods of irrigation methods for potato farming					
T6. Due to subsidy programme, I use mechanized farming equipment for potato farming					
T7. Due to subsidy programme, I use digital technologies for information in for potato farming					

THANK YOU

Appendix III: Interview guide

Thematic Areas

1. Access to subsidized farm inputs

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2. Affordability of farm inputs

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.....
.....

3. Impact on using subsidy farm inputs on production

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.....
.....

4. Impact on using subsidy farm inputs on profitability

.....
.....
.....

5. Impact on using subsidy farm inputs on production

.....
.....
.....

6. Challenges for the inputs program

.....
.....
.....

5. Proposed way forward

.....
.....
.....

Thank you for taking part in this discussion.

Appendix IV: Preliminary Results

Table A1: Enterprise Budgeting Per Acre of Potatoes, without Fertilizer Subsidies from 2020 to 2023

	Year		
	2020	2021	2022
Revenue from potato sales			
Average units of potato harvested	9.7	9.5	10.4
Number of planting seasons	2	2	2
Unit cost of potato	24	25	23
Total revenue	465,600	475,000	478,400
Variable costs			
Cost of potato seeds	157,276	159,263	157,389
Cost of fertilizers	74,863	72,930	74,738
Cost of farm labour	35500	36000	35000
Cost of herbicides	40000	38000	36000
Cost of land cultivation	7200	7000	7500
Weeding costs	1350	14500	15000
Harvesting costs	5000	4000	5000
Total variable cost (TVC)	321,189	331,692	330,628
Fixed costs			
Land rates	10000	10000	10000
Amortization	2400	2400	2400
Interest on fixed cost	13,392	13,392	13,392
<i>Total fixed cost</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>
Total cost (TC)	346,981	357,484	356,420
Net returns above TVC	144,411	143,308	147,772
Net returns above TC	118,619	117,516	121,980
Margin above TVC (%)	31	30	31

Table A2: Enterprise Budgeting Per Acre of Potatoes, Fertilizer Seed Subsidies from 2020 to 2023

Year	2020	2021	2022	Average
Revenue earned from potato farming				
Average units of potato harvested	16.7	17.3	17.6	17.1
Number of planting seasons	2	2	2	2
Unit cost of potato	24	25	23	24
Total revenue	801,600	865,000	809,600	820,800
Variable costs				
Cost of potato seeds	175,234	170,450	164,500	17550
Cost of fertilizers	77,450	78,550	76,700	77567
Cost of farm labour	37800	38000	37500	37767
Cost of herbicides	45000	42500	39500	43500
Cost of land cultivation	7500	7500	8000	7667
Weeding costs	25000	19450	18450	20967
Harvesting costs	6000	5000	7000	6000
Total variable cost (TVC)	373,984	361,450	351,650	362,361
Fixed costs				
Land rates	10000	10000	10000	10000
Amortization	2400	2400	2400	2400
Interest on fixed cost	13,392	13,392	13,392	13,392
<i>Total fixed cost</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>
Total cost (TC)	399,776	387,242	377,442	388,153
Net returns above TVC	427,616	503,550	457,950	458,439
Net returns above TC	401,824	477,758	432,158	432,647
Margin above TVC	53	58	57	56

Table A3: Enterprise Budgeting Per Acre of Potatoes, with Seed Subsidies from 2020 to 2023

Year	2020	2021	2022	Average
Revenue earned from potato farming				
Average units of potato harvested	12.5	13.4	12.8	12.9
Number of planting seasons	2	2	2	2
Unit cost of potato	24	25	23	24
Total revenue	600,000	670,000	588,800	619,200
Variable costs				
Cost of potato seeds	157,276	159,263	157,389	157,976
Cost of fertilizers	74,863	72,930	74,738	74,177
Cost of farm labour	35,500	36,000	35,000	35,500
Cost of herbicides	40,000	38,000	36,000	38,000
Cost of land cultivation	7,200	7,000	7,500	7,233
Weeding costs	1,350	14,500	15,000	10,283
Harvesting costs	5,000	4,000	5,000	4,667
Total variable cost (TVC)	321,189	331,692	330,628	327,836
Fixed costs				
Land rates	10,000	10,000	10,000	10,000
Amortization	2,400	2,400	2,400	2,400
Interest on fixed cost	13,392	13,392	13,392	13,392
<i>Total fixed cost</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>
Total cost (TC)	346,981	357,484	356,420	353,628
Net returns above TVC	278,811	338,308	258,172	291,364
Net returns above TC	253,019	312,516	232,380	265,572
Margin above TVC	46	50	44	47

Table A4: Enterprise Budgeting Per Acre of Potatoes, with Fertilizer + Seed Subsidies from 2020 to 2023

Year	2020	2021	2022	Average
Revenue earned from potato farming				
Average units of potato harvested	21.4	21.7	21.4	22
Number of planting seasons	2	2	2	2
Unit cost of potato	24	25	23	24
Total revenue	1,027,200	1,085,000	984,400	1,046,400
Variable costs				
Cost of potato seeds	157,276	159,263	157,389	157,976
Cost of fertilizers	74,863	72,930	74,738	74,177
Cost of farm labour	35500	36000	35000	35500
Cost of herbicides	40000	38000	36000	38000
Cost of land cultivation	7200	7000	7500	7233
Weeding costs	1350	14500	15000	10283
Harvesting costs	5000	4000	5000	4667
Total variable cost (TVC)	321,189	331,692	330,628	327,836
Fixed costs				
Land rates	10000	10000	10000	10000
Amortization	2400	2400	2400	2400
Interest on fixed cost	13,392	13,392	13,392	13,392
<i>Total fixed cost</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>	<i>25,792</i>
Total cost (TC)	346,981	357,484	356,420	353,628
Net returns above TVC	706,011	753,308	653,772	718,564
Net returns above TC	680,219	727,516	627,980	692,772
Margin above TVC	69	69	66	69

Table A5: Rating of Agricultural Technology Adoption in Potato Farming

Perception	Strongly Disagree		Disagree		Not sure		Agree		Strongly Agree	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Due to subsidy programme, I am fully aware of the modern potato farming techniques	7	2.1	0	0.0	1	.3	159	48.8	159	48.8
Due to subsidy programme, I have adopted the modern potato farming techniques	1	.3	0	0.0	1	.3	170	52.1	154	47.2
Due to subsidy programme, I have access to the best quality potato seeds for farming	48	14.7	63	19.3	31	9.5	135	41.4	49	15.0
Due to subsidy programme, I know fertilizer application rates in potato farming	47	14.4	95	29.1	54	16.6	68	20.9	62	19.0
Due to subsidy programme, I use the modern methods of irrigation methods for potato farming	48	14.7	13	4.0	1	.3	136	41.7	128	39.3
Due to subsidy programme, I use mechanized farming equipment in potato farming	48	14.7	63	19.3	31	9.5	135	41.4	49	15.0
Due to subsidy programme, I use digital technologies information in potato farming	47	14.4	95	29.1	54	16.6	68	20.9	62	19.0

Table A6: Multiple Linear Regression Model Showing the Relationship between Potato Production (T/Ha.) and Subsidies

Regression Statistics						
Model summary						
Multiple R	0.856					
R Square	0.733					
Adjusted R Square	0.714					
Observations	326					
Standard Error	0.9581					
ANOVA	SS	df	MS	F	P-value	
Regression	367.466	10	36.74	15.633	<0.01	
Residual	134.009	315	2.351			
Total	501.474	325				

Table A7: Estimated Results on Influence of Agricultural Input Subsidy on Potato Profitability

Regression Statistics					
Model summary					
Multiple R	0.82				
R Square	0.67				
Adjusted R Square	0.66				
Observations	326				
Standard Error	2.58				
ANOVA					
	SS	df	MS	F	<i>P</i> -value
Regression	21459.79	10	2145.979	34.4179	<0.01
Residual	19640.46	315	62.351		
Total	41100.26	326			

Appendix V: NACOSTI Research Permit


REPUBLIC OF KENYA


NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 942389 Date of Issue: 03/May/2024

RESEARCH LICENSE



This is to Certify that Mr. BEN KIBOR of University of Eldoret, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Elgeyo-Marakwet on the topic: EVALUATION OF THE INFLUENCE OF AGRICULTURAL INPUT SUBSIDY ON PRODUCTIVITY OF POTATOS AMONG SMALL-HOLDER FARMERS IN MARAKWET WEST SUB-COUNTY, ELGEYO MARAKWET COUNTY, KENYA for the period ending : 03/May/2025.

License No: NACOSTIP/24/34745

942389
Applicant Identification Number


Director General
NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY &
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**Appendix VI: Ministry of Interior & National Administration Research
Authorization**



**OFFICE OF THE PRESIDENT
MINISTRY OF INTERIOR AND NATIONAL ADMINISTRATION
State Department for Internal Security and National Administration**

Telephone: (053) 42007
Fax: (053) 42289
E-mail: ccelgeyomarakwet@yahoo.com
ccelgeyomarakwet@gmail.com
When replying please quote

**COUNTY COMMISSIONER'S OFFICE,
ELGEYO-MARAKWET COUNTY,
P.O. BOX 200-30700
FIEN**

PUB/CC/ 24/2 VOL.III/208

13th May, 2024

Ref.....

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION

MR. BEN KIBOR

This is to confirm that the above named has been authorized to carry out a research on "EVALUATION OF THE INFLUENCE OF AGRICULTURAL INPUT SUBSIDY ON PRODUCTIVITY OF POTATOS AMONG SMALL-HOLDER FARMERS IN MARAKWET WEST SUB COUNTY, ELGEYO - MARAKWET COUNTY" for the period ending 3rd May, 2025

Please accord him the necessary assistance.

**COUNTY COMMISSIONER
ELGEYO MARAKWET COUNTY**

Julius K. Maiyo HSC.
**For: COUNTY COMMISSIONER,
ELGEYO MARAKWET COUNTY.**

CC

Deputy County Commissioner,
MARAKWET WEST SUB COUNTY.

Appendix VII: Ministry of Education Research Authorization



**REPUBLIC OF KENYA
MINISTRY OF EDUCATION
STATE DEPARTMENT FOR BASIC EDUCATION**

TELEGRAM: **EDUCATION - ITEN**
WHEN REPLYING PLEASE QUOTE OUR REFERENCE
EMAIL: cdeetqeyomarakwet@gmail.com

**COUNTY DIRECTOR OF EDUCATION
ELGEYO MARAKWET COUNTY
P.O. BOX 214-30700
ITEN**

DATE: 8th May 2024

REF No: *CDE/EMC/R/26/VOL.IV (98)*

Mr. Ben Kibor
University of Eldoret
P.O. Box 1125
ELDORET

RE: RESEARCH AUTHORIZATION

Following the authorization by the National Commission for Science, Technology and Innovation (NACOSTI) to carry out research in Elgeyo Marakwet County vide authority letter Ref. No. NACOSTI/P/24/34745 dated 3rd May 2024, you are hereby formally granted authority by this office to proceed with your study on “ *Evaluation of the Influence of Agricultural Input subsidy on Productivity of Potatoes Among Small –Holder Farmers in Marakwet West –Sub-County in Elgeyo Marakwet County .*” for a period ending 3rd May, 2025.


Kiproch Cheruiyot


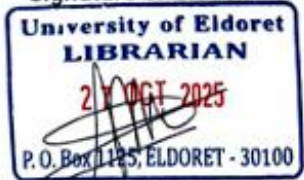
For: County Director of Education
ELGEYO MARAKWET

FOR: COUNTY DIRECTOR OF EDUCATION
ELGEYO MARAKWET
P. O. Box 214-30700,
ITEN

Copy to:

1. The Director General/CEO -NACOSTI
2. Sub County Director of Education- **MARAKWET WEST SUB- COUNTY**

Appendix VIII: Similarity Report

 University of Eldoret Certificate of Plagiarism Check for Thesis	
Author Name	Ben Kibor SAGR/AGE/M/2007/16
Course of Study	Type here ..
Name of Guide	Type here...
Department	Type here...
Acceptable Maximum Limit	Type here... ↻
Submitted By	titustoo@uoeld.ac.ke
Paper Title	EVALUATION OF THE INFLUENCE OF INPUT SUBSIDY ON POTATO PRODUCTION, PRODUCTIVITY AND TECHNOLOGY ADOPTION AMONG SMALLHOLDER FARMERS IN MARAKWET WEST SUB- COUNTY, ELGEYO MARAKWET COUNTY, KENYA
Similarity	4%
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