

Assessing the Impact of Input Subsidies on Agricultural Productivity in Sub-Saharan Africa: Applied Political Economy Analysis

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Abstract

The increasing policy interests and vibrant scholarly debate surrounding the impact of input subsidy programs in Sub-Saharan Africa have inspired a growing literature on how input subsidies affect agricultural productivity. The available empirical evidence provides contrasting views, with one school of thought supporting input subsidies as agricultural productivity catalysts, while another school of thought views input subsidies as agricultural policies that failed to stimulate productivity but instead imposed unsustainable pressure on national fiscal resources. Therefore, understanding the extent to which input subsidies influence agricultural productivity, the prevailing effect, and the drivers behind one effect or the other is a pressing matter to guide policy and practice. As such, this study systematically reviewed existing literature on the subject matter and synthesized the evidence through an applied political economy analysis lens. Concurrently, a meta-analysis was conducted to disentangle the potential determinants of heterogeneity in estimates of the impact of input subsidy programs across different countries. The findings showed that input subsidy programs contributed to boosting agricultural productivity in Sub-Saharan Africa in general. The average pooled effect size of input subsidies on crop value is US\$128/ha ($p < 0.01$). However, there exists a significant heterogeneity in the effect of input subsidy programs from one study to the other ($I^2 = 100\%$). This underscored the role played by the prevailing political economy landscape and other subsidy-specific characteristics on the effectiveness of input subsidy programs in Sub-Saharan Africa. Input subsidy programs providing input packages with both fertilizer and improved seeds, as well as the use of a voucher system, enhance the effectiveness of input subsidies. The incidences of political patronage in subsidized input distribution, on the other hand, undermine the effectiveness of input subsidies. Contingent upon these findings, it is therefore proposed that input subsidy packages should include both fertilizer and improved seeds rather than fertilizer alone. There is also a need to deliberately incorporate legume crops, both from crop diversity and soil fertility points of view. The use of a voucher system is also encouraged to strengthen transparency and increase logistics efficiency and recipient targeting, while also permitting the timely delivery of subsidized inputs to farmers. To curb political patronage, it is suggested that farmer production return forms be used in input subsidy targeting to identify productive (but resource-constrained) farmers and, as a result, remove the involvement of public officials.

Keywords: input subsidies, impact, agricultural productivity, meta-analysis, political economy analysis, and Sub-Saharan Africa.

1. Introduction

Background

Agriculture plays a key role in the socio-economic development and poverty reduction in Sub-Saharan Africa. To boost agricultural productivity and strengthen pro-poor growth, African governments have implemented input subsidies since the 1960s (Holden, 2019). Although input subsidy programs were once phased out in the 1990s due to increased pressure on the fiscus, the momentum changed significantly after Maputo's declaration in 2003, where the Comprehensive Africa Agriculture Development Program (CAADP)¹ was born during the African Union Summit (Jayne et al., 2018). After years of little progress, in June 2014 at the African Union Summit in Malabo, Equatorial Guinea, African governments renewed efforts to implement CAADP and adopted a remarkable set of concrete agriculture goals to be attained by 2025. These goals are commonly referred to as the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods (AU, 2014). The goals provide a more targeted approach to achieve the agricultural vision for the continent of shared prosperity and improved livelihoods, particularly through increasing public investment in agriculture by a minimum of 10 per cent of national budgets and raising agricultural growth by at least 6 per cent (AU, 2014).

Through these commitments, African governments increased agriculture expenditure, particularly through input subsidies. The arguments for such a remarkable re-emergence of input subsidies were that this second generation of input subsidies was called "smart subsidies" and they were designed in such a way as to correct shortcomings of previous subsidy programs through the involvement of private sector players (Jayne et al., 2018). Nevertheless, the input subsidy programs remained a contested agricultural policy debate in Africa despite their rebranding into smart² input subsidies (Gautam, 2015; Holden, 2019; Jayne et al., 2018). This is mainly due to mixed results, as other economists argued that, apart from putting pressure on the national treasury, creating opportunities for rent-seeking and crowding out private investments, input subsidies weakly contributed to agricultural productivity growth (Holden, 2019; Jayne et al., 2018; Lunduka et al., 2013; Shonhe & Scoones, 2022). On the other hand, other schools of thought believed that subsidies stimulated

¹ CAADP, a Pan-African flagship Program to enhance agriculture production to ensure food security on the continent

² Smart input subsidies are defined as subsidies whose implementation facilitates development of private sector-led input markets, targets the poor, sustains existing commercial markets, and uses instruments such as e-vouchers, matching grants and partial loan guarantees.

agricultural production through increased adoption of new technologies and hence contributed to increased productivity and poverty reduction (Harou, 2018; Mwale et al., 2022). These diverging results suggest that there are political economy variables influencing cross-country variations in outcomes and effects of input subsidies programs. It is therefore important to review recent evidence (from a political economy point of view) on the impact of input subsidies to inform policy programming and adapt design and implementation modalities based on what works well and best practices. Most input subsidy programs focused on supporting staple crop production in Sub-Saharan Africa; therefore, the scope of this study is limited to crop sector production (Chirwa & Dorward, 2013; Holden, 2019; Jayne et al., 2018; Kangasniemi & Pirttilä, 2022; Mason et al., 2013; Seleka & Mmopelwa, 2020).

Research issue and problem statement

During the structural adjustment era, input subsidy programs were withdrawn. However, as the execution of CAADP commitments is currently taking course, there is substantial fiscal disbursement towards input subsidies. As an effort to curb shortcomings noted during the 1980s and 1990s in the implementation of input subsidy programs, the new generation of input subsidies under CAADP has been rebranded as smart subsidies to strengthen design and distribution (Jayne et al., 2018; Jayne & Rashid, 2013; Kato & Greeley, 2016; Nhlengethwa et al., 2022). Nevertheless, the input subsidy programs remained a contentious policy debate in Africa (Gautam, 2015; Hemming et al., 2018; Jayne et al., 2018). In the realm of input subsidies, the political and institutional environment within which they are distributed can strengthen or constrain targeting and hence reach of inputs to intended recipients. Since there is involvement of public officials, such as extension officers and politicians, in the identification of beneficiaries and distribution of input subsidies, there are possibilities of corruption, political patronage, and rent seeking. Reviewed literature showed that in most countries, input subsidy programs are characterized by political patronage and rent seeking, where receipt of inputs is based on political party affiliation (Chinsinga, 2011, 2012; Chinsinga & Poulton, 2014; Chirwa & Dorward, 2013; Lunduka et al., 2013). These political economic factors have implications for the effectiveness of input subsidies on agricultural productivity. As a result, two schools of thought have emerged: proponents view input subsidies as catalysts for agricultural productivity, while critics argue that these policies have failed to sustainably boost productivity and have instead imposed unsustainable pressure on national fiscal resources. The proponents of input subsidies are of the view that input subsidy programs have considerably increased uptake of innovations/technology and use of improved inputs among smallholder farmers, thereby contributing to increased agricultural

productivity, improved food supply and nutrition outcomes (Jayne & Rashid, 2013; Matita et al., 2022; Sibande et al., 2017). On the other hand, the opponents believe that input subsidy programs have imposed unsustainable pressure on national fiscus, crowded out private sector input distribution systems and weakly supported agricultural Gross Domestic Product (GDP) growth and poverty reduction in rural areas (Holden, 2019; Kato & Greeley, 2016; Shonhe & Scoones, 2022). Likewise, other studies further argued that the input subsidies are associated with input diversion, patronage, and rent-seeking opportunities, which negatively affect their effectiveness in boosting agricultural productivity (Chinsinga, 2012; Cooksey, 2012; Jayne et al., 2013). This polarized discourse highlighted the relevance of political economy variables in influencing cross-country variances in outcomes, posing a critical problem for policymakers and scholars in deciding whether to design and propose policies in favour of or against input subsidy programs. This quandary can occasionally lead to the development of suboptimal policies and, as a result, the inefficient allocation of scarce public resources. To the best of our knowledge, synthesis studies attempting to reconcile the above-divided perspectives on the impact of input subsidy programs are limited (Hemming et al., 2018; Holden, 2019; Jayne et al., 2018; Jayne & Rashid, 2013; Lunduka et al., 2013).

Concurrently, these previous review studies assumed a homogenous political economy context in which input subsidies are distributed and utilized. Thus, although these studies based on the traditional review of literature provide insights into the overall effect of input subsidies across countries, such an approach leaves unanswered additional research questions related to the mediating roles of political economy factors such as patronage and elite capture, given the contested nature of input subsidy programs in Sub-Saharan Africa. Again, findings from studies based on experimental, quasi-experimental, and econometric modelling are heterogeneous, further reflecting the underlying role played by political economy factors from one country to the other (Jayne et al., 2018; Walls et al., 2018). In light of these considerations, an urgent review and synthesis of current evidence is required to determine if accounting for the political economy variables enhances or reduces the effect of input subsidies on agricultural productivity. Attempts by available review studies mainly focused on the influence of subsidy size or value of a subsidy without interrogating how political economy factors affect the effectiveness of subsidies on various outcomes of interest (Hemming et al., 2018; Jayne et al., 2018; Minviel & Latruffe, 2017). As such, this study aims to bridge this knowledge gap and generate evidence to inform policy programming and design of agricultural input subsidies in Sub-Saharan Africa through a meta-analysis.

Meta-analysis has recently re-emerged as a feasible and robust alternative to traditional literature reviews to identify key sources of heterogeneity from existing published articles (Nguyen et al., 2023; Stanley et al., 2008). Meta-analysis consists of a set of statistical and econometric methods that allow the integration and synthesis of evidence from different but comparable empirical studies to identify sources of heterogeneity (Santeramo & Lamonaca, 2019; Stanley et al., 2008; Stanley & Doucouliagos, 2011). Such an analysis helps to settle the debate around the impact of input subsidy programs by identifying sources of heterogeneity and cross-country variation. This was accomplished by addressing the following research questions: What is the overall impact of agricultural input subsidy programs on productivity based on the published literature to date? and does accounting for political economy variables matter when assessing the impact of input subsidies on agricultural productivity? As a result, the study's specific objectives were to: assess the overall impact of input subsidy programs on agricultural productivity based on available literature, and determine if political economy factors affect the effectiveness of input subsidy programs in boosting agricultural productivity. Evidence from this review is critical to support policy programming, learning, and enable interventions or reforms to maximize intended benefits from input subsidy programs. This is timely given that most governments are currently exploring sustainable pathways to ramp up input subsidies to cushion farmers against rising input prices as a result of intensified geopolitical tensions, which are causing havoc on global inputs and food markets (Arndt et al., 2023; Bizikova et al., 2023; Nhlengethwa et al., 2022).

Research hypotheses

The preceding sub-sections highlighted the crucial role of the political economy context in the attainment of input subsidies' intended outcomes. This study, therefore, develops the following hypotheses focusing on three key political economy factors: political patronage, elite capture, and rent-seeking. The intense debate around input subsidies underscored the important need to evaluate how the political economy landscape mediates the effect of input subsidies in enhancing or constraining agricultural productivity. As such, this study explored the mediating influence of key identified political economy variables (elite capture, political patronage, and rent-seeking) on the effectiveness of input subsidy programs on agricultural productivity. The following null hypotheses will be tested, and the in-depth review of the three political economy variables to be assessed is provided in sub-section 2.4.

Hypothesis 1: Input subsidy programs do not increase agricultural productivity in Sub-Saharan Africa.

Hypothesis 2: Accounting for political economy variables when assessing the impact of input subsidies on agricultural productivity does not matter.

The specific hypotheses for each political economy variable to be assessed are as follows:

H2.1: Accounting for political patronage when assessing the effectiveness of input subsidy programs on agricultural productivity in Sub-Saharan Africa does not matter.

H2.2: Accounting for elite capture when assessing the impact of input subsidy programs on agricultural productivity in Sub-Saharan Africa does not matter.

H2.3: Accounting for rent-seeking when assessing the effectiveness of input subsidy programs on agricultural productivity in Sub-Saharan Africa does not matter.

2. Literature Review, Theoretical and Conceptual Framework

In recent years, input subsidies have been a common feature of agriculture and food systems development policies in Sub-Saharan Africa (Chirwa & Dorward, 2013; Hemming et al., 2018; Jayne et al., 2018). Key examples of input subsidies include free provision of agricultural inputs such as fertilizer, seeds, animal feeds, and veterinary medicines; fuel; agro-chemicals; machinery; tax exemptions and price subsidies to make inputs more affordable to farmers (Hemming et al., 2018; Jayne et al., 2018). Despite substantial public funds disbursements, there are mixed results on the impact of input subsidy programs on agricultural productivity. Such diverging results suggest that design, targeting, and implementation modalities have some influence on the success or failure of these input subsidy programs. Thus, to comprehensively understand the impact and what works well in implementing input subsidy programs for desired welfare outcomes whilst boosting agricultural productivity, one school of thought is no longer sufficient (Gautam, 2015; Hemming et al., 2018). It is therefore important to deliberately integrate the political economy analysis and the traditional agricultural productivity theories. As such, this study systematically reviewed the available evidence on the impact of input subsidies from both neoclassical and political economy analysis perspectives. This provides a holistic approach to input subsidy programs' evaluation to provide insights for improving design, adapting,

targeting, and implementation based on what works well and regional best practices.

Why input subsidy programs in Sub-Saharan Africa?

Agricultural input subsidy programs have been identified as a common strategy to increase agricultural production, ensure food security, and reduce rural poverty in Africa (Dionne and Horowitz, 2016; Jayne et al., 2018; Hemming et al., 2018; Mazwi et al., 2019). Since the Maputo declaration in 2003, most African governments have increased public investment in agriculture through input subsidy programs in line with a CAADP target of a minimum of 10 per cent national budget allocation to agriculture (AU, 2014). This has become part of national social protection policies as governments want to optimize the welfare of citizens despite the trade-off between efficiency, equity, and sustainability. In 2011, 10 Sub-Saharan African countries, including Malawi, Ghana, Zambia, Mali, Tanzania, Senegal, and Nigeria, spent US\$1 billion annually on input subsidy programs since inception, accounting for about 28.6 percent of their agricultural budgets (Jayne & Rashid, 2013). Through these input subsidy programs, African governments also aim to increase input use, thereby increasing agricultural production (Jayne et al., 2018; Hemming et al., 2018; Alabi & Oshobugie, 2020). For example, input subsidy programs have been implemented in Zambia and Ghana since 2002 and 2008, respectively, to increase investment in the agriculture sector and promote the uptake of improved varieties and use of fertilizers (Mason et al., 2013; Kangasniemi & Pirttilä, 2022). In Zimbabwe, input subsidy programs have also been implemented since the early 2000s after the land reform program, supporting newly resettled farmers to increase agricultural production (Govere et al., 2009). Following episodes of the food insecurity crisis in the late 1990s, the government of Malawi also introduced input subsidies to increase maize production (Chinsinga, 2011). Furthermore, since food insecurity might have dire political implications for the ruling governments, many other African governments provide input subsidies to ensure food security and hence national security (Chinsinga, 2011). Concurrently, as input subsidies are essentially direct transfers of public resources to citizens, the impact is immediate and can be recognized easily as measured by increased production. This, in essence, allows ruling governments to signal decisive leadership and concern to their citizens. Based on this evidence, input subsidy programs in Sub-Saharan Africa have four major objectives: (1) increase public agricultural investments in line with Maputo Declaration; (2) increase input use mainly fertilizer and improved seeds; (3) increase national food and nutrition security and hence national security; (4) reduce rural household poverty; and to address multiple market failures faced by poor farmers in accessing agricultural inputs

(Azomahou *et al.*, 2022; Chirwa & Dorward, 2013; Benin *et al.*, 2013; Jayne *et al.*, 2018; Mazwi *et al.*, 2019).

Neoclassical theories for input subsidies

The implementation and resurgence of input subsidies is primarily based on the argument to boost agricultural productivity through the adoption of improved technologies, including fertilizer and improved seed varieties (Azomahou *et al.*, 2022; Jayne *et al.*, 2018). Thus, the neoclassical theoretical underpinnings of input subsidies are based on agricultural production, productivity, investment, and technology adoption theories (Solow, 1957; Hayami & Ruttan, 1985; Odhiambo *et al.*, 2003). It is also understood that input subsidies are meant to address market failures by generating positive overall net economic returns when input costs to the farmer are perceived to be higher than their true social costs (Chirwa & Dorward, 2014). As such, it is argued that input subsidies help to address market failures and reduce the costs of inputs, thereby increasing input use, particularly by smallholder farmers, and leading to increased agricultural production and productivity³ as well as improvement in overall welfare outcomes (Holden, 2019; Mwale *et al.*, 2021). Growth models showed that agricultural output growth emanates from either increased input use (seeds, fertilizer, land, capital & labor) or the adoption of new technologies (Odhiambo *et al.*, 2004). However, given the complex nature of input subsidy program implementation, recent evidence showed that design, political and governance systems play a key role in explaining the variation of success or failure of input subsidy programs (Gautam, 2015; Shonhe, 2018; Hemming *et al.*, 2018; Jayne *et al.*, 2018). The quality of institutions, measured by the level of corruption and government effectiveness, among other indicators, significantly affects the realization of intended outcomes from input subsidies and other public policies in agriculture (Soko *et al.*, 2023). It is, therefore, important and urgent to understand the impact of input subsidies also from a political economy analysis lens.

Political economy analysis theoretical framework

As a departure from the neoclassical theoretical analysis on agricultural productivity growth, there are concerns that input subsidies are significantly associated with rent-seeking opportunities, leakages, political patronage, diversion of subsidized inputs and growth of secondary inputs markets, all of which have negative effects on the general welfare of both the producers and consumers as well as taxpayers (Chirwa & Dorward, 2013; Jayne *et al.*, 2013; Mason *et al.*, 2013; Mason & Smale, 2013; Matita *et al.*, 2022; Pan &

³ Measured as an index of output divided by inputs

Christiaensen, 2012; Poulton, 2014). Thus, the incorporation of political economy variables has brought a new dimension to the impact of input subsidies. This has resulted in diverging results on the effect of input subsidies from one country to the other. Given such contested nature of findings, as other schools of thought suggest that input subsidies do not live up to the expected market smart principles whilst other studies showed that input subsidy programs often suffer from design and implementation failures, it is therefore critical to understand the impact of input subsidies from political economy analysis perspective (Holden, 2019). As such, this review study is grounded in applied political economy analysis. The political economy analysis is emerging as an important theoretical and analytical framework to bridge the shortcomings of neoclassical analysis of input subsidies and other agricultural developmental policies. This is because political economy analysis integrates different schools of thought and analytical approaches to ensure an in-depth and more pragmatic analysis of societal problems. Concurrently, it allows discussion of three superstructures which have a significant influence on the design and implementation of input subsidies and drive society viz: markets, community, and the State. Unfortunately, rigorous synthesis studies on the impact of input subsidies from a political economy perspective are limited, particularly at the regional level, since most of the previous studies mainly focused on experimental and quasi-experimental analysis. Thus, this study is filling this knowledge gap through a comprehensive systematic review of recent evidence on the impact of input subsidies from a political economy analysis point of view. The study helps to draw important policy lessons and suggests avenues to improve design, targeting, fiscal disbursement, and input distribution based on regional best practices and success stories.

Key political economy variables assessed

The provision of agricultural input subsidies in Sub-Saharan Africa has returned strongly to the development agenda, especially following recent spikes in fertilizer and food prices. The humanitarian sector also provides aid in the form of agricultural and farm support as complementary interventions to government input subsidy programs (Benin et al., 2013). However, these input subsidy programs are characterized by political patronage, rent-seeking opportunities, diversion of subsidized inputs, and growth of secondary inputs markets (Chirwa & Dorward, 2013; Chinsinga & Poulton, 2014; Dionne and Horowitz, 2016; Mason et al., 2017; Holden, 2019). For example, in Zambia, evidence showed that from 1996 to 2011, the ruling government at that time favored households in areas that it won in previous presidential elections in fertilizer subsidies distribution (Mason et al., 2017). This evidence shows political patronage in input subsidy programs. This concurs with observations

of Nino (2016) in Mozambique that input subsidies act as a vehicle to ensure much-needed political mobilization, especially in rural areas. In Ghana, evidence also shows that input subsidies were used as an attempt at vote-buying (Banful, 2011). A recent study by Kato and Greeley (2016) also pinpoints the issue of elite capture, fraud, and corruption incidents in agricultural input subsidies in Tanzania. This concurs with earlier evidence indicating that in Tanzania, input subsidies are prone to elite capture (Pan & Christiaensen, 2012). Zimbabwe is also no exception, as input subsidies are also shrouded by elite capture and patronage (Mazwi et al., 2019; Shonhe & Scoones, 2022). In this case, the private sector actors work with the government in input subsidy distribution as a strategy to extract value from the government for their operations, for example, receiving high interest rates from Treasury bills or relying on state loans. Concurrently, input subsidies were distributed through patronage networks (Mazwi et al., 2019).

Likewise, input subsidy programs remain highly contested in Malawi due to political patronage, collusion, and nepotism (Chinsinga, 2011; Chinsinga & Poulton, 2014). Again, incidences of rent-seeking, which led to market distortions, were also noted in various cases of input subsidy programs in Sub-Saharan Africa (Chirwa & Dorward, 2014). This includes corrupt public procurement of agricultural inputs in which public officials intentionally ignore the rules and regulations for issuing government contracts and collusion, where organizations or individuals involved in input subsidy distribution work together to manipulate implementation and input subsidy delivery mechanisms for individual gains. As such, input subsidy programs created a distinct political economy research issue that needs in-depth analysis. Therefore, in this study, the main political economy variables assessed are incidences of political patronage (i.e., receiving input subsidies based on political party affiliation and past voting patterns), elite capture, and rent-seeking in input subsidy programs. A detailed overview of these political economy variables is provided below.

Elite capture

The reviewed literature showed that the distribution of input subsidies is associated with incidences of corruption due to the involvement of public officials and politicians. Although there are many definitions for corruption, for this study, corruption refers to abuse of public official power for individual gain through bribery, prejudice, or embezzlement, among other immoral and unethical activities (Transparency International, 2023). Thus, corruption results in cases where farmers pay bribes to Government officials to receive input subsidies. Subsequently, these subsidized inputs will then be allocated to non-productive farmers and, in some cases, re-routed to informal markets or

smuggled to neighboring countries (Lunduka et al., 2013; Mason & Jayne, 2013; Jinbaani & Wale, 2023). For instance, smuggling cases of input subsidies to neighboring countries were reported in Ghana and Malawi (Khonje et al., 2022; Jinbaani & Wale, 2023). This implies that the subsidized inputs will not be used for production purposes among the recipients, and this is likely to stymie productivity. Furthermore, corruption paves the way for elite capture where non-productive wealthier farmers receive subsidized inputs at the expense of resource-constrained but productive farmers (Azumah & Zakaria, 2019; Houssou et al., 2017; Jinbaani & Wale, 2023; Tsiboe et al., 2021). In most cases, the wealthier farmers are also closely connected to influential politicians (Banful, 2011; Mason & Jayne, 2013; Takeshima & Liverpool-Tasie, 2015). In Malawi and Tanzania, the reviewed literature showed evidence of elite capture of subsidized inputs where politicians and wealthy households were more likely to receive inputs as compared to the intended poor households (Lunduka et al., 2013, 2014; Pan & Christiaensen, 2012).

Wealthier households also tend to benefit more from input subsidies as compared to the poor as the subsidized inputs in most cases are tied to the level of production and hence benefit rich households with large farms (Jayne & Rashid, 2013; Mason et al., 2013; Nazaire & Asante-Addo, 2017; Damania et al., 2023). In Botswana, for example, wealthier farmers received more subsidized inputs during the 2013/14 farming season as compared to poor farmers (Seleka, 2022). As such, the magnitude of the positive impact of increased agricultural spending in agriculture through subsidies is determined by the quality of institutions, including the extent of corruption and/or elite capture (Chinsinga, 2012; Chinsinga & Poulton, 2014; Jayne et al., 2018; Soko et al., 2023). Based on these insights from empirical literature, it has been noted that corruption and elite capture are intertwined. Nevertheless, literature explicitly showed that in most cases, wealthier farmers were more likely to receive subsidized inputs than their intended resource-constrained counterparts; as such, the effect of elite capture will be assessed. The literature provides a duality view of elite capture on the effectiveness of input subsidies on agricultural productivity. Other scholars observed that input subsidy programs enhance productivity despite cases of elite capture, while other literature is inconclusive (Ricker-Gilbert & Jayne, 2011; Vondolia et al., 2021). It is therefore this background which motivates this study to test if accounting for elite capture when assessing the impact of input subsidy programs on agricultural productivity in Sub-Saharan Africa matters, since previous studies assumed a homogenous political economy context from one country to the other.

Political patronage

The input subsidy programs are also characterized by political patronage, where receipt of inputs is based on political party affiliation. In Zambia, for example, between 1999 and 2011, subsidized inputs were allocated to constituencies where the ruling party won the presidential election (Mason et al., 2013; Mason et al., 2017; Mason & Jayne, 2013). This shows that outcomes of previous elections significantly influence subsidized inputs distribution and hence reflect political patronage as a key determinant for receiving subsidized inputs (Mason et al., 2017). Evidence from Malawi also showed the incidence of political patronage in subsidized input distribution (Chinsinga, 2012; Chinsinga & Poulton, 2014). Political patronage in input subsidy programs is used as a mechanism to bolster the ruling political party's legitimacy and strengthen ties between traditional leaders and governing elites (Chinsinga, 2012). In Nigeria, the literature also showed that governors patronize their districts of origin with preferential access to resources, including subsidized fertilizer (Takeshima & Liverpool-Tasie, 2015). Input subsidy distribution in other countries like Tanzania and Zimbabwe is also not immune from political patronage (Cooksey, 2012; Mazwi et al., 2019; Shonhe & Scoones, 2022). Generally, input subsidies in Sub-Saharan Africa are characterized by patronage and clientelist purchases of votes (Hemming et al., 2018; Jayne et al., 2018; Jayne & Rashid, 2013; Poulton, 2014). Nevertheless, the impact assessment of different input subsidy programs on agricultural productivity reported diverging results in the context of political patronage incidences. For instance, other studies argued that input subsidies distributed based on political incentives undermine agricultural productivity (Chinsinga, 2012; Chinsinga & Poulton, 2014; Cooksey, 2012; Soko et al., 2023; Takeshima & Liverpool-Tasie, 2015). On the other hand, other scholars noted that input subsidies enhanced agricultural productivity despite evidence of political patronage (Chirwa & Dorward, 2013; Mason et al., 2013; Chibwana et al., 2014). Given the polarization of the argument, it is critical to consolidate and synthesize the research using meta-analysis and thus draw conclusions based on findings from several individual studies.

Rent-seeking

Another key political economy variable assessed in this study is rent-seeking. While subsidy policies aim for a noble cause of improving productivity, the implementation process is also characterized by incidences of rent-seeking, which may distort intended objectives (Chinsinga, 2011, 2012; Chinsinga & Poulton, 2014; Chirwa & Dorward, 2013; Lunduka et al., 2013). Just like the control structure of external trade, the provision of input subsidies provides a convenient source of rents to political loyalists, given the prevailing political

economy landscape in most Sub-Saharan African countries (Abebe et al., 2015; Chinsinga, 2012; Mason et al., 2017; Mason & Jayne, 2013; Mazwi et al., 2019). The incidences of rent-seeking imply that resources are being misallocated, and this results in increased wealth inequality among non-rent seekers and for the whole economy (Acemoglu et al., 2015; Angelopoulos et al., 2021). In this case, the rents created by input subsidies also help politicians secure and maintain political power (Chinsinga & Poulton, 2014). Such rent-seeking opportunities include corrupt public procurement of agricultural inputs, in which public officials intentionally ignore the rules for issuing government contracts. Concurrently, public officials also manipulate input subsidy delivery mechanisms and collude with companies or individuals involved in input subsidy distribution for individual gains (Chinsinga, 2011; Mazwi et al., 2019).

In some cases, due to manipulated public procurement procedures, collusion between politicians and fertilizer importers results in overpricing of fertilizer to be distributed through input subsidy programs. As a result, the costs of agricultural input subsidy programs in Sub-Saharan Africa generally outweigh the benefits, and the impact fails to meet expectations (Jayne et al., 2018; Jayne & Rashid, 2013). Significant fertilizer price distortions and divergence that exist between import and retail prices in Sub-Saharan Africa are a testament to this assertion (Abebe et al., 2015). As such, only the influential politicians and elites enjoy a significant share of benefits from input subsidy programs (Acemoglu et al., 2015; Angelopoulos et al., 2021; Chinsinga & Poulton, 2014). Furthermore, price distortions impair competition and the development of the fertilizer market (Abebe et al., 2015). Subsequently, this hurts the growth of the agricultural sector since increases in agricultural productivity and intensification largely depend on the availability of affordable fertilizers and other inputs (Holden, 2019; Jayne et al., 2018; Nhlengethwa et al., 2022). Incidents of collusion and distorted public procurement processes also create possibilities for the distribution of poor-quality inputs (i.e., counterfeit seeds and low-quality or underweight fertilizer) to farmers (Liverpool-Tasie, 2014). Although intuitively, one may expect to find the impact of rent-seeking to be negative and significant, previous studies did not explicitly assess whether rent-seeking in input subsidy programs is associated with sub-optimal agricultural productivity outcomes (Abebe et al., 2015; Mason & Jayne, 2013; Mazwi et al., 2019). As such, we aim to test whether accounting for rent-seeking when assessing the effectiveness of input subsidy programs on agricultural productivity matters.

Linking input subsidy programs and agricultural productivity: A conceptual framework

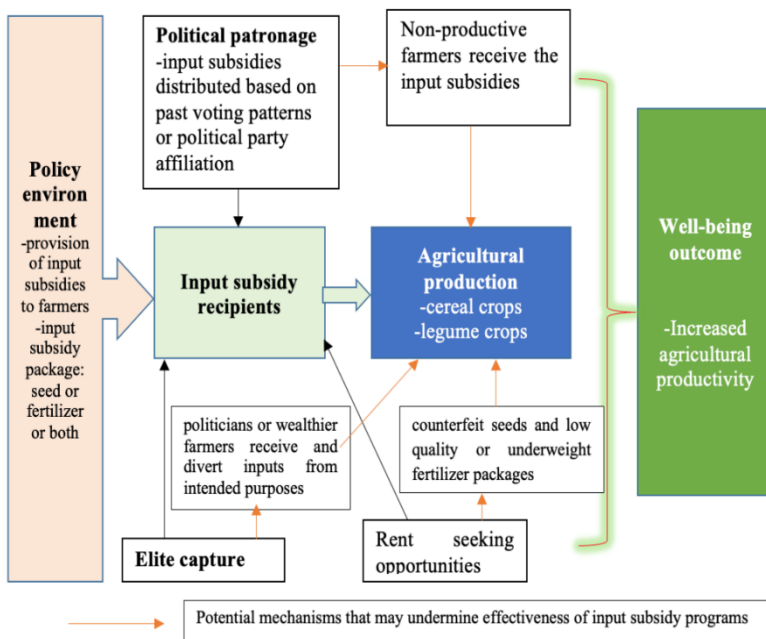
A vast amount of research has been conducted to investigate the influence of input subsidy programs on agricultural productivity (Jayne et al., 2018). Nonetheless, the evidence is equivocal, and the debate over input subsidies continues. This stems from the fact that other scientists saw input subsidies as a significant enabler for agricultural output, but others were unable to show a positive relationship between input subsidies and agricultural productivity. Because understanding the effects of input subsidy programs remains an important policy question, especially in countries attempting to reform agricultural development policies (Jayne et al., 2018; Nguyen et al., 2023), such duality views of the impact of input subsidies on agricultural productivity necessitate the need to synthesize insights and reconcile the debate. We intend to contribute to this literature by first doing a meta-analysis to sum up the findings and conclusions from various studies. Second, the literature suggests that diverse political economy contexts may mediate or hinder the effectiveness of input subsidy programs in attaining their intended goals. We included these variables in our study to examine whether accounting for different political economy aspects, like political patronage and elite capture, when measuring the impact of input subsidies on agricultural output truly matters.

However, understanding the mechanisms or channels by which political economy considerations mediate the impact of input subsidy programs is critical. To accomplish this, we developed a conceptual framework for visualizing and explaining how identified political economy variables affect the effectiveness of input subsidy programs in boosting agricultural productivity among recipients. The conceptual link between input subsidy programs and household livelihood outcomes is that households that received inputs, i.e., fertilizers and improved seeds, use these inputs to maximize returns, such as increased crop production (Hemming et al., 2018; Khonje et al., 2022; Matita et al., 2022). Thus, increased use of inputs such as fertilizer from input subsidy programs is assumed to be associated with increased agricultural production, *ceteris paribus* (Kato & Greeley, 2016; Marenya & Barrett, 2009; Sheahan et al., 2013). For instance, it has been noted that input subsidies resulted in increased agricultural productivity in Malawi (Hemming et al., 2018). Nonetheless, other studies indicated that the input subsidies reversed agricultural productivity gains (Azumah & Zariah, 2019). At the same time, other scholars observed that input subsidy programs failed to stimulate agricultural productivity (Kato, 2016; Vondolia et al., 2021). These conflicting results present a significant challenge to policymakers in developing optimal policies or changes to improve the

effectiveness of input subsidy programs in improving farmers' livelihoods through higher productivity (Chirwa & Dorward, 2013; Soko et al., 2023; Walls et al., 2018). This piqued our interest to examine why input subsidy programs performed better in one country than another, or from one input subsidy program versus another, as an attempt to reconcile the debate and inform policy direction.

We therefore argue here that political economy factors can either positively or negatively affect the outcomes of input subsidies. For example, political patronage and elite capture in input targeting and distribution are likely to result in negative outcomes where the intended beneficiaries are not receiving the inputs (Chinsinga, 2012; Jayne et al., 2018). Potential reverse impacts are also possible when beneficiaries divert inputs to other crops or sell the inputs (Jayne et al., 2013). Against this backdrop, we explored these and other possible mechanisms in which the political economy factors, mainly patronage, elite capture, and rent-seeking, can influence the effectiveness of input subsidy programs. Figure 1 presents the conceptual framework we developed to assess the input subsidy programs- agricultural productivity - political economy nexus.

Figure 1: Conceptual framework for input subsidy programs- political economy and agricultural productivity linkage



3. Methodology

Data collection method

This study is based primarily on a literature review. An in-depth systematic literature review and meta-analysis were conducted to address the research objectives and bring to light what works well and what needs to be done to strengthen smart input subsidies programming, targeting, and disbursement in Sub-Saharan Africa. We described the method as systematic because evidence is synthesized using a systematic search strategy (using a search string, review protocol, and a predefined eligibility criterion) to inform policy (Thompson et al., 2023). The researchers limited the geographic scope to Sub-Saharan Africa, where similar input subsidy programs have been implemented in the past. The review of literature is taking stock of the existing recent evidence on the impact of input subsidies on agricultural productivity. The systematic review is guided by the principles of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). As such, a protocol that outlines the main rationale and steps to be followed during the review was developed and outlined below:

Review protocol

The review follows a stepwise procedure. It consists of five key steps: setting of eligibility criteria, search strategy, screening and selection of studies, article management, and data extraction, and then analysis. These are key steps applied extensively in a systematic review of the literature (Jellason et al., 2022; Ngwili et al., 2021).

Eligibility criteria

To allow a review of all potentially eligible articles, the literature search is not delimited by year of publication (Davidson et al., 2022). However, only studies conducted in Sub-Saharan Africa and peer-reviewed journals are included to ensure the analysis of authentic documents. Articles published in English are included due to the proficiency of the researchers. The included articles are restricted only to those focusing on the impact of input subsidy programs. The researchers also added further exclusion criteria. The population, indicator, comparison, outcome, and study design (PICOS) strategy (Table 1) were followed for eligibility criteria (Taguta et al., 2022). This strategy further shaped the search and screening process.

Table 1: PICOS Strategy employed

PICOS strategy	Description
Population	Peer-reviewed articles (journal articles or book chapters)
Indicator	Political economy analysis of input subsidy impact in Sub-Saharan Africa
Comparison	Not Applicable
Outcome	Agricultural productivity
Study design	Quantitative (experimental or quasi-experimental methods)

Search strategy

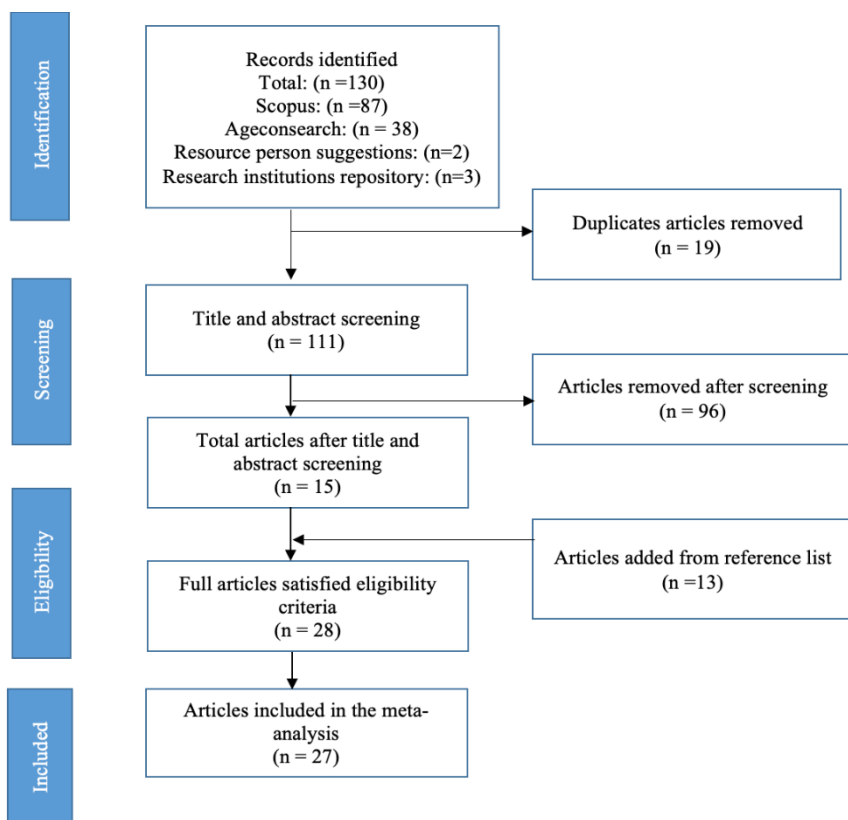
A search strategy command was developed to pick out relevant articles for review from open-access online databases, mainly SCOPUS and Ageconsearch (<https://ageconsearch.umn.edu/>), among others (Figure 2). These databases are selected based on their known strength in covering applied agricultural economics literature. Again, a multiple-database search was used to optimize access to all potentially eligible articles. A Boolean logic operator was implemented, which allows one to retrieve more accurate and precise results by linking two or more terms or related concepts to another. In this case, logical connectors mainly “AND & OR” were employed in the search process, where “AND” narrows a search whilst “OR” broadens it. An example that narrows search results was “input subsidy AND agricultural productivity AND Sub-Saharan Africa”. This restricts the results of research articles conducted in Sub-Saharan Africa on the impact of input subsidies on agricultural productivity. To be able to retrieve research articles focusing on political economy analysis of the impact of input subsidy programs on agricultural productivity, the following search commands were employed: “Political economy OR Political Patronage OR Traditional authorities OR elites AND input subsidy AND agricultural productivity AND Sub-Saharan Africa”. Depending on the accepted search command in each database, a streamlined combination of these keywords was used at a single entry. The literature search was conducted between March and August 2023.

Screening and selection of studies

The inclusion and exclusion criteria were based on title and abstract, a common procedure used in other review studies (Dukuzumuremyi et al., 2020; Ngwili et al., 2021). Once the article’s title and abstract failed to elaborate concisely on

issues around wider research objectives on the impact of input subsidies in any Sub-Saharan African country, the paper was dropped from the analysis. A double review process was conducted. Thus, a single reviewer (one member of the research team) assessed studies for inclusion eligibility based on title and abstract, and then the other team member repeated the process independently by randomly selecting 50% of the articles to reinforce consistency. Where disagreements arose, exclusion or inclusion eligibility was resolved through consensus. Other articles were identified by checking the reference lists of selected eligible articles. This is a common strategy to boost the chances of obtaining more relevant articles (Salehi et al., 2021). A total of 28 articles met the eligibility criteria and were included in the review, whilst 27 articles were included in the meta-analysis (Figure 2).

Figure 2: PRISMA flow chart of literature review



Article management, data coding and extraction

A database from existing studies which applied experimental, quasi-experimental, panel and pooled data on the effect of input subsidies in Sub-

Saharan Africa was constructed. A qualitative synthesis of relevant implementation, contextual and political economy factors was conducted per each study. A data extraction Excel sheet was developed where all extracted key characteristics of reviewed articles necessary to answer the research questions were coded and organized. These key characteristics included first author name, year of publication, country of study, study design, type of input subsidy, sample size, type of data used, peer review process, use of voucher system status, and the impact of the input subsidy on agricultural productivity. Marginal effects and average treatment effects from econometric models, as well as crop yield change due to input subsidies per hectare and value of crop change per hectare due to the use of input subsidies, were captured where applicable. These variables were used as indicators of agricultural productivity change due to input subsidies. However, for standardizing, the value⁴ of crop change per hectare due to the use of input subsidies was used as the dependent variable in the meta-regression analysis. Thus, the first step in meta-analysis was to create a database consisting of all relevant study characteristics and their results as well as other covariates of interest (Andreyeva et al., 2022; García-Quevedo, 2004; Liu et al., 2022; Stanley et al., 2008; Stanley & Doucouliagos, 2011; Stanley & Jarrell, 1989). All the retrieved articles were exported, merged, and duplicates removed in Zotero. Zotero is a reference management software that allows for easy and efficient reference management as well as the removal of duplicate articles.

Data analysis and presentation

With regards to analysis, the abstract, conclusion, and recommendation sections were thoroughly reviewed, and key themes and emerging issues were picked and concisely summarized for each article. Again, a double data extraction process was employed where the process was independently repeated by another team member for 50% of the reviewed articles. When it was deemed necessary, a full article review was conducted.

In terms of the empirical approach, a meta-analysis was conducted. The meta-analysis provides a quantitative data synthesis, allowing the calculation of pooled effect sizes and assessing the effects of interventions across multiple studies (Hunter & Schmidt, 2004). In this case, the meta-analysis enabled the calculation of the pooled effect size of the impact of input subsidies on agricultural productivity using results from multiple studies. This adds a level of precision and statistical rigour often missing in traditional literature reviews, typically qualitative and narrative (Cooper et al., 2009; Paul & Criado, 2020). Specifically, meta-analysis helped to estimate the average effect of input

⁴ A monetary value of yield change per hectare due to input subsidies

subsidies on productivity [value⁵ (US\$) of crop per hectare]. This approach helps to simplify analysis by having a standardised comparable metric since different studies assessed the impact of input subsidies on different crops [cereals (mainly maize) and legumes (i.e., groundnuts)]. In this study, the dependent variable was standardised and converted into its economic value (Damania et al., 2023; García-Quevedo, 2004; Nguyen et al., 2023; Wagenaar et al., 2009). This dependent variable was also informed by best practices in meta-regression analysis, where an outcome variable of interest, which is comparable across studies, is used (Nguyen et al., 2023). This quantitative approach allows for a more objective assessment of the strength and direction of relationships between variables and minimises subjective biases that may affect traditional literature reviews, where the reviewers' perspectives can influence the selection and interpretation of studies (Shah et al., 2008; Cooper et al., 2009; Paul & Criado, 2020; Arslan, 2020). Further, by pooling data from multiple studies, meta-analysis increases statistical power and allows for detecting effects that may not be apparent in individual studies (Greenberg et al., 2003; Borenstein et al., 2009). This is particularly useful in this study, where previous individual studies yield inconsistent results.

The pooled effect size and associated confidence intervals, presented graphically in a forest plot, make meta-analysis a robust approach compared to traditional literature review (Sedgwick, 2015; Verhagen and Ferreira, 2014; Arslan, 2020). Meta-analysis also facilitates the econometric identification of sources of heterogeneity (Santeramo & Lamonaca, 2019; Stanley & Doucouliagos, 2011). In this case, it helped pinpoint the political economy issues and study-specific factors contributing to cross-country variation in the effects of input subsidies. This method enables a more rigorous assessment of the overall effect of input subsidies, providing policymakers with valuable insights to support informed decision-making.

Empirical strategy

Meta-analysis entails an econometric approach that integrates and synthesizes empirical estimates and evidence from different but broadly comparable previously published studies to illuminate variation and explore sources of such heterogeneity across studies (Andreyeva et al., 2022; Han et al., 2022; Liu et al., 2022; Minviel & Latruffe, 2017; Santeramo & Lamonaca, 2019; Stanley, 2001; Stanley et al., 2008; Stanley & Doucouliagos, 2011; Thompson & Sharp, 1999).

⁵ For example, the value of maize per hectare was calculated by multiplying the observed yield change per hectare due to input subsidies by average annual world price of maize in 2022 using agricultural commodity prices from World Bank

The empirical model for the meta-regression model can be expressed as follows, based on (Harbord & Higgins, 2008; Kelley & Kelley, 2012):

$$\gamma_i = \theta + \varepsilon_i + \mu_i \quad (1)$$

Where ε_i represents the meta-regression disturbance term and μ_i represents the between-study variance τ^2 that must be estimated from the data (Harbord & Higgins, 2008; Kelley & Kelley, 2012; Wainaina et al., 2022). Let (γ_i) be the effect estimate of input subsidies on the outcome of interest (i.e., agricultural productivity) from study i of n studies to be included in the meta-regression analysis and σ_i be the standard error of the estimate to be estimated from the data of each study (i). For this study, the value⁶ (US\$) of crop change per hectare due to the use of input subsidies was used as the dependent variable to assess the impact of input subsidies [agricultural productivity (γ_i)]. All studies included in the analysis are assumed to estimate the same overall effect (i.e., a single true effect size θ of input subsidies).

Apart from generating an overall effect size from pooling various studies, the influence of different potential covariates on the overall effect size and direction of the effect of input subsidy programs was also estimated. As such, following (Greenberg et al., 2003; Liu et al., 2022; Stanley et al., 2008) the random effects meta-regression model can therefore be expressed as follows:

$$\gamma_i = \alpha + \sum_{k=1}^K \beta_k Z_{kj} + \mu_i + \varepsilon_i \quad (j = 1, 2, \dots, n) \quad (2)$$

where β_k are the meta-regression coefficients to be estimated, and mean θ is replaced by Z_{kj} , which is the vector of covariates that measure key characteristics of each empirical study and explain its systematic variation from other findings in the literature. The covariates used in this study are different political economy factors, which include dummy variables on incidences (1=yes and 0 otherwise) of political patronage (PP), elite capture (EC), and rent-seeking (RS) in input subsidy programs. The moderating effect of voucher system use (VS) in input distribution was also explored. The regional dummies R (Southern Africa-SA, East Africa-EA, and West Africa-WA) were also used to assess the

⁶ measured in constant 2015 prices from World Bank pink price sheet

regional effects. Based on these details, the model can further be simplified as follows:

$$\gamma_i = \beta_{pp}PP + \beta_{ec}EC + \beta_{rs}RS + \beta_rR + \beta_{vs}VS + \mu_i \quad (3)$$

This random-effects meta-regression model initially estimates τ^2 , the between-study variance, followed by β_{ks} , the regression coefficients (Harbord & Higgins, 2008; Ruzzante et al., 2021). A weighting function approach was employed to estimate the random-effect meta-regression analysis model. The study-specific weight (w_i) is given by the inverse of the variance:

$$w_i = \frac{1}{\sigma_i^2 + \tau_i^2} \quad (4)$$

where σ_i^2 represents the standard error of the estimated effect size from study i (Nguyen et al., 2023). The tau-squared (τ^2) quantifies the between-study variance or heterogeneity across studies (Afshin et al., 2017). Thus, it provides an absolute value of the heterogeneity (Harbord & Higgins, 2008; Hemming et al., 2018; Kelley & Kelley, 2012). Furthermore, to measure the percentage of the variability in effect estimates arising due to this heterogeneity rather than sampling error, the I^2 statistic was used and reported (Afshin et al., 2017; Andreyeva et al., 2022; Kelley & Kelley, 2012). Generally, the I^2 statistic value of 0% shows no observed heterogeneity, and larger values show increasing heterogeneity (Higgins et al., 2003). For comparison, the I^2 statistic values of 25-50%, 51-74%, and 75% and above reflect low, moderate, and high heterogeneity, respectively (Afshin et al., 2017; Higgins et al., 2003). The weighting function approach in meta-analysis also creates a forest plot and generates the overall effect size of input subsidy programs as well as the extent of heterogeneity from different studies, an estimation technique not possible through ordinary least squares (Dettori et al., 2021; Verhagen & Ferreira, 2014). This forest plot provides readers with a quick and synthesized visual/graphical presentation of the pooled effect size estimate of input subsidies and heterogeneity among the studies. By performing all these tests, analyzing and validating whether heterogeneity exists across studies, meta-analysis presents a novel and sterling opportunity to assess the role of political economy and contextual factors shaping or influencing the impact of input subsidies. Such assessments are not possible through conventional literature reviews (Afshin et al., 2017; Fan et al., 2018; Lichter et al., 2015; Santeramo & Lamonaca, 2019;

Stanley et al., 2008; Stanley & Doucouliagos, 2011; Teng et al., 2019; Woodward & Wui, 2001).

To control for publication bias, often associated with meta-analysis, the quality of studies was assessed (Minviel & Latruffe, 2017). The publication bias frequently arose from the fact that research studies with a high likelihood of being published and cited are those with statistically significant and interesting results (Minviel & Latruffe, 2017; Stanley, 2001; Sterne et al., 2000). Theoretical competition can also influence empirical findings to be published (Santeramo & Lamonaca, 2019). To assess this publication bias, two key aspects were covered in this study: evidence of robust impact evaluation approaches and rigorous reporting of methods and results. Secondly, working papers published by the World Bank and international and regional research institutions were also reviewed. This helped to avoid publication selection bias, where only peer-reviewed articles are included in the analysis. Since all the studies included in this study were deemed to meet the expected scientific soundness as they used robust and rigorous impact evaluation approaches, the dummy variable for quality of studies was dropped in the modelling.

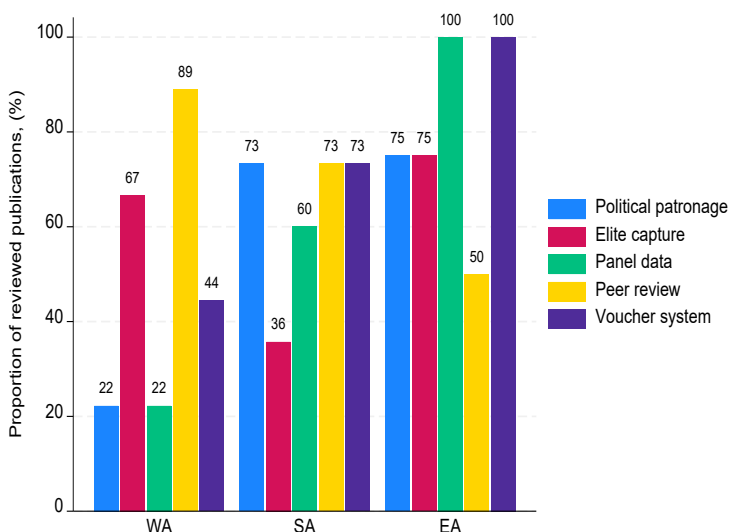
4. Results and Discussion

Descriptive statistics of reviewed articles and key political economy variables

A total of 28 articles were reviewed, and these studies were published between 2011 and 2022, with most studies published in 2021 (*Appendix A*). Most of the input packages consisted of both fertilizer and improved seeds of cereal crops, mainly maize. However, only 7% of the reviewed articles indicated the inclusion of legume crops such as groundnuts in input subsidies. Concurrently, about 33% of the reviewed studies were conducted in Malawi. This concurs with previous studies, which indicated that most countries in Sub-Saharan Africa implemented input subsidies inspired by the successful roll-out in Malawi during the 2005/06 farming season (Asfaw et al., 2017; Hemming et al., 2018; Jayne et al., 2018; Nhlengethwa et al., 2022). Disaggregating articles by region, 53.6% of the reviewed articles were conducted in Southern Africa (SA), 32.1% in West Africa (WA), and 14.2% in East Africa (EA). This regional distribution of reviewed articles provides a considerable breadth in terms of differences in the political economy context in which subsidies are being distributed. This further helped to provide comprehensive insights into which key political economy variables mediate the effectiveness of input subsidy programs. A closer look at study-specific characteristics and the key political economy variables by region,

the following key findings are as follows. In East Africa, all the studies reported that a voucher system was used for the input subsidy program (Figure 3). Again, the impact estimates were based on panel data analysis.

Figure 3: Overview of study-specific characteristics and key political economy variables



Source: Author’s computation

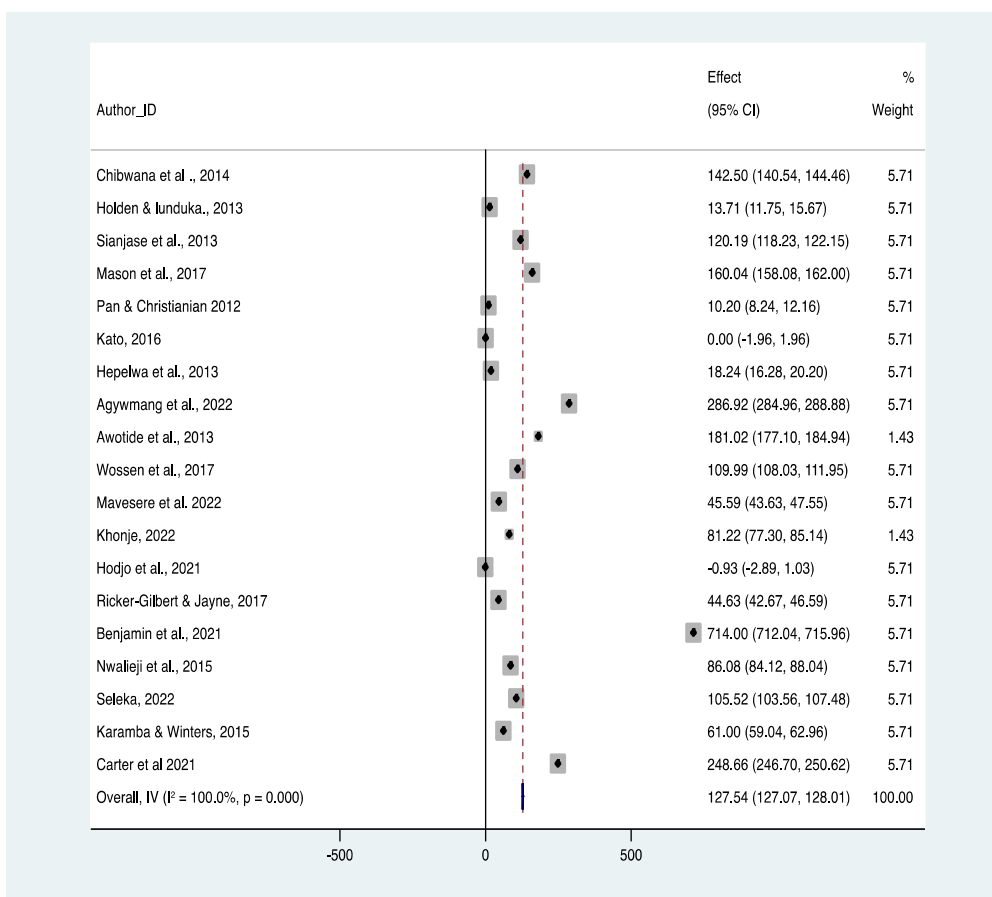
With regards to peer review, 89 percent, 73% and 50% of the reviewed publications from WA, SA and EA were peer reviewed respectively. Incidences of political patronage were reported in 22% of the reviewed publications in WA and 73 % in SA whilst 75% was recorded in EA. Again, 67% of reviewed studied in WA, 36% in SA and 75% in EA reported incidences of elite capture.

Meta-analysis of the impact of input subsidy on agricultural productivity

The average pooled effect size of input subsidies on crop value is US\$128/ha ($p < 0.01$). These findings indicate that input subsidy programs have a positive impact on agricultural productivity based on crop value per hectare. These findings concur with our *a priori* expectations (Hypothesis 1) and other prior studies (Hemming et al., 2018; Nguyen et al., 2023). Thus, we failed to reject the null hypothesis that input subsidy does not increase agricultural productivity. However, the magnitude is generally low due to low yield response to fertilizer mainly caused by inefficient fertilizer use which characterize most input subsidy

programs in Sub-Saharan Africa (Jayne et al., 2018; Jayne & Rashid, 2013; Mason et al., 2017). The forest plot also indicated that although input subsidies positively contributed to an increase in agricultural productivity in general, most effect sizes from individual studies were below the estimated pooled effect size of US\$128/ha from meta-analysis (Figure 4). This suggests that contextual factors are limiting the effectiveness of input subsidies to attain intended objectives. As an attempt to explore these factors responsible for reducing the effectiveness of input subsidies, a random effect meta-regression analysis was conducted, and the findings are presented in subsequent sub-sections.

Figure 4: Forest plot showing a summary of the impact of input subsidies on agricultural productivity



Source: Author's computation

Meta-regression analysis on the determinants of cross-country heterogeneity on the effect of input subsidy programs

The Random Effects Meta-regression analysis showed that there exists high and significant heterogeneity in the effect of input subsidy programs from one country to the other ($I^2 = 100\%$). This underscored the role played by the political economy landscape in shaping and influencing the effectiveness of input subsidy programs in Sub-Saharan Africa. Given that the political economy factors and input subsidy specifications play a mediating role rather than a direct relationship with productivity, we did not focus on interpreting the magnitude of the estimated coefficient but on the observed direction of the association. As such, the positive sign on variables of interest indicates that those variables strengthen the effectiveness of input subsidies to bolster agricultural productivity and vice versa. For instance, the use of a voucher system in the distribution of subsidized inputs strengthens the effectiveness of input subsidy programs ($p < 0.01$) (Table 3). Through the voucher system, farmers receive entitlements through short message services on mobile phones to redeem specified quantities of subsidized inputs in designated local agro-shops within their proximity. This enhances transparency and crowds in the private sector players in input distribution (Wossen et al., 2017). As such, the use of a voucher system provides a best-case alternative as compared to the traditional way of input distribution, where traditional or local political leaders are involved in the selection of beneficiaries.

Among the challenges hindering the effectiveness of input subsidy to achieve intended outcomes is logistic inefficiencies where input delivery is delayed due to the involvement of public officials in the distribution process. These delays in the delivery of the inputs resulted in low productivity when farmers end up receiving fertilizers late in the planting season. This reduces the expected harvest due to sub-optimal application of fertilizer and other essential inputs for productivity or late planting. Fertilizers require a reasonably timed application to achieve the intended outcome. Thus, access to vouchers significantly enhances logistic efficiency and hence increases agricultural productivity as farmers timely receive inputs as suggested by (Aloyce et al., 2014).

Table 2: Determinants of cross-country heterogeneity on the effect of input subsidy programs

Covariate	Marginal effects	Std. Err.
Type of subsidy		
Reference: Fertiliser subsidy		
Fertiliser and seed (yes=1)	69.35**	33.22
Seed subsidy (yes=1)	46.14	56.73
Voucher system		
Reference: Otherwise		
Use of voucher (yes=1)	0.86***	0.10
Political economy variables		
Political patronage (yes=1)	-73.54*	37.66
Elite Capture (yes=1)	49.26	38.64
Rent seeking (yes=1)	13.38	41.33
Regional dummies		
Reference: Southern Africa		
East Africa (yes=1)	-56.14	42.45
West Africa (yes=1)	-6.09	39.64
Constant	11.62	30.41
I^2	98%	
Adj. R-squared	81%	
Model F (8,18)	14.8***	
Number of observations	27	

*** p<0.01, ** p<0.05, * p<0.1

Source: Author's computation

Furthermore, the provision of subsidized input packages consisting of both fertilizer and improved seeds was also found to enhance the effectiveness of input subsidies (p<0.05) as compared to providing fertilizer alone to farmers.

This suggests that hybrid seeds improve yield response to fertilizer and, hence, crop value per hectare. The high responsiveness of improved seed varieties to fertilizer application has significant implications for increased productivity. A recent study in Zimbabwe showed that hybrid maize seeds optimize fertilizer use even when applied in small amounts among resource-constrained smallholder farmers (Chisaka et al., 2020). This underscored the importance of improved seeds to bolster yield response to fertilizer application and hence increased agricultural productivity.

On the other hand, among the political economy variables tested, political patronage in subsidized input distribution was found to be significant in reducing the effectiveness of input subsidy programs ($p < 0.1$), whilst elite capture and rent-seeking were not significant. This shows that the political economy landscape, characterized by political patronage activities, undermines the impact of input subsidies and the realization of intended outcomes. These findings concur with our *a priori* expectations and other prior studies. As such, we reject the null Hypothesis 2.1 that accounting for political patronage when assessing the effectiveness of input subsidy programs on agricultural productivity in Sub-Saharan Africa does not matter. However, we failed to reject the null Hypotheses 2.2 and 2.3 that accounting for elite capture and rent-seeking, respectively, when assessing the effectiveness of input subsidy programs on agricultural productivity in Sub-Saharan Africa does not matter. These insights suggest that among the political economy factors assessed, political patronage plays an important mediating role⁷ in reducing the overall impact of input subsidy programs on agricultural productivity. The magnitude of change in agricultural productivity due to input subsidies tends to significantly decline for countries with incidences of political patronage than for their counterparts without political patronage. In exploring the potential reasons why political patronage undermines/plummets the intended impact of input subsidy programs, the converged narrative from reviewed literature suggests mechanisms related to engrained forms of inequality which tend to prevent subsidized inputs from reaching resource-constrained but productive farmers. Thus, while input subsidies generally enhance productivity, their effectiveness appears to be weakened by political patronage incidences in subsidized input targeting and distribution. These insights also concur with prior studies, which indicated that institutional quality and political economy landscape play a key mediating role in the effect of agricultural spending on

⁷ We did not focus on interpreting the magnitude of estimated coefficient but rather on interpreting the observed direction of association between political economy factors and productivity. This is because the political economy factors play a non-linear mediating role rather than a direct relationship.

outcome variables of interest, like productivity in Sub-Saharan Africa and other regions (Soko et al., 2023). For instance, due to political patronage, subsidized inputs end up distributed to non-productive and inefficient farmers (Asfaw et al., 2017; Bulte et al., 2007; Pan & Christiaensen, 2012).

Evidence from Malawi, Nigeria, Zambia, and other countries in Sub-Saharan Africa also showed that, due to political patronage, subsidized inputs are used as an attempt at vote-buying to impress supporters and/or to bolster the legitimacy of the ruling elites (Banful, 2011; Jayne et al., 2018; Poulton, 2014; Takeshima & Liverpool-Tasie, 2015). Subsequently, public resource allocations based on patronage and political incentives are often inefficient (Soko et al., 2023; Takeshima & Liverpool-Tasie, 2015). Thus, political patronage undermines the impact of public policies, including input subsidy programs, where minority elites and non-productive farmers benefit at the expense of the majority (Cooksey, 2012; Mason et al., 2013; Mason & Smale, 2013; Pan & Christiaensen, 2012; Takeshima & Liverpool-Tasie, 2015). As countries in Sub-Saharan Africa seek to increase public spending through input subsidies to bolster agricultural productivity, these findings suggest that targeting reforms to strengthen the allocation of subsidies to resource-constrained but productive farmers should precede increased public spending on subsidies. It is also important to note here that while the study was unable to detect the influence of elite capture and rent-seeking, this does not imply that elite capture and rent-seeking do not affect the impact of agricultural subsidies. The result might suggest that the effect is small given the context in which the reviewed studies were conducted, where incidences of political patronage are difficult to separate from instances of elite capture and rent-seeking, making it difficult to isolate specific effects from one factor to another (Carter et al., 2021). Future research should investigate this further with large sample sizes of studies from different continents.

5. Conclusions and Recommendations

This study systematically reviewed existing literature on the impact of input subsidy programs on agricultural productivity and synthesized the evidence through an applied political economy analysis lens. A meta-analysis was also conducted to disentangle the potential determinants of heterogeneity in estimates of the impact of input subsidy programs across different countries. Such an analysis enhances our understanding of the influence of different political economy variables on the success and failure of input subsidy programs. The findings showed that input subsidy programs generally helped to increase agricultural productivity in Sub-Saharan Africa. The average pooled effect size of input subsidies on crop value is US\$128/ha ($p < 0.01$). This shows

that, on average, input subsidy programs helped to increase crop value per hectare *ceteris paribus*. However, there exists a significant heterogeneity in the effect of input subsidy programs from one study to the other ($I^2 = 100\%$). The meta-analysis results further demonstrate that the increased productivity motive behind input subsidy programs tends to decrease from one country to the other due to the prevailing political economy context in which these subsidies are distributed. Particularly, the political patronage in subsidized inputs targeting and distribution results in a suboptimal effect of input subsidy programs on agricultural productivity. Nevertheless, the provision of both fertilizer and improved seeds, as well as the use of a voucher system, enhanced the effectiveness of input subsidy programs in Sub-Saharan Africa. Overall, these findings emphasized the importance of meta-analysis over traditional reviews of literature because the pooled effect size, which demonstrated that input subsidy programs enhanced agricultural productivity, helped to reconcile the debate over the impact of input subsidy programs. Concurrently, by aggregating data from different earlier published studies, meta-analysis helped to discover sources of heterogeneity. As a result, meta-analysis is a new frontier for synthesizing available knowledge to influence policy decisions and reforms. Given the preceding, policymakers in Sub-Saharan Africa should continue to use input subsidy programs as one of the policy instruments to boost agricultural output and enhance rural farmers' livelihoods. However, efforts should be made to address political patronage in subsidized inputs targeting and distribution in future input subsidy programs. This can be accomplished in a variety of ways, such as the use of farmer production return forms in input subsidy targeting, which will help to eliminate political patronage in the allocation of subsidized inputs. This will aid in identifying productive (but resource-constrained) farmers and, as a result, remove the involvement of public officials and decrease discrepancies in the provision of inputs to the intended households. To combat corruption and patronage practices even more effectively, it is critical to strengthen the use of hybrid accountability approaches in which traditional interventions through state institutions such as the justice and legislative systems, as well as the establishment of anti-corruption agencies, are combined with other innovative social accountability mechanisms. One example of an innovative social accountability strategy is the direct inclusion of citizens through civil society systems to demand accountability from government officials and politicians. Under such bottom-up initiatives, citizens will be able to express their views on input subsidy delivery systems by participating in public policymaking processes, oversight committees, and public expenditure tracking. This is especially essential in Southern Africa, where political patronage is prevalent. Concurrently, stronger

parliamentary oversight of input subsidies is required to reduce political patronage. This will entail training parliamentarians on public expenditure tracking in agriculture.

We also suggest that subsidized input packages should include fertilizer as well as enhanced seed varieties rather than only fertilizer. This is due to the discovery that giving fertilizer as well as hybrid seeds boosted the effectiveness of input subsidy programs. Given that most input subsidy programs tend to encourage cereal production, there is a need to intentionally incorporate improved legume crop seeds, both from crop diversity and soil health & fertility point of view. The increased inorganic fertilizer application and concentration on cereals at the expense of legumes due to input subsidy programs may lead to soil fertility loss and limit the yield response to fertilizer use (Chibwana et al., 2012; Ngoma et al., 2021; Seleka & Mmopelwa, 2020). Thus, the responsiveness of soils to inorganic fertilizer application needs to be strengthened through the provision of legume crops in input subsidy programs. Limited soil organic matter content and acidity are among the key factors responsible for the poor responsiveness of crops to fertilizer use in Sub-Saharan Africa (Cedrez et al., 2020; Jayne et al., 2018; Jayne & Rashid, 2013; Morgan et al., 2019). To replenish soil fertility and address acidity constraints, it is, therefore, critical to strengthen the distribution of legumes and lime through input subsidy programs (Jayne et al., 2018; Seleka & Mmopelwa, 2020). Provision of organic fertilizers and increased investments in soil testing and farmer training on agronomic practices to restore soil fertility, as well as crop rotation and intercropping, will also help in this regard (He et al., 2022; Jayne & Rashid, 2013; Musara et al., 2022). The organic fertilizers and intercropping with legumes help to improve soil fertility.

Since the use of an e-voucher system was discovered to considerably improve the effectiveness of input subsidy programs, the provision of input subsidy packages should therefore be done through the e-voucher systems, with farmers redeeming the input vouchers at nearby agro-dealers. The voucher system increases logistics efficiency and recipient targeting while also permitting timely delivery of subsidized inputs to farmers. This will then enhance productivity since farmers will plant at optimal planting dates.

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APPENDIX A: Overview of some of the reviewed articles

Table 3: Sample of reviewed articles

Authors	Publication year	Type of subsidy	Type of crop	Country of study	Type of data	Voucher system	Value of crop (USD/ha)
(Abman & Carney, 2020)	2020	Fertilizer	Cereals	Malawi	Pooled panel data	Yes	19
(Ricker-Gilbert & Jayne, 2012)	2012	Fertilizer	Cereals	Malawi	Panel data	Yes	63
(Chibwana <i>et al.</i> , 2014)	2014	Fertilizer & Seed	Cereals	Malawi	Panel data	Yes	143
Ricker-Gilbert & Jayne, 2011	2011	Fertilizer	Cereals	Malawi	Panel data	Yes	42
Mason <i>et al.</i> , 2013	2013	Fertilizer	Cereals	Zambia	Panel data	Yes	24
Holden & Lunda., 2013	2013	Fertilizer & Seed	Cereals	Malawi	Pooled cross-sectional data	No	14
Sianjase & Seshamani, 2013	2013	Fertilizer & Seed	Cereals	Zambia	Cross sectional data	No	120
Mason <i>et al.</i> , 2017	2017	Fertilizer & Seed	Cereals	Kenya	Panel data	Yes	160
Pan & Christianian 2012	2012	Fertilizer & Seed	Cereal	Tanzania	Panel data	Yes	10
Kato, 2016	2016	Fertilizer & Seed	Cereals	Tanzania	Panel data	Yes	0
Hepelwa <i>et al.</i> , 2013	2013	Fertilizer & Seed	Cereals	Tanzania	Panel data	Yes	18
Agyemang <i>et al.</i> , 2022	2022	Fertilizer & Seed	Cereals	Ghana	Cross sectional data	No	287
Azumah & Zariah 2019	2019	Fertilizer	Cereals	Ghana	Cross sectional data	No	-51
Tsiboe <i>et al.</i> , 2021	2021	Fertilizer	Cereals	Ghana	Panel data	No	165
Awotide <i>et al.</i> , 2013	2013	Seed	Cereals	Nigeria	Cross sectional data	Yes	181
Wossen <i>et al.</i> , 2017	2017	Fertilizer & Seed	Cereals	Nigeria	Cross sectional data	Yes	110
Mavesere & Dzawanda, 2022	2022	Fertilizer & Seed	Cereals & legumes	Zimbabwe	Cross sectional data	No	46
Khonje, 2022	2022	Seed	Legumes	Malawi	Panel data	Yes	81
Hodjo <i>et al.</i> , 2021	2021	Fertilizer & Seed	Cereals	Malawi	Pooled cross-sectional data	Yes	-1
Vondolia <i>et al.</i> , 2021	2021	Fertilizer	Cereals	Ghana	Cross sectional data	No	0
Ricker-Gilbert & Jayne, 2017	2017	Fertilizer & Seed	Cereals	Malawi	Panel data	Yes	45
Benjamin <i>et al.</i> , 2021	2021	Fertilizer & Seed	Cereals	Nigeria	Panel data	Yes	714
Nwaliejil <i>et al.</i> , 2015	2015	Fertilizer & Seed	Cereals	Nigeria	Cross sectional data	Yes	86
Seleka, 2022	2022	Fertilizer & Seed	Cereals	Botswana	Panel data	No	106
Ngoma <i>et al.</i> , 2021	2021	Fertilizer	Cereals	Zambia	Panel data	Yes	11
Karamba & Winters, 2015	2015	Fertilizer & Seed	Cereals	Malawi	Cross sectional data	Yes	61
Wiredu, 2015	2015	Fertilizer	Cereals	Ghana	Cross sectional data	No	13
Carter <i>et al.</i> , 2021	2021	Fertilizer & Seed	Cereals	Malawi	Cross sectional	Yes	249

Source: Authors' compilation



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