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The political economy of gender bias in access to fertiliser

A case study on fertiliser subsidies in Malawi and Tanzania

by

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Abstract: It is increasingly agreed upon by both scholars and policymakers that policies have different gendered effects. Agricultural input subsidies are highly debated policies in Africa. They were popular in the 1960s and 1970s, removed under the SAPs and liberalisation schemes in the 1980s and 1990s, and have been making a comeback since the turn of the century. This study aims to analyse to what extent gender bias has impacted access to fertiliser in the context of the re-introduction of fertiliser subsidies, after the assumed liberalisation-induced increase in gender bias. A two-fold method is used, by first conducting an econometric analysis using OLS and Probit models, and next explaining and contextualising the findings using a political economy approach. The data used is the first three waves of the AFRINT project of Lund University. Based on the analysis, it can be concluded that no direct gender bias (positive or negative) was found in the econometric analysis. Nevertheless, the discussion has shown that there are potential indirect negative gender biases through factors such as access to political networks, information, education, and market participation. The results of the analysis, thus, indicate that through the targeting criteria of the fertiliser subsidies, it is unlikely that the gender bias in access to fertiliser will be significantly reduced. This study contributes both to the literature analysing the effectiveness of input subsidies as well as to the agricultural political economy literature. Additionally, it is relevant for policy makers interested in the impacts of input subsidies on the gender gap.

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1 Introduction

The 1980s and 1990s in African economic history are marked by the neoliberal policies introduced through Structural Adjustment Programmes (SAPs) and economic liberalisation schemes funded by multilateral organisations such as the World Bank and the International Monetary Fund (IMF). These programmes marked a drastic turn in economic approach after the 1950s to 1970s were dominated by state intervention (Rakowski, 2000). Some of the major policies in these two eras were fertiliser subsidies and their subsequent removal (Harrigan, 2003). The removal of these subsidies and privatisation of parastatals in the 1980s and 1990s was grounded in that they caused inefficiencies and market failure, and were, thus, supposed to increase economic efficiency, productivity and growth (Rakowski, 2000). Yet, with the turn of the century, fertiliser subsidies have started to make a come-back, after the limited effectiveness of the liberalisation policies in creating agricultural development (Chirwa & Dorward, 2013a). Additionally, they fit into the currently policy culture focusing on pro-poor growth as they are usually targeted towards smallholder farmers (Andersson Djurfeldt et al., 2018).

1.1 Research Problem

Although the SAPs and liberalisation policies introduced in the 1980s and 1990s were deemed to be gender neutral, it can be argued that this is not the case since there is evidence that there is gender bias both in the outcomes and the implicit assumptions of the theory behind the policies (Rakowski, 2000). As women were less likely to be able to enjoy the economies of scale created by liberalisation due to the small-scale and informal nature of their work, they were arguably less able to reap the benefits of liberalisation (Baden, 1998). This, in turn, widened the gender gap. Fertiliser subsidies, and more specifically those targeted towards females, are increasingly being introduced as a tool to, among others, reduce this gender gap (Rakowski, 2000). This study aims to investigate the effectiveness of fertiliser subsidies in closing this assumed gap.

1.2 Aim and Scope

The aim of this study is to analyse the impact of fertiliser subsidies on gender bias in the post-liberalisation context, to be able to shed light on if these subsidy schemes aid in closing the gender gap in agriculture which arguably widened during the liberalisation era. To do so, a focus will be given to gender bias in access to fertiliser. It is assumed that the subsidies should have a positive significant effect on access to fertiliser as, theoretically, women should gain from them. The aim of this study can be summarised into the following research question:

"To what extent does gender bias impact access to fertiliser in the context of the re-introduction of fertiliser subsidies?"

To be able to answer the research question an econometric analysis using an OLS model is performed. Next, the statistical findings are explained and contextualised using a political economy approach. Due to the political and contextual influence on the effects of agricultural input subsidies, the Malawian Farm Input Supply Programme (FISP) and the Tanzanian National Agricultural Input Voucher Scheme (NAIVS) are used as case studies. Due to their similarities as well as differences, these two input subsidies are relevant case studies to be compared and contrasted. Malawi was chosen as a case study because of the pilot-nature of the subsidy, as the Malawian FISP changed the stance of several donors in relation to fertiliser subsidies (Sachs, 2012). The Tanzanian case was selected based on the clear cut between liberalisation and fertiliser introduction. Additionally, the NAIVS was introduced with donor support, an exit strategy, and clear targeting criteria. The data used for this study is the first three waves of the dataset from the AFRINT project of Lund University, which is panel data on household level covering two Tanzanian and four Malawian regions.

Through answering this question, a gendered analysis of the effectiveness of fertiliser subsidies is performed. This contributes to the literature analysing the effectiveness of input subsidies, as there is only limited gendered analysis in this literature. This is relevant for both future research and policy makers as it is recognised that women play a crucial role in the road to agricultural intensification and increased productivity (Andersson Djurfeldt et al., 2019). Additionally, by combining a political economy approach with a gender approach, this study also contributes to the agricultural political economy literature. Furthermore, the findings of this study are relevant for policy makers and other actors working with gender equality in agriculture, input subsidies, and access to fertiliser, and the sustainability as well as inclusivity aspect of these topics.

1.3 Outline of the Thesis

This thesis is structured as follows: in chapter 2, the theories and literature are presented and reviewed. Chapter 2 first discusses agricultural liberalisation and gender bias, and then introduces and reviews fertiliser subsidies and their gendered effects. Chapter 3 discuss the agricultural liberalisation and fertiliser subsidies in Tanzania and Malawi respectively. Next, chapter 4 presents the data used in this study while chapter 5 explains the methods used. In turn, chapter 6 consists of the empirical analysis, which is split up into a results and a discussion section. Finally, chapter 7 concludes and gives suggestions for future research.

2 Theory and literature

This chapter presents and discusses the theories and related literature on agricultural liberalisation and the re-introduction of fertiliser subsidies in relation to gender and gender bias. First, the African agricultural liberalisation and its potential gender bias is discussed. Next, fertiliser subsidies are explained, and their gendered effects discussed. Third and fourth are the case studies of Tanzania and Malawi respectively, where agricultural liberalisation and fertiliser subsidies are presented in the country-specific context.

Based on the discussed theory and literature, it is concluded that fertiliser schemes are not tackling the underlying gendered differences which also influence access to fertiliser. Even so, some of the targeting criteria are inherently gender biased due to structural and cultural constraints affecting female farm managers. Furthermore, it is found that there is a literature gap in analysing the gendered effect of the input subsidies on access to fertiliser.

Due to the limited awareness of gender within the field of economic history and researchers' lack of willingness to educate themselves, it is relevant to use this thesis as a pedagogical opportunity. It is necessary to highlight that gender and sex are not the same. While gender is a social construct that is not binary, sex is the binary category that is assigned at birth based on biological trademarks. For further information, the Gender Unicorn can be consulted (TSER, 2015).

2.1 Agricultural Liberalisation and Gender Bias

In terms of liberalisation and structural adjustment within the agricultural sector, the removal of fertiliser subsidies was the most important policy (Harrigan, 2003). Although agricultural input subsidies were popular in the 1960s and 1970s, they were phased out in the 1980s and 1990s as part of IMF and World Bank funded SAPs and liberalisation policies. It was argued by the IMF and World Bank that the market distortions and inefficiencies in the agricultural sector were high and that the price support to parastatals was becoming too big of a fiscal burden (Korinek, 2005; Baden, 1998). Additionally, it was hypothesized that because these market distortions were so high, the gains from liberalisation could also be very high. However, in retrospect, it is generally agreed that the agricultural liberalisation period did not always bring the intended benefits, especially for smallholder farmers (Andersson Djurfeldt et al., 2018)

When assessing the impact of liberalisation, it is interesting to look at how it impacted smallholders differently, here how it impacted male and female smallholders differently. It is argued that agricultural markets are gendered in themselves, which results in liberalisation policies having different impacts on men and women (Baden, 1998). As women often participate in more informal and small-scale agricultural trading, increasing standards and formalisation of informal trading increases competition and affects women harder (Baden, 1998). Additionally, as agriculture is often one of the sectors most affected by structural adjustments, and women are heavily employed in this sector, women are more likely to be affected by the changes (Korinek, 2005). Yet, they are also more constrained than men, making them less able to enjoy the benefits of agricultural trade expansion and economies of scale. However, as explained by Korinek (2005) it can be argued that agricultural liberalisation will lead to increased productivity, which would lift some of women's constraints such as access to credit and fertiliser. Nevertheless, the literature reporting on these gendered effects of (agricultural) liberalisation is mixed (Rakowski, 2000). This could be due to the contextual differences both between and within countries, as well as different conditions under which agricultural liberalisation took place. Additionally, different scholars have different definitions for what are positive and negative impacts of liberalisation (Rakowski, 2000).

2.2 Fertiliser Subsidies

Agricultural input subsidies have been making a comeback in many African countries since the turn of the century. The fundamental driver behind the comeback of the input subsidies in Africa was, according to Chirwa and Dorward (2013a), the apparent failure of liberalisation in supporting and creating agricultural development and sustainable intensification. They, furthermore, fit under the rubric of pro-poor growth as they are targeted towards small-holder farmers, and thus mark a distinct break with the neglect of smallholder agriculture in the 1980s and 1990s (Andersson Djurfeldt et al., 2018).

Currently, it is agreed upon that inorganic fertiliser is a crucial tool with immense potential for ensuring food security, while also enabling smallholder farmers to rise out of poverty and increase their income and assets (Benson et al., 2012). Fertiliser subsidies allow smallholders to invest in fertiliser without risking to lose much money, thus lowering the entry barrier (Senkoro et al., 2017).

The difference between the initial subsidies and the new subsidy programmes is that the former were universal programmes while the latter are targeted, also called smart subsidies. According to Morris et al. (2007) there are 10 features of smart subsidies, some of which are empowering farmers, involving an exit strategy, ensuring sustainability, promoting pro-poor economic growth, promoting fertiliser as part of a larger strategy and favouring market solutions. They do, however, recognise that in exceptional circumstances food security or poverty reduction can have precedence over sustainability and efficiency. In theory, agricultural input subsidies should promote productivity as it makes investment in new technology more attractive to smallholder farmers (Chirwa & Dorward, 2013a). Based on the 10 features put forward by Morris et al. (2007), and in accordance with economic theory, input subsidies should reduce deadweight losses and leakages, and have low administration fees to be effective (Chirwa & Dorward, 2013a). Additionally, to reduce economic losses, crowding out should be avoided through appropriate targeting.

2.2.1 Gendered effect of Fertiliser Subsidies

Considering the majority of the Sub-Saharan African population are smallholder farmers, a smallholder-based model such as a targeted fertiliser subsidy could be considered appropriate for increasing agricultural productivity. These subsidies are considered a smallholder-based model as they mainly target smallholder farmers. However, due to the heterogeneity of smallholder farmers, the smallholder-based model is increasingly deemed inappropriate for resource-constrained households (Andersson Djurfeldt et al., 2018). This is due to their limited engagement, and chances of engagement, in the commercial sector. As female-headed households are often resource-constrained households and considering the institutional bias against women is well-documented, it could be said that the smallholder-based model is a priori gender biased. However, this is too easy of a conclusion as there are studies suggesting the gender segmentation of intra-household relations and livelihoods is complementary with women's combination of farm and non-farm activities (Andersson Djurfeldt et al., 2018). Research assessing the gender bias of smallholder-based models such as target fertiliser subsidy programmes have come to mixed conclusions, which emphasises the heterogeneity of smallholder farmers as well as the spatial and temporal differences in the programmes (Msuya et al., 2018).

This heterogeneity and importance of contextualisation is also reflected in the differential results reported in studies analysing the impact of fertiliser subsidy programmes. While some studies find statistically significant positive or negative gendered effects on fertiliser subsidy programmes (Diiro et al., 2015; Kilic et al., 2015; Thomson et al., 2015), others do not (Isham, 2002; Chirwa, 2005; De Groote et al., 2002). Differences in fertiliser uptake among gender lines have been explained by access to credit, information constraints and limited networks, education level, market participation, plot size, wealth, and mobility constraints (Kaliba et al., 2018; Kaliba et al., 2020; Komarek et al., 2017).

Regarding access to credit, it has been widely documented that women generally have constrained access to credit (Duflo et al., 2011). This not only affects women's opportunities in joining the formal labour market, but it also limits their opportunities in accessing subsidised fertiliser, especially when there is a co-financing requirement. One of the main aspects of recent smart subsidies is that there is a requirement for co-financing by the recipient (Andersson Djurfeldt et al., 2019). This usually means the recipient has to finance between 25 and 75 percent of the fertiliser by themselves, with the other part being financed by subsidies. However, this often excludes the very people the subsidies are targeted to - resource-constrained farmers. Due to cultural and economic constraints, women are over-represented in this group, effectively excluding them from access to subsidised fertiliser (Andersson Djurfeldt et al., 2019). Additionally, due to their responsibility for the household and nutrition, women are more likely to prioritise expenditures on food rather than investments in fertiliser (Andersson Djurfeldt et al., 2018).

Information and social networks are a crucial part in the adoption of a new technology such as fertiliser. Although fertiliser is not a new technology in itself, it is a new technology for a large number of smallholder farmers as they have not used it before. When someone does not know of the existence or impact of a technology, they will not adopt it (Kaliba et al., 2018). This information is usually shared through social networks and through extension agents. However, Kaliba et al. (2018) argue that the social networks of poor farmers and females are limited, which makes it more difficult for them to access accurate, available information about agricultural technologies such as fertiliser. Moreover, extension agents have been found to neglect poor and female-headed households, further limiting their access to information. Additionally, as agriculture, and especially agricultural technology, is still seen as a largely male sector and/or topic, information regarding these is mainly shared within male social networks (Andersson Djurfeldt et al., 2019).

Education level has been found to have a statistically significant effect on fertiliser adoption (Chirwa, 2005; Kalinda et al., 2014). Education level reflects human capital and the farmer's ability to adapt to conditions within production methods as well as within the market. Education may also reflect higher access to information or more knowledge on agricultural technologies, both affecting the access to and adoption of fertiliser. As men are often, traditionally, higher educated compared to women, education, in itself, also reflects a gender bias. This, thus, makes women less likely to be able to access and/or adopt (subsidised) fertiliser.

The positive effect of market participation is not only linked to the presence and an institutional support system, it also increases the net returns of farmers, and this way increases capital (Kaliba et al., 2018). Market participation can be constricted for females due to mobility constraints, but also due to their traditional responsibility for the household and nutrition of the family, leading to women prioritising food consumption over market participation. Additionally, due to lack of control over income, some women do not have incentives, or have low incentives to participate in markets (Chirwa & Dorward, 2013b). These physical as well as financial restrictions and lower incentives for female farm managers are not necessarily addressed by input subsidies, allowing for questioning if fertiliser subsidies can reduce the gender bias in access to fertiliser.

Although not all studies find a similar effect of plot size on fertiliser adoption, it is believed to still have an impact on it. While Nkonya et al. (1997) found a negative effect of plot size on fertiliser adoption, meaning the larger the plot, the less likely one is to use fertiliser, Jayne et al. (2013) and Chirwa (2005) found a positive effect. Smaller plots of land may disincentivise farmers from using fertiliser, as they likely only produce for subsistence while farmers with larger plots could increase their returns of investment by using fertiliser. On the other hand, the returns of investment may be higher on a smaller plot as less fertiliser is needed, and thus the entry barriers and investment costs are lower. Due to inheritance structures and weak land rights for women, especially within patriarchal societies, women have less access to land, are more likely to lose their land and often have smaller plots (Izumi, 1999; Razavi, 2003).

Wealth, although connected to access to credit, is not the same as it can be expressed through other aspects such as housing standards and assets. Wealth, however, does increase access to credit, as it allows farmers to take larger risks and dedicate more resources to aspects that have longer-term return of investment. Chirwa (2005), Komarek et al. (2017), Kalinda et al. (2014) and Kaliba et al. (2018) found a positive association between wealth and fertiliser adoption. According to Kaliba et al. (2018), the likelihood of a farmer trying a new agricultural technology is higher when they are wealthier. Due to cultural and traditional structures, men and male-headed households are often wealthier than women and female-headed households.

Mobility constraints entail the constraints women face due to their responsibility for household chores, care burdens and social norms. This time-consuming unpaid work limits women's ability to engage in agriculture, with the problem being exacerbated for female-headed households (Andersson Djurfeldt et al., 2019). The time-constraint caused by unpaid household labour further influences already existing constraints such as lack of access to credit, lack of time, low or no market participation, etc.

On top of the above discussed factors influencing fertiliser adoption, and thus the impact of fertiliser subsidies, several studies also found other factors of influence such as non-farm income, land security and land rights, labour availability, expectations about yields and area planted (Komarek et al., 2017; Ricker-Gilbert et al., 2011; Chirwa, 2005; Kalinda et al., 2014; Kaliba et al., 2018). Yet, it is clear, from the above discussion, that the different factors influencing fertiliser adoption are interlinked and interdependent. As Baden (1998) argues, the agricultural sector and market is gendered, which is manifested in different ways dependent on the specific historical, social, political and agro-ecological contexts. Although fertiliser subsidies target female-headed households and are often introduced with an aim to reduce the gender gap in access to fertiliser, they do not tackle the direct and indirect gendered effects influencing access to fertiliser and even subsidised fertiliser. The physical, financial restrictions, incentive, and information constraints female farm managers face are not necessarily addressed by input subsidies, allowing for questioning if fertiliser subsidies can reduce the gender bias in access to fertiliser.

Based on the literature and the above analysis of it, the factors education, access to credit, access to information and social networks, wealth and plot size can be seen as the most important factors to be studied in the context of this study's analysis. This is not only the case because they are so interlinked with gender, but also because they are the factors most explored within the existing literature. Furthermore, they are also linked to the political economy of agriculture. The political economy of agriculture and agricultural policies is the influence of both politics as well as economics on policy decisions, implementations and effects (Jerven, 2014). Analysing both the fertiliser subsidies as well as the effects of gender and the above-mentioned factors in relation to the subsidies through a political economy lens is relevant as the subsidies are economic policies which are highly politicised due to the political importance of maize and food security (Mdee et al., 2020). The factors mentioned above can be summarised into the two political economy categories of access to information, and access to political processes and networks. Additionally, corruption and patronage are also relevant factors to be taken into account in the analysis because of their influence on policy decisions, implementation as well as (gendered) inequality in access (Mdee et al., 2020; Cooksey, 2012; Chinsinga & Poulton, 2014). The political economy analysis using these factors will provide an understanding of the political and economic processes within a given context and how they influence (access to) fertiliser subsidies.

3 Cases

As the historical, social, political, and economic contexts are different in every country, this study focuses on the two cases of Malawi and Tanzania, to ensure the context-specific factors are taken into account. These cases were chosen based on their respective fertiliser subsidy programmes and the differences as well as similarities between said programmes.

In the following sections, the neo-liberal policies introduced, their impacts, and the fertiliser subsidy programme are discussed for both countries individually using relevant literature.

Figure 1: Map of Africa. Map Design: Emre Guerbuezer. Map Data: World Bank (2021)

3.1 Tanzania

Tanzania is a country in East Africa, bordering Uganda, Kenya, Rwanda, Burundi, the DRC, Zambia, Malawi, and Mozambique. Tanganyika gained independence in 1961, while Zanzibar received independence in 1963. In 1964, the two entities merged and became the United Republic of Tanzania – here called Tanzania. The agricultural sector accounted for more than 85 percent of the economy until 1998, and more than 70 percent until 2012, as can be seen in figure 1. The importance of the agricultural sector and agricultural development in Tanzania is also shown by the fact that 70 percent of the Tanzanian rural population is still dependent on agriculture for their livelihoods (Msuya et al., 2018).

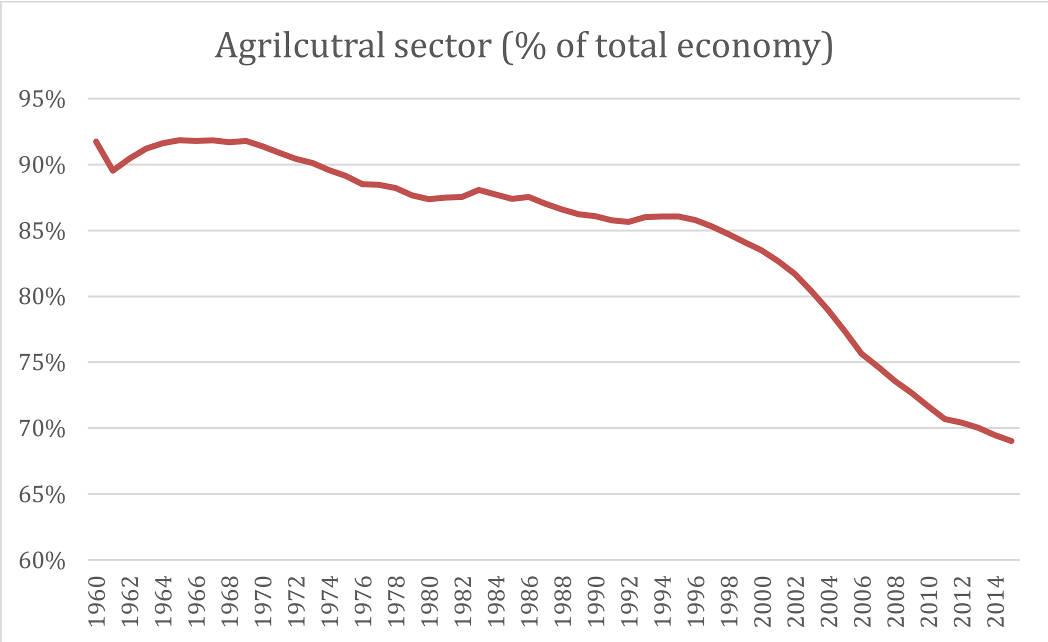

Figure 2: Tanzanian agricultural sector as percentage of the total economy.
Data Source: Mensah and Szirmai (2018)

Note: the expression "as percentage of total economy" is taken from the data source.

3.1.1 Structural Adjustment and Liberalisation

From independence until the early 1980s, Tanzania, similar to most of Sub-Saharan Africa, had an economy based on strong state intervention (Rakowski, 2000). On top of a universal input subsidy programme, an important part of this state intervention approach was the fertiliser subsidy programme which was in place in the Southern Highlands of Tanzania from 1974 until 1984. Although this programme was very successful and created a mini-green revolution, it could not be scaled up or sustained due to the high subsidy costs (Msuya et al., 2018). After the publication of the Berg Report in 1981, the interventionist regime was being increasingly challenged by the World Bank and the IMF. This marked the start of two decades of Structural Adjustment Programmes, consisting of liberalisation and phasing out of government intervention (Baden, 1998). By 1994, all subsidies had been phased out. The phasing out of the fertiliser subsidies opened up the markets to private traders, a market that had been in the hands of the Tanzania Fertiliser company, which was financed by state-owned banks (Cooksey, 2011).

Although the structural adjustments and liberalisation were introduced because of widespread inefficiencies and market failure (Baden, 1998), Cooksey (2011) argues that the liberalisation of input and output markets has led to market failure as fertiliser use, and the role of cooperatives drastically fell. Yet, the liberalisation of the maize market in Tanzania did not spark riots and the market was able to keep up the demand of maize. This upkeep of demand, though, only just covered population growth and was not induced by an increase in productivity, but by increasing the area of land cultivated (Cooksey, 2011). However, since the early 1980s, the costs of farm inputs rose, and maize prices fell. It is, thus, argued that the ‘success’ of the maize market liberalisation needs to be seen in relation to the liberalisation of farm inputs, of which the most important one is inorganic fertiliser (Cooksey, 2011). Liberalisation of fertiliser did not only mean the removal of subsidies, but also the removal of state monopolies. Although these state monopolies were arguably very costly and inefficient, they did manage to reach relatively remote areas and supply smallholders with the necessary inputs. The privatisation, indeed, led to higher efficiency of procurement and distribution of agricultural inputs, but also increased prices, which drove many farmers back into subsistence (Cooksey, 2011). Though this increase in efficiency of procurement and distribution did not mean an increase in outreach, rather distribution to rural areas was often scaled down due to it being deemed inefficient by private fertiliser companies. Fertiliser use fell by 50 percent after the removal of the subsidy, averaging 10kg per hectare in 1994 in Tanzania, compared to 18kg per hectare in Africa and 94kg in the world (Isham, 2002). According to Isham (2002), fertiliser use among Tanzanian smallholders did not increase between the early 1980s and 2002.

3.1.2 Fertiliser Subsidy

The turn of the century brought, again, a change in the approach to economic policies. In 2003, Tanzania introduced a limited but untargeted subsidy aimed at fertiliser transport, which was discontinued in 2007 due to its ineffectiveness as it was untargeted (Kim et al., 2021). Following this, and with support from international donors, the Tanzanian government introduced the National Agricultural Input Voucher Scheme (NAIVS) in 2008. This scheme entails a 50 percent subsidy for inorganic fertiliser and improved seeds for maize and rice, targeted at 6 high-potential regions within the country (Andersson Djurfeldt et al., 2019).

a. National Agricultural Input Voucher Scheme

NAIVS was introduced in response to issues of low agricultural productivity and falling yields, with its main aim to enhance food security (Kim et al., 2021). It was developed as a pro-poor scheme as it targets smallholder farmers and aims to enhance their production of maize and rice (Msuya et al., 2018). Additionally, the scheme aimed to increase farmer's access to fertiliser and strengthen the private sector fertiliser supply chain (Mather et al., 2016). The subsidy is distributed through vouchers in the targeted area, and smallholders have to meet two main criteria to be eligible (Chirwa & Dorward, 2013d). The first criteria being that the farmer can only grow one hectare or less of maize or rice. Second, the recipient needs to be willing and able to pay 50 percent of the subsidised fertiliser at market rate. In case there are more households fulfilling these criteria than there were vouchers, priority should have been given to households who have not used fertiliser in the past five years and female-headed households (Andersson Djurfeldt et al., 2019). The eligible smallholder farmers were decided upon by a village voucher committee, which consisted of local elected officials, several local farmers, and the extension agent that covered the village (Mather & Minde, 2016). The targeted regions were selected based on the number of maize and rice farmers per region (Chirwa & Dorward, 2013d). The smallholder farmer recipients were supposed to receive the vouchers for three consecutive years, after which they 'graduate' the programme (Kim et al., 2021). The intention of the programme and its subsequent graduation is that throughout the three years the farmers should have gained enough experience and income to further use fertiliser at market price. In subsequent years, eligible farmers who had not yet received vouchers would then start receiving these (Mather & Minde, 2016).

An important feature of the NAIVS programme is that it can be considered a smart subsidy. One of the important criteria for a smart subsidy is that it should be designed to work within the existing private sector and support the development of this sector (Morris et al., 2007). This would reduce the known inefficiencies of state monopolies and while incentivising the private sector to further develop and increase its reach (Mather & Minde, 2016). This would, further, also limit the role of the government to only the distribution of vouchers, thus minimising government intervention. In the case of the NAIVS programme, these criteria are fulfilled, as the vouchers are distributed through the government, and recipients can acquire the fertiliser at local, private input dealers. The recipient pays 50 percent of the fertiliser and the voucher, with which the dealer can redeem the other 50 percent from the government. This, thus, shows that the subsidy programme does not work against the interest of the private fertiliser sector (Benson et al., 2012). Another key feature of a smart subsidy is that it should target a population that will be able to make productive use of the fertiliser but is known to not have been using fertiliser (as otherwise this would create a crowding-out effect) (Morris et al., 2007). Again, the NAIVS programme fulfils this feature through its specific targeting criteria. Additionally, the pre-planned ‘graduation’ moment creates a clear exit strategy. NAIVS can, thus, be considered a ‘smart subsidy’.

b. Gendered Effect

Although the NAIVS was developed, on paper, as a pro-poor scheme (Msuya et al., 2018) and targets female-headed households, it is often the poor (and) female-headed households who are not able to meet the co-financing criteria of the programme (Chirwa & Dorward, 2013d). Interestingly, it was later-on argued that the programme does not intend to be pro-poor, but target middle-level farmers who would be able to make the best use of the inputs (Chirwa & Dorward, 2013d). In line with this statement, Chirwa and Dorward (2013d) have found that beneficiaries of the programme tend to be wealthier compared to non-beneficiaries. Kim et al. (2021) confirm this with their findings that beneficiaries are more likely to own livestock and earn non-farm income than non-beneficiaries. They also argue that this is likely because of the co-financing criteria. In relation to this, Mather and Minde (2016) found that, depending on the year, between 25 and 37 percent of the recipients did not redeem their vouchers because they could not afford the contribution. This, further, also indicates that these households did not gain the experience of using fertiliser under the NAIVS programme, reducing the programme’s effectiveness. Yet, Mather et al. (2016) did find a significant increase in fertiliser use between 2008 and 2013. Senkoro et al. (2017) also found an increase in fertiliser use from 9 kg per hectare per year to 17 kg per hectare per year since the introduction of the subsidy scheme in 2008.

Regarding the eligibility criteria of not farming more than 1 hectare of maize or rice, Kim et al. (2021) found that this criteria was likely not strictly enforced, as 40 percent or more of the beneficiaries cultivated more than 1 hectare. However, they did find that the mean area cultivated was similar for beneficiaries and non-beneficiaries, suggesting the subsidy was not disproportionately captured by larger farmers. This is especially relevant as female farmers are likely to own smaller plots of land (Izumi, 1999). Nevertheless, the criteria of not having used fertiliser in the 5 prior years does seem to be largely met, as found by Mather et al. (2016). Although the programme's aim was that after graduation, the farmers would continue using fertiliser, as they now had had the low-risk experience and higher output and income, only 37 percent of farmers continued using fertiliser after the 3-year programme ended (Msuya & Isinika, 2016).

Even though there are several studies analysing the different factors influencing the impact of the NAIVS, little studies have investigated if these effects are gender biased. Additionally, most studies, such as Andersson Djurfeldt et al. (2019), discussing the gendered effects of fertiliser and agricultural intensification analyse the effects on yields instead of access to fertiliser. This study aims to fill this gap by looking at the gender bias in access to fertiliser in the context of the post-liberalisation re-introduction of fertiliser subsidies such as NAIVS.

3.2 Malawi

Malawi is a landlocked country in East Africa, bordering Tanzania, Zambia, and Mozambique. The country gained independence in 1964, after which it renamed itself from Nyasaland to Malawi. Malawi is highly dependent on agriculture, and in particular on smallholder agriculture (Chirwa & Dorward, 2013c). Nearly 80 percent of the Malawian population is employed in agriculture (World Bank, 2021b). As can be seen from figure 2, agriculture still accounted for more than 55 percent of the total economy in 2014. Nevertheless, Chirwa and Dorward (2013c) argue that Malawian smallholder farmers are stuck in a low maize productivity trap, which leads to low incomes and their subsequent inability to afford inputs at market prices.

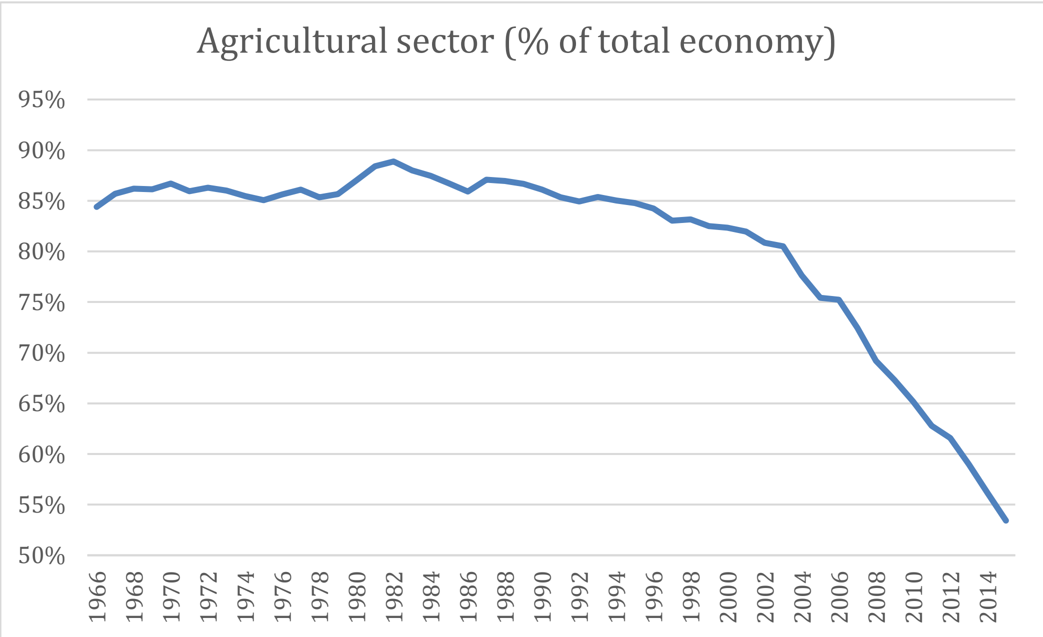

Figure 3: Malawian agricultural sector as percentage of the total economy.
Data Source: Mensah and Szirmai (2018)

Note: the expression "as percentage of total economy" is taken from the data source.

3.2.1 Structural Adjustment and Liberalisation

Since independence in 1964, until the late 1970s, Malawi had a strong state-interventionist programme, where smallholder farmers were restricted from cultivating high value cash crops such as tobacco (Chirwa & Dorward, 2013c). Instead, they were only allowed to cultivate food crops and low value cash crops as well as provide cheap labour for estate agriculture. Within the government, chronic poverty was downplayed and there was little attention to social welfare in policies. This was especially seen in the fertiliser subsidy programme, which was not targeted at the poor, but at the better-off smallholders (Chirwa & Dorward, 2013c). The approach, however, changed after multiple external shocks. This led Malawi to seek financial assistance from the World Bank, who started a structural adjustment programme in 1981 (Mvula & Mulwafu, 2018). As a part of this SAP, and most prominent within the agricultural sector, fertiliser subsidies were removed. It was argued by the World Bank that the best way to achieve food security was by exporting cash crops such as tobacco and using the returns from this to import food in case of a food deficit (Harrigan, 2003). However, the Malawian Ministry of Agriculture did not agree as it equated food security with self-sufficiency. The ministry criticised the World Bank's approach as higher food crop productivity was a necessity for freeing up land for export crop production without jeopardising food self-sufficiency. In general, the SAPs had limited attention to poverty alleviation and production constraints, while focusing more on promoting market and price mechanisms (Chilowa, 1998). This meant that the losers of the SAPs were mainly the smallholder farmers, especially those that were net food buyers, which are largely women (Mvula & Mulwafu, 2018), while the winners were net food sellers and private and institutional traders (Chilowa, 1998).

Due to the inappropriate implementation and poor sequencing of the price and market liberalisation, Malawi was facing a food crisis in 1987 (Harrigan, 2003). In response, a 22 percent fertiliser subsidy was re-introduced in 1987. Coinciding with the re-introduction of the subsidy, a re-appraisal of the Washington Consensus approach happened, leading to a more neoclassical paradigm in the 1990s, supported by the IMF (Harrigan, 2003). In 1994, Malawi had its first democratic elections. Although it was generally acknowledged by the Malawian government that the adjustment reforms in the agricultural sector had failed, it accelerated the agricultural liberalisation process due to its need for donor-funded foreign exchange (Harrigan, 2003). In 1996/7, due to pressure from the World Bank, the fertiliser subsidies introduced in 1987 were again removed as part of a financial restructuring and decentralisation programme (Harrigan, 2003). This, in combination with problems in Mozambique and subsequent high transport costs, resulted in one of the highest fertiliser-maize price rations in the world. Between the early and late 1990s, the maize production per capita had fallen from 163 kg to less than 150kg (Chinsinga, 2007).

3.2.2 Fertiliser Subsidy

In response to increasingly common food shortages and the high fertiliser prices, the Malawian government, once again, introduced an input programme, called the Starter Pack (SP) programme in 1998/9 (Chinsinga, 2007). The SP distributed small quantities (0.1 ha worth) of fertiliser and seeds to all rural farming families. However, this subsidy was too little to have any impact on the country's food security. As an exit strategy and for sustainability purposes, the SP was scaled down to the Targeted Input Programme (TIP) in the 2000/1 growing season, targeting only the very needy such as the elderly and HIV/AIDs patients (Msuya et al., 2018). In most cases, the TIP recipients ended up selling their inputs or not using them effectively (Chinsinga, 2007). The TIP was abandoned in 2004/5 due the withdrawal of donor support in response to the programme's failure of achieving any increase in productivity. In the 2005/6 growing season, the Farm Input Supply Programme (FISP) was introduced after the 2004 elections had been dictated by the re-introduction of an input subsidy (Chinsinga, 2012).

a. Farm Input Supply Programme

The FISP is a targeted subsidy programme which does not aim to distribute fertiliser as a safety net, such as the SP and the TIP, but to those who have the resources to use it effectively but would otherwise be too resource-constrained to obtain it (Chinsinga, 2007). Although the introduction was not supported by the donor community, and thus funded by the Malawian government, it turned out to be successful and subsequently, Malawi became a pioneer for the implementation of a smart subsidy (Chinsinga, 2012). In 2006/7, after the success of the programme had been shown, it received donor support (Dorward et al., 2008). After almost two decades of food deficits, the country became self-sufficient. More so, it achieved a 53 percent food surplus in 2006/7, compared to a 43 percent deficit in 2005 (Chinsinga, 2012). However, there is an ongoing debate on the sustainability and extent of its effectiveness.

The FISP is allocated using vouchers which, in theory, on district level, are based on the area planted to maize, the soil characteristics and the number of farming households (Chinsinga, 2012). Based on this, a distribution matrix is developed each year. However, it has been argued that the targeting criteria are not clear, consistent or transparent (Dorward et al., 2008). Additionally, irregularities have been reported concerning the coupon distribution, with Chinsinga (2012) explaining there are two distribution rounds – a formal and an informal one.

Tambulasi (2009) also argues there is large corruption regarding the distribution and acquiring of subsidised fertiliser, which involves village leaders as well as politicians. On village level, a village development committee decides on the allocation of the coupons by identifying the beneficiaries. This committee is chaired by village leaders and religious leaders (Chinsinga, 2007).

Although the FISP has been considered a success, there are also reports of crowding out (Ricker-Gilbert et al., 2011). Additionally, one of the main criticisms from donors has been that the private sector is not (enough) involved in the programme since it was only involved in 2006/7 and 2007/8 for fertiliser distribution. Most of the time, the coupons can only be redeemed at parastatal outlets, which allows beneficiaries to buy fertiliser at about 25 percent of the market price (Dorward et al., 2008). The large involvement of the state, unclear targeting criteria and exclusion of the private fertiliser sector lead to the conclusion that, according to Morris et al. (2007) their criteria for a 'smart' subsidy, the Malawian case is not fully a 'smart' subsidy.

b. Gendered Effect

Officially, female-headed households have been among the target criteria since 2008 (Andersson Djurfeldt et al., 2019), though there are reports of social and political connections influencing how much subsidised fertiliser a household receives (Ricker-Gilbert et al., 2011). This resulted in female-headed households reportedly receiving 12kg less subsidised fertiliser compared to their male counterparts. Additionally, due to the egalitarian cultural sentiments in rural communities in Malawi, there has been evidence of beneficiaries sharing bags with their neighbours or even village leaders obliging the beneficiaries to share the inputs with the village (Ricker-Gilbert & Jayne, 2017). However, Chibwana et al. (2012) do report that beneficiaries allocated 16 percent more land to maize production compared to non-beneficiaries.

Even though there is a vast literature discussing the effects of the FISP, there is limited literature on the gendered effects of this subsidy scheme. Moreover, studies which do include a gender perspective (Andersson Djurfeldt et al., 2019; Andersson Djurfeldt, 2018) often look at the gendered yield difference instead of the gendered difference in access to fertiliser. This study aims to fill this gap by performing a gendered analysis of the effect of FISP on access to (subsidised) fertiliser.

4 Data

This chapter discussed the data used in this study. First the source of the data is discussed, and the dataset explained. This will give an understanding of both the origin and the quality of the data. Next, some descriptive statistics are presented, showing the underlying distributions and characteristics of the variables which will be used in the econometric model.

4.1 Source Material

The dataset used for this study is the AFRINT database from the Afrint Project of Lund University. The project started in 2002 with the aim of looking into the possibilities for an Asian-style Green Revolution in nine Sub-Saharan African countries, using household level data from smallholder farmers (AFRINT, 2020). The current database has four waves, of which I received access to the first three. The first wave, Afrint 1, was conducted in 2002. The second wave, Afrint 2 was collected in late 2007 / early 2008, and Afrint 3, the third wave, was launched in 2013 in Malawi and 2015 in Tanzania (Andersson Djurfeldt et al., 2018). The data was collected by research teams from local universities, coordinated by researchers from Lund University (AFRINT, 2020).

The dataset provided to me by Agnes Andersson Djurfeldt, the project leader of the Afrint project, was crispy clean and consists of panel data on household level. However, over the different waves, the data gathered through the questionnaires changed slightly. This resulted in some variables not having data for all three waves. The continuity of the variables, thus, had to be taken into account, which means I was limited to only using the variables that did have continuity. Additionally, to account for attrition, some households are added to the sample each wave (Andersson Djurfeldt et al., 2018). These households, however, were excluded in this study as they did not have data for all three waves. The person interviewed was the farm manager (Andersson Djurfeldt et al., 2018). To ensure a more accurate representation, households where the farm manager changed over time, or was not re-interviewed were excluded from the sample.

Although the dataset includes data for nine countries, only the data for Malawi and Tanzania are used. These two case studies are chosen based on the nature of their fertiliser subsidies and their comparability as well as differences. Based on the choice of the countries, I found the Afrint dataset. The choice of countries was, thus, not influenced by the data. Malawi was chosen as a case study because of the pilot-nature of the subsidy, as the Malawian FISP changed the stance of several donors in relation to fertiliser subsidies (Sachs, 2012). The Tanzanian case was selected based on the clear cut between liberalisation and fertiliser introduction. Additionally, the NAIVS was introduced with donor support, an exit strategy, and clear targeting criteria. This makes it different compared to the Malawian case. The similarities and differences between the Tanzanian and Malawian case make them appropriate case studies to be compared and contrasted.

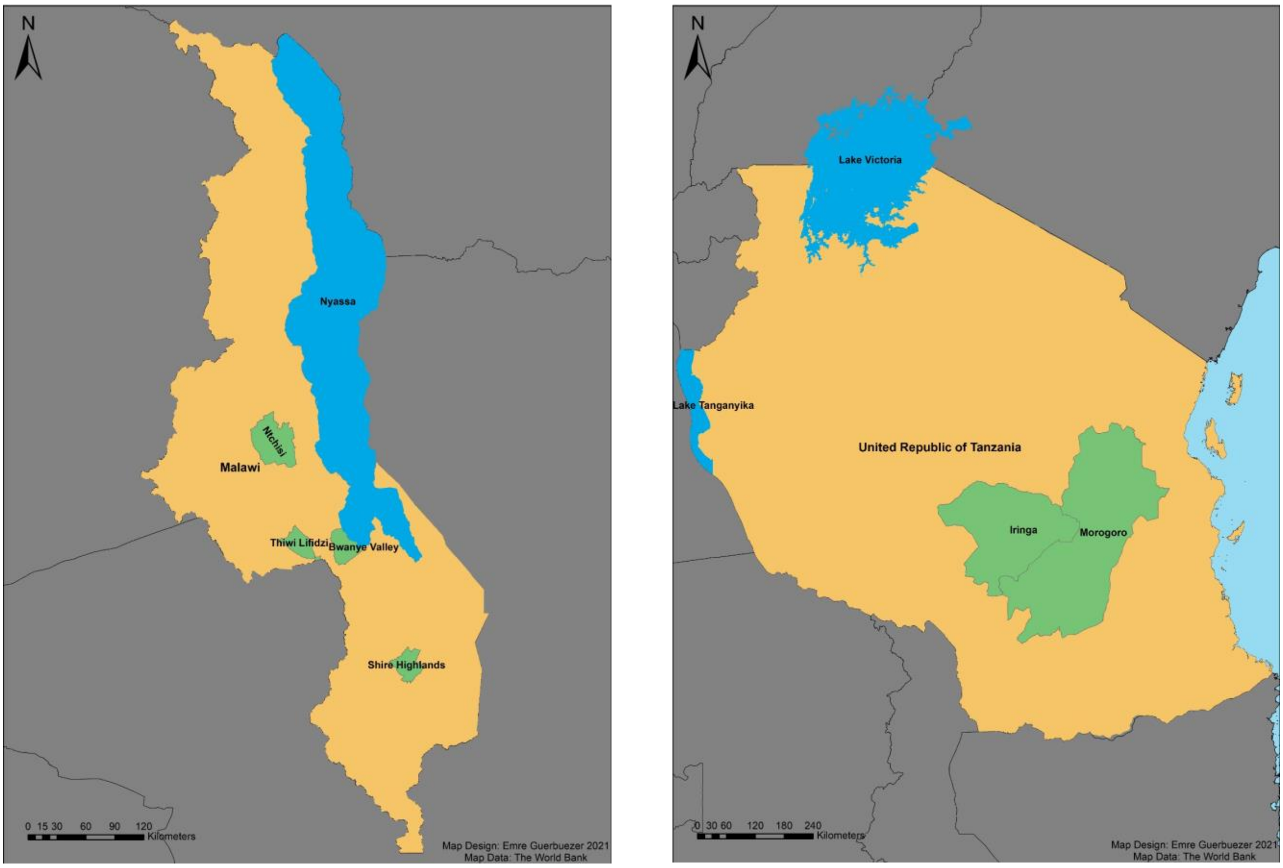

Figure 4: Maps of Malawi and Tanzania. Map Design: Emre Guerbuezer. Map data: World Bank (2021)

In Tanzania, the data was collected in two regions, namely Morogoro and Iringa. Iringa is part of the Southern Highlands, one of the largest maize-producing regions in Tanzania (Cooksey, 2012). Morogoro is a region known for its fertile soil and not only produces maize but also rice (Msuya et al., 2018). In Malawi, the regions where data was collected are Bwanye Valley, Ntchisi, Thiwi Lifidzi, and Shire Highlands. The location of the regions is shown on figure 3. Shire Highlands is in Southern Malawi, a region marked by very high population density (Ricker-Gilbert et al., 2014). Thiwi Lifidzi and Bwanye Valley are in central Malawi, with Thiwi Lifidzi being located in the Dedza region, known for its tobacco sale and closer proximity to the capital region Lilongwe (Andersson Djurfeldt et al., 2018). Although Ntchisi is still considered central Malawi, it is close to Northern Malawi and could have some influences from there. The differences between the regions also allow for interesting within-country comparisons. In the Afrint study, the regions in Tanzania were selected based on one being dynamic and one less dynamic (Andersson Djurfeldt et al., 2018). In Malawi, the regions were selected based on crop production characteristics. Within each region, several villages were selected, and within each village a random sample of the population was selected based on household lists (Andersson Djurfeldt et al., 2018). For confidentiality reasons, the villages selected are not published.

The micro-nature of the data, thus, means that the data is not representative on country-level. Rather, it is representative at the village level (Andersson Djurfeldt et al., 2018). However, because the villages are unknown to me, and due to the low number of farm managers interviewed at the village level, the data will be treated on regional level in this study. This is still relevant as the subsidy is applied on regional level in Tanzania and national level in Malawi.

4.2 Descriptive Statistics

In this section, the variables used for the econometric analysis of this study are presented, described, and discussed. First, the dependent and next the independent variables are presented.

4.2.1 Dependent Variable

As the aim of this study is to analyse to what extent gender bias impacts access to fertiliser in the context of the re-introduction of fertiliser subsidies, it is relevant to analyse the gender bias in access to fertiliser before and after the introduction of the subsidy programme. Therefore, the use of fertiliser for maize production is the dependent variable. I restrict the study only to fertiliser use on maize production, as this was the main food crop targeted by both the fertiliser schemes, and since maize is the most important food crop in both Tanzania and Malawi. The question in the data collection survey asked about the total amount of artificial fertiliser used on fields planted with maize in the most recent season. In Afrint 1, this was expressed in kilograms, in Afrint 2 in both the local currency and U.S. Dollars, and in Afrint 3 it was expressed in both kilograms and U.S. Dollars. Due to the price differences between commercial fertiliser and subsidised fertiliser, the amount of fertiliser used expressed in U.S Dollars cannot be used for this study. The data from Afrint 1 and 3, expressed in kilograms, however, can be used.

In turn, given the data limitations, there are two variants of the dependent variable used in this study. First, only using the data from Afrint 1 and 3 (2002 and 2013/15), the dependent variable is the use of fertiliser expressed in kilograms. However, a limitation of this variant of the dependent variable is the large time difference between the observations, which could lead to a lower likelihood of finding an effect. Second, to somewhat bridge this time difference, using Afrint 1, 2 and 3, the use of fertiliser can be expressed as a dummy variable where 1 is yes and 0 is no. This variable was made in such a way that as soon as some fertiliser was used (amount larger than 0 kg or 0 USD), it is counted as fertiliser is used. A limitation of this version of the dependent variable is that both farmers using 0.1kg of fertiliser and 100kg of fertiliser are counted as using fertiliser.

For both variants of dependent variable, missing datapoints were re-coded to zero. This was done as it was assumed the farm manager would be able to estimate the amount of fertiliser used when it was used. It is, thus, assumed that when the variable was missing no fertiliser was used. Table 1, below, presents the descriptive statistics of both variants of the dependent variable for both countries.

Table 1: Descriptive Statistics Dependent Variables

	Tanzania					Malawi				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Fertiliser use (Dummy)	618	0.262	0.440	0	1	747	0.486	0.500	0	1
Fertiliser use (kg) Afrint 1 & 3	412	37.049	92.459	0	650	498	61.723	110.474	0	1000

4.2.2 Independent Variables

The independent variable, the sex of the farm manager, is the variable with which the possible correlation between gender and access to fertiliser can be measured. Although most studies use head of the household as the gender variable, I chose to not do so, as the farm manager can be a female within a male-headed household. Additionally, due to differences in power relations within a household, there can be differences in access to inputs between the farm manager and a household head. Moreover, the farm manager was the interviewee, and not the head of household. Hence, the sex of the farm manager is used as the gender variable in this study. This variable is a dummy, for which 1 is female and 0 is male. The descriptive statistics of this variable, together with the other independent (control) variables can be found in table 2 for the complete dataset containing all three Afrint waves. The descriptive statistics of the independent variables for the reduced dataset containing only Afrint waves 1 and 3 can be found in Appendix A.

The second independent variable is subsidy. This dummy variable indicates when the fertiliser subsidy, NAIVS in the case of Tanzania and FISP in the case of Malawi, was in place. The value 1 is given to when it is in place and 0 before it is in place. In Malawi, FISP was introduced in 2006, hence the subsidy variable becomes 1 from Afrint 2 onwards. In Tanzania, NAIVS was introduced in 2008, while the data in Tanzania was collected in early 2008. Due to delays in the distribution of subsidised fertiliser, the subsidy dummy for Tanzania is only 1 for Afrint 3 (2015). This is because although the subsidy was officially already in place, it is unlikely smallholder farmers would have already received subsidised fertiliser for early 2008's most recent season.

The control variables used are based on the literature review discussed above. In those studies, it was found that wealth, area cultivated and being a member of a farmer organisation could influence the access to and usage of fertiliser. Additionally, it was also found that access to markets could be important, for which the proxy "(intend to) sell" is used. This is based on the Afrint question if the farm manager did or intends to sell any of the produce harvested. Furthermore, 'household member workers' and 'non-household workers' are variables measuring the access to extra labour. 'Household member workers' stands for people within the household who are able workers, while 'non-household workers' stands for family members who regularly come to help with the farm work but are not part of the household. Non-family members who regularly sleep at the household are counted as household members within the Afrint study. Education and age of the farm manager are added as further control variables, as age can be a proxy for both experience as well as willingness to take risks, while education is a proxy for human capital as well as access to information. Lastly, wealth is a variable created based on several variables within the Afrint study. Wealth consists of 5 dummy variables for if the farm manager possesses a mobile or stationary telephone, a TV-set, a bicycle, a sewing machine and/or a kerosene or other modern stove. These variables are always 1 if the farm manager does own the asset and zero if they do not. The variable 'wealth', in turn, is the sum of the five different dummy variables.

Table 2: Descriptive Statistics Independent Variables

	Tanzania					Malawi				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Sex farm manager	618	0.199	0.400	0	1	747	0.396	0.489	0	1
Subsidy	618	0.333	0.472	0	1	747	0.333	0.472	0	1
Sex * subsidy	618	0.074	0.263	0	1	747	0.123	0.329	0	1
Age	604	46.661	14.060	19	95	733	46.576	15.066	19	88
Education	614	5.507	3.086	0	14	746	4.145	3.172	0	14
HH member workers	618	2.641	1.485	0	15	747	2.700	1.416	0	13
Non-HH workers	618	0.793	1.539	0	12	747	0.348	1.029	0	8
Farmer org member	618	0.206	0.404	0	1	747	0.225	0.418	0	1
Wealth	618	1.154	0.983	0	5	747	0.669	0.805	0	5
(Intend to) sell	618	0.489	0.500	0	1	747	0.266	0.442	0	1
Cultivated area	548	0.970	0.829	0.1	9.9	744	0.611	0.807	0	16

Several measures were taken to account for missing variables. For age, when there was an age given in one of the other waves, the age was manually calculated based on the age given in the other year. For education, the same years of education was taken as the years given in a different wave. Missing variables in household member workers, non-household workers, member of farmer organisation, the variables within wealth, and (intend to) sell were replaced with the value zero. This is done as it is assumed that missing variables are often a ‘don’t know’ situation, and it further is assumed that a farm manager would know if they were a member of an organisation or about how many household and non-household members would be able workers, which of the different wealth variables they own, or if they (intend to) sell their produce. Regarding the cultivated area of maize, the missing variables were not replaced or calculated. This is because over the three waves, the area cultivated was always different, without a clear pattern, for all the households. In turn, the area cultivated could not be manually calculated or derived when the value was missing. This explains the lower number of observations for cultivated area.

5 Methods

This chapter presents and discusses the methods used in this study. The approach is two-fold: first an econometric analysis is performed, after which a Political Economy approach is used to further contextualise and explain the findings.

5.1 Methodology

To answer this study's research question, a two-fold approach is used. First, a quantitative and econometric methodology is appropriate to estimate the correlation between gender and access to fertiliser in relation to the re-introduction of a fertiliser subsidy. Both a standard Ordinary Least Squares (OLS) model and a Probit model are used to estimate this correlation. This design and approach is based on the research design suggested by Creswell (2013). The Probit model is used for when the dependent variable is in the form of a dummy variable. This is done as a dummy variable violates the homoskedasticity and normality of errors assumption of OLS, which can lead to invalid standard errors (Angrist & Pischke, 2009). Although the homoskedasticity problem can easily be solved using robust standard errors, it is relevant to use a Probit model, as this is specifically made for dependent variables that are binary in form. Since the econometric models only indicate estimated correlations, but do not explain the reason behind these, a political economy approach will be used to further explain and contextualise the results found through the econometric estimations.

Political economy analysis aims to provide an explanation for how a situation is by looking at different actor's strategies, motivations and incentives (Jerven, 2014). This approach pays attention to context having an influence on the output and outcome of policy processes (Chinsinga, 2013). It also provides an understanding of the different processes, either political or economic, or both, shaping policy choices within a given context (Scoones, 2005). Since maize is the key staple food in both Tanzania and Malawi, it is politically significant, especially in the context of food shortages and insecurity (Mdee et al., 2020). In addition, it is appropriate to use a political economy approach to further analyse the impact of the re-introduction of (maize) fertiliser subsidies on the gender bias as the provision of these subsidies is embedded within political economies, and the distribution is affected by social and political relations (Jerven, 2014).

Within the political economy of input subsidies, a wide range of factors are important, yet only a few can be addressed in this study. Due to the lack of a gender perspective in the political economy literature in relation to input subsidies, gender is one of the factors which will be focussed on in the analysis. This is also one of the contributions of this study. Additionally, as stated in chapter 2, access to information, access to political processes and networks, corruption, and patronage are focused upon in the political economy analysis. These factors were chosen based on their implied importance as presented in the literature on political economy of input subsidies (Eriksen, 2018; Mdee et al., 2020; Cooksey, 2012; Poulton, 2012; Chinsinga & Poulton, 2014).

5.2 The Econometric Model

Based on the literature study and data discussed before, the following models will be used:

$$Fertiliser\ use\ dummy = \beta_0 + \beta_1 sex\ farm\ manager + \beta_2 subsidy + \beta_3 controls + \varepsilon$$

To make sure the estimation is as accurate as possible, the dummy variable for fertiliser use will be used, as this allows for also using Afrint 2 data, thus increasing the number of observations. For this model, the Probit model is used instead of OLS. However, to account for the amount of fertiliser used, as there is a large difference between 1 kg and 1000kg, a second model is run with the data of only Afrint 1 and 3, expressing fertiliser use in kilograms. This second model is estimated using OLS.

$$Fertiliser\ use\ (kg) = \beta_0 + \beta_1 sex\ farm\ manager + \beta_2 subsidy + \beta_3 controls + \varepsilon$$

Thirdly, to truly capture the interactive effect of subsidy and gender on fertiliser use, both the models are also run with an interaction variable of sex of the farm manager and subsidy. This variable captures the effect of when the subsidy is in place and the farm manager is female on fertiliser use.

$$Fertiliser\ use = \beta_0 + \beta_1 sex\ farm\ manager * subsidy + \beta_2 controls + \varepsilon$$

In these models, β_1, β_2 and β_3 stand for the parameters which will be estimated in the regression. β_0 stands for the constant and ε is the error term. The control variables in all the models consist of all the control variables presented in table 2 above. In the analysis, each model will first be run with just the dependent variable and the independent variable, after which the control variables are added. All the models will be run with clustered standard errors on household level, to account for correlation of the standard errors over time.

Additionally, to avoid country-level results being strongly influenced by a certain region, all the regressions will be run for each region separately. This allows for the analysis to observe within-country regional differences in the effect of the re-introduction of fertiliser subsidy on gender bias in access to fertiliser.

6 Empirical Analysis

In this chapter, the econometric analysis is presented, after which the results are discussed. The results are broken down into each country, where Tanzania is presented first and then Malawi. Within each country, the regions are also compared as the subsidy programmes are likely to have different effects in each region. Next, in the discussion, the results for both countries are compared and contrasted and a political economy approach is used to further contextualise and explain the findings.

6.1 Results

6.1.1 Tanzania

a. Probit

Table 3 below presents the results for the regressions for Tanzania using the full dataset (Afrint 1, 2 and 3). This, thus, means the dependent variable is the dummy variant of fertiliser use, and the Probit model is used. The regression is run on country level with and without the control variables, both for sex of farm manager and the interaction between sex and subsidy as independent variables. Additionally, the full regressions, with both variants of independent variables are also run on regional level.

As can be seen from table 3, neither the sex of the farm manager, nor the interaction between sex and subsidy variable are statistically significant in any of the regressions. This, thus, means that the sex of the farm manager does not correlate with the use of fertiliser. This is not in line with the expected, theoretical, effect, as it was assumed women would gain from the subsidy. On the national level, both education and (intend to) sell are significant respectively at the 90 percent and 95 percent confidence level. Both variables have positive coefficients, meaning a higher education level and (the intention to) selling your produce increases the usage of fertiliser. When the interaction variable is used, age also becomes significant at the 90 percent confidence level, and is positive in magnitude, meaning older women are more likely to use fertiliser when the subsidy is in place.

Interestingly, on regional level, no variables are statistically significant for Morogoro. Conversely, for Iringa, on top of education and (intend to) sell, age, wealth, being a member of a farmer's organisation and the cultivated area of land are statistically significant. While age and wealth have positive coefficients, meaning older and wealthier people use fertiliser, being a member of a farmer's organisation and the cultivated area of land have negative coefficients. The negative correlation between smaller land and fertiliser use could be expected as it is in line with the subsidy targeting, but the negative correlation between being a member of a farmer's organisation and the usage of fertiliser is unexpected based on the literature study. The different results between the different Tanzanian regions could be due to their relative importance in producing maize and their difference is soil fertility. While Iringa is the main maize-producing region in the country, Morogoro has highly fertile soil (thus needing less fertiliser) and produces rice, decreasing the focus on maize productivity (Msuya et al., 2018).

b. OLS

When looking at the results for the OLS regressions using only Afrint 1 and 3 (Table 4), where the dependent variable fertiliser use is expressed in kilograms, it can be seen that the statistically significant variables are the same on country level compared to the Probit analysis. However, on regional level there are some differences.

Although there are no statistically significant variables in the regression using sex of farm manager as independent variable for Morogoro, when the sex and subsidy interaction is used, wealth becomes statistically significant at the 95 percent confidence level. For Iringa, education, wealth, (intend to) sell and cultivated area are still statistically significant, same as in the Probit analysis. However, being a member of a farmer's organisation is not significant anymore, and non-household workers, meaning family members who help on the farm who are not a part of the household, is statistically significant at the 95 percent confidence level for both types of independent variables. Interestingly though, the coefficient of non-household workers is negative, meaning that when the farm manager has more family members helping who are not a part of their household, they use less fertiliser. This could be because households needing more support from family members do not have the resources to invest in fertiliser.

Table 3: Results Tanzania: Probit with full dataset

PROBIT - Dependent Variable: Fertiliser use (dummy)

VARIABLES	Tanzania				Morogoro	Iringa	Morogoro	Iringa
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex farm manager	0.0406	0.245			0.00759	-0.0121		
	(0.192)	(0.227)			(0.661)	(0.267)		
Subsidy	0.325***	0.233			0.710	-0.0765		
	(0.0773)	(0.153)			(0.456)	(0.197)		
Sex * Subsidy			0.135	0.190			0.271	-0.136
			(0.193)	(0.216)			(0.762)	(0.254)
Age		0.00616		0.00910*	0.00896	0.0164**	0.0167	0.0156**
		(0.00644)		(0.00550)	(0.0132)	(0.00814)	(0.0103)	(0.00762)
Education		0.0594*		0.0558*	0.0270	0.101***	0.0345	0.0975**
		(0.0315)		(0.0317)	(0.0761)	(0.0378)	(0.0723)	(0.0390)
HH member workers		0.0268		0.0138	0.142	-0.0134	0.131	-0.0152
		(0.0483)		(0.0481)	(0.107)	(0.0647)	(0.117)	(0.0629)
Non-HH workers		0.0108		0.00675	0.0657	-0.0251	0.0660	-0.0242
		(0.0424)		(0.0415)	(0.0711)	(0.0609)	(0.0714)	(0.0618)
Farmer org member		-0.194		-0.175	0.0374	-0.511*	0.0643	-0.514*
		(0.175)		(0.171)	(0.325)	(0.269)	(0.323)	(0.264)
Wealth		0.0899		0.129	0.163	0.337**	0.296	0.326**
		(0.0931)		(0.0844)	(0.200)	(0.141)	(0.187)	(0.132)
(Intend) to sell		0.406**		0.382**	0.284	0.722***	0.223	0.724***
		(0.159)		(0.157)	(0.317)	(0.198)	(0.314)	(0.199)
Cultivated area		0.0336		0.0145	-0.0968	-0.460***	-0.0962	-0.451***
		(0.0803)		(0.0783)	(0.322)	(0.144)	(0.305)	(0.141)
Constant	-0.761***	-1.735***	-0.647***	-1.691***	-3.545***	-1.411***	-3.680***	-1.372***
	(0.0916)	(0.427)	(0.0801)	(0.395)	(0.727)	(0.482)	(0.759)	(0.473)
Observations	618	377	618	377	153	224	153	224

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4: Results Tanzania: OLS with reduced dataset

	OLS - Dependent variable: Fertiliser use (kg)							
VARIABLES	Tanzania				Morogoro	Iringa	Morogoro	Iringa
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex farm manager	-14.95	4.432			-0.169	-11.85		
	(9.173)	(9.846)			(2.543)	(13.78)		
Subsidy	6.799	3.735			4.309	-16.44		
	(6.099)	(7.944)			(3.700)	(13.60)		
Sex * Subsidy			-7.690	2.627			-0.694	-18.53
			(9.648)	(10.49)			(4.064)	(14.88)
Age		0.208		0.258	-0.037	0.678	0.029	0.479
		(0.304)		(0.274)	(0.099)	(0.454)	(0.060)	(0.436)
Education		2.984*		2.895*	0.0563	4.443**	0.0216	4.354*
		(1.690)		(1.682)	(0.441)	(2.222)	(0.411)	(2.278)
HH member workers		2.594		2.382	1.355	1.522	1.238	1.775
		(3.233)		(3.244)	(1.140)	(5.038)	(1.119)	(4.897)
Non-HH workers		-2.941		-2.948	0.653	-6.051*	0.783	-5.605*
		(1.872)		(1.857)	(0.770)	(3.346)	(0.773)	(3.167)
Farmer org member		-11.66		-11.23	-0.727	-20.26	-0.816	-23.34
		(10.44)		(10.53)	(3.231)	(16.08)	(3.222)	(15.55)
Wealth		6.389		6.984	1.540	21.74**	2.541*	19.78*
		(6.643)		(6.369)	(1.639)	(10.02)	(1.481)	(10.02)
(Intend) to sell		37.01***		36.64***	1.932	64.07***	1.522	64.82***
		(10.26)		(10.36)	(1.890)	(16.14)	(1.649)	(16.34)
Cultivated area		5.382		4.991	2.332	-12.90**	1.791	-11.29*
		(6.547)		(6.463)	(3.629)	(6.349)	(3.234)	(6.232)
Constant	36.66***	-23.39	37.91***	-22.40	-6.092	-15.95	-7.343	-15.59
	(8.336)	(21.38)	(6.209)	(19.62)	(4.739)	(30.75)	(4.636)	(28.64)
Observations	412	351	412	351	139	212	139	212
R-squared	0.005	0.074	0.001	0.074	0.112	0.164	0.100	0.162

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

6.1.2 Malawi

a. Probit

Table 5 below presents the results for the Probit regressions for Malawi using the full dataset (Afrint 1, 2 and 3), with fertiliser use as a dummy variable. Similarly to Tanzania, the regressions are first run on country level (short and long regressions), and next on regional level.

On national level, for both variants of the independent variables, education is statistically significant at the 99 percent confidence level. When sex of the farm manager and subsidy are separate independent variables, both in the short and long regression, subsidy is also significant at the 99 percent confidence level and has a positive coefficient. This means that the subsidy positively influences fertiliser use. However, the sex of farm manager variable is insignificant. When using the sex of farm manager and subsidy interaction as the independent variable on national level, the (intention to) sell maize and the cultivated area of land are statistically significant at the 95 and 90 percent confidence level, respectively. Both these variables have positive coefficients, meaning a positive correlation between them and fertiliser usage. The interaction variable, however, is still insignificant, indicating no effect of the subsidy on female use of fertiliser.

When looking at the regional level output, it can be seen that the sex of farm manager variable is insignificant for all regions except for Thiwi Lifidzi, where it is significant at the 95 percent confidence level and has a negative coefficient. This, thus, means that in Thiwi Lifidzi, female farm managers are less likely to use fertiliser. Though the statistically significant variable 'subsidy' is positive in magnitude. However, when the interaction variable is used as the independent variable, it is not significant in Thiwi Lifidzi, but it is significant at the 90 percent confidence level in Ntchisi. Additionally, the interaction variable in Ntchisi has a positive coefficient, meaning women are more likely to use fertiliser for maize production when the subsidy is in place. Education also positively and statistically significantly influences fertiliser use in Ntchisi. In the Shire Highlands, however, no variable is significant, while in Bwanye Valley only wealth is significant at the 95 percent confidence level and has a positive coefficient when the independent variable is the interaction variable. When the sex and subsidy are separate variables for Bwanye Valley, only the subsidy variable is statistically significant at the 99 percent confidence level and positive in magnitude. When the interaction variable is used in Thiwi Lifidzi, only the (intention to) sell maize is statistically significant at the 90 percent confidence level and has a positive coefficient. This result could be due to Thiwi Lifidzi being located in a tobacco-intensive region, indicating that farmers are more commercial oriented, in addition to being the study region in closest proximity to the urban area of the capital region Lilongwe.

b. OLS

As can be seen in table 6, on national level, both the variables sex of farm manager and subsidy are statistically significant at the 99 percent confidence level in the short regression, where sex of farm manager has a negative coefficient and subsidy a positive coefficient. However, this is not the case anymore in the extended regression, where only education and (intend to) sell are statistically significant and positive in magnitude. This is the same for when the interaction variable is used. Interestingly, this result on country level is different when the OLS model (and the reduced dataset) is used compared to the Probit model (and the full dataset).

On regional level, similarly as for the Probit model, the variable sex of farm manager is statistically significant at the 99 percent confidence level and negative in magnitude in Thiwi Lifidzi. However, subsidy is not significant in this output for Thiwi Lifidzi, unlike in the Probit model. Interestingly though, while the interaction variable was not significant for Thiwi Lifidzi in table 6, it is significant and negative in magnitude under the OLS model. Additionally, (intention to) sell and area cultivated are statistically significant at the 99 percent confidence level and positive in magnitude. This, thus, means that in Thiwi Lifidzi women use less fertiliser when the subsidy is in place, but people who intend to sell their produce and who have a larger cultivated area use more fertiliser. While all variables are still insignificant for Shire highlands when the interaction variable is used, education is statistically significant and positive in magnitude when sex of farm manager and subsidy are separate independent variables. In Bwanye valley, both variants of independent variables are insignificant, but education and area cultivated are statistically significant and positive in magnitude. This, thus, means that more educated people and people with more land are likely to use (more) fertiliser in Bwanye Valley. In Ntchisi, education is also positively and significantly correlated with fertiliser use for both independent variables, but wealth is only positively and significantly (at the 95 percent confidence level) correlated when the interaction variable is used.

Table 5: Results Malawi: Probit with full dataset

PROBIT - Dependent Variable: Fertiliser use (dummy)

VARIABLES	Malawi				Ntchisi	Bwanye Valley	Thiwi Lifidzi	Shire Highlands
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex farm manager	-0.151	-0.0971			-0.186	-0.421	-0.503**	-0.131
	(0.105)	(0.108)			(0.247)	(0.300)	(0.208)	(0.230)
Subsidy	0.547***	0.519***			1.008***	0.985***	0.581***	-0.164
	(0.0978)	(0.106)			(0.218)	(0.247)	(0.210)	(0.243)
Sex * Subsidy			0.165	0.216				
			(0.136)	(0.145)				
Age		-0.00398		-0.00144	-0.00954	-0.00230	-0.00167	-0.00463
		(0.00370)		(0.00356)	(0.00729)	(0.00910)	(0.00688)	(0.00870)
Education		0.0565***		0.0577***	0.0818**	0.0426	0.0187	0.0270
		(0.0180)		(0.0175)	(0.0355)	(0.0435)	(0.0322)	(0.0384)
HH member workers		-0.0277		-0.0197	-0.0304	0.0266	0.0328	-0.0584
		(0.0364)		(0.0363)	(0.0708)	(0.0732)	(0.0746)	(0.102)
Non-HH workers		0.00544		0.0339	-0.0221	-0.103	-0.0173	0.0956
		(0.0453)		(0.0461)	(0.0828)	(0.0938)	(0.103)	(0.114)
Farmer org member		-0.105		-0.139	0.0395	0.256	-0.192	0.494
		(0.110)		(0.109)	(0.179)	(0.247)	(0.274)	(0.414)
Wealth		0.0342		0.0843	0.157	0.260	0.136	-0.0845
		(0.0713)		(0.0703)	(0.136)	(0.194)	(0.180)	(0.105)
(Intend) to sell		0.169		0.215**	-0.106	-0.404	0.303	-0.110
		(0.109)		(0.108)	(0.188)	(0.400)	(0.237)	(0.242)
Cultivated area		0.0618		0.114*	0.0319	-0.0965	0.222	-0.0407
		(0.0535)		(0.0615)	(0.0580)	(0.312)	(0.187)	(0.222)
Constant	-0.157**	-0.227	-0.0555	-0.343	-0.346	-1.260**	-0.203	0.962
	(0.0730)	(0.229)	(0.0542)	(0.216)	(0.457)	(0.599)	(0.417)	(0.706)
Observations	747	729	747	729	196	165	201	167

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5 continued

PROBIT - Dependent Variable: Fertiliser use (dummy)				
VARIABLES	Ntchisi	Bwanye Valley	Thiwi Lifidzi	Shire Highlands
	(9)	(10)	(11)	(12)
Sex farm manager				
Subsidy				
Sex * Subsidy	0.662*	0.475	-0.150	0.154
	(0.384)	(0.350)	(0.258)	(0.280)
Age	-0.00365	0.00198	0.00150	-0.00671
	(0.00721)	(0.00888)	(0.00676)	(0.00812)
Education	0.0827**	0.0328	0.0249	0.0339
	(0.0329)	(0.0406)	(0.0320)	(0.0357)
HH member workers	-0.0286	0.0451	0.0441	-0.0410
	(0.0651)	(0.0706)	(0.0705)	(0.0978)
Non-HH workers	-0.00676	-0.0471	0.0771	0.0961
	(0.0787)	(0.106)	(0.102)	(0.113)
Farmer org member	-0.00571	0.275	-0.327	0.527
	(0.169)	(0.241)	(0.269)	(0.424)
Wealth	0.200	0.390**	0.223	-0.0965
	(0.132)	(0.175)	(0.173)	(0.108)
(Intend) to sell	0.170	-0.541	0.420*	-0.0712
	(0.195)	(0.406)	(0.236)	(0.241)
Cultivated area	0.130	0.0602	0.256	-0.0780
	(0.0855)	(0.280)	(0.223)	(0.218)
Constant	-0.565	-1.480***	-0.502	0.829
	(0.440)	(0.559)	(0.381)	(0.599)
Observations	196	165	201	167

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6: Results Malawi: OLS with reduced dataset

	OLS - Dependent variable: Fertiliser use (kg)							
VARIABLES	Malawi				Ntchisi	Bwanye Valley	Thiwi Lifidzi	Shire Highlands
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex farm manager	-29.48***	0.640			-14.33	-1.327	-28.99**	-1.158
	(9.371)	(9.590)			(13.98)	(8.682)	(12.15)	(29.22)
Subsidy	60.53***	-0.054			40.22**	10.44	-18.20	-87.99
	(9.013)	(17.76)			(17.75)	(17.01)	(11.86)	(54.68)
Sex * Subsidy			4.126	2.167				
			(13.67)	(11.85)				
Age		0.513		0.503	0.238	-0.118	0.156	0.701
		(0.383)		(0.348)	(0.589)	(0.315)	(0.483)	(0.826)
Education		5.818***		5.831***	6.067**	4.506**	-2.337	5.516*
		(1.470)		(1.473)	(2.929)	(1.906)	(2.380)	(2.840)
HH member workers		3.166		3.166	-0.108	6.858	-3.703	6.465
		(4.159)		(4.346)	(7.111)	(4.358)	(5.392)	(10.87)
Non-HH workers		10.59		10.56	9.065	2.718	-5.470	17.62
		(7.258)		(6.891)	(11.26)	(7.489)	(6.178)	(12.90)
Farmer org member		-16.61		-16.50	6.895	-7.947	-7.850	44.55
		(13.29)		(12.97)	(23.64)	(11.26)	(13.76)	(35.38)
Wealth		17.92		18.00	25.39	-3.023	-0.459	35.98
		(11.86)		(11.91)	(15.49)	(8.057)	(11.54)	(23.62)
(Intend) to sell		56.93***		56.79***	10.47	1.231	63.91**	62.22
		(16.77)		(15.92)	(22.48)	(20.31)	(24.60)	(42.02)
Cultivated area		28.33		28.23	-0.298	63.78*	120.0***	76.48
		(25.17)		(23.38)	(4.049)	(33.74)	(5.401)	(54.04)
Constant	42.71***	-33.37	60.96***	-33.18	-18.57	-29.20	32.63	-28.67
	(5.395)	(24.72)	(5.295)	(21.31)	(33.52)	(20.81)	(26.60)	(71.82)
Observations	498	417	498	417	111	90	116	100
R-squared	0.094	0.273	0.000	0.273	0.224	0.402	0.731	0.341

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6 continued

VARIABLES	Ntchisi (9)	Bwanye Valley (10)	Thiwi Lifidzi (11)	Shire Highlands (12)
	OLS - Dependent variable: Fertiliser use (kg)			
Sex farm manager				
Subsidy				
Sex * Subsidy	14.62	-5.231	-49.02**	-30.81
	(24.59)	(15.20)	(19.10)	(28.54)
Age	0.579	-0.0798	0.136	0.216
	(0.572)	(0.294)	(0.462)	(0.680)
Education	6.786**	4.238**	-2.835	4.447
	(2.952)	(1.979)	(2.404)	(3.127)
HH member workers	1.417	7.333*	-2.408	4.436
	(6.903)	(4.315)	(5.012)	(8.816)
Non-HH workers	9.465	3.487	-7.080	11.19
	(11.15)	(7.888)	(6.374)	(11.72)
Farmer org member	11.07	-10.73	-4.128	52.95
	(23.81)	(11.21)	(12.58)	(32.78)
Wealth	26.09*	-4.670	-3.182	32.49
	(15.29)	(8.362)	(11.19)	(24.28)
(Intend) to sell	26.91	4.804	64.10***	50.02
	(23.88)	(19.22)	(22.36)	(38.22)
Cultivated area	3.070	74.54***	121.2***	41.34
	(5.538)	(23.44)	(6.618)	(41.11)
Constant	-33.68	-28.32	23.49	-9.007
	(32.33)	(19.33)	(25.53)	(41.99)
Observations	111	90	116	100
R-squared	0.198	0.398	0.736	0.294

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

6.2 Discussion

This section explains the results presented above using a political economy approach and links them to the literature discussed in chapter 2. The political economy approach focuses on the influences of patronage, access to information, access to political processes and networks, and corruption.

In both Malawi and Tanzania, input subsidies are politically important programs. In both countries, maize is the main food crop, but especially in Malawi food security is equalled to maize availability (Mdee et al., 2020). This creates a political incentive for the government to promote maize, and thus subsidise maize inputs, to gain popularity within the electorate. Patronage is, thus, an important factor incentivising and influencing the implementation and distribution of the fertiliser subsidy schemes (Cooksey, 2012). This can also be seen by the close link between the FISP and the re-election of Malawian president Mutharika in 2009 (Jerven, 2014), as well as the NAIVS expenditure peaking in the 2010/11 season, right before the Tanzanian elections (Poulton, 2017). This, thus, means that the subsidised fertiliser was not always allocated based on the official criteria, as was found by Pan and Christiaensen (2012) in the Kilimanjaro region in Tanzania, where almost 60 percent of the recipients had a household member who had an elected position within the village. Although patronage cannot be measured within this study, it is linked to having access to political processes. According to Poulton (2012), education level can be a proxy for awareness of political processes, where more educated people have more awareness of these processes. This can explain the results found in the analysis above, with education being statistically significant and positive in magnitude for both countries on national level and in some regions. These results are also in line with the findings of Chirwa (2005) and Kaliba et al. (2018). It should be kept in mind though, that in Tanzania the mean education of the female farm managers was 3.79 years compared to 5.94 years for men. Similarly, in Malawi, the female mean years of education was 3.46 compared to 4.60 years for male farm managers. This shows that a potential underlying gender bias could be captured by the education variable as lower education leads to less access to and awareness of political processes, a factor found to be important in accessing subsidised fertiliser. As Kaliba et al. (2020) expresses, gender can be directly or indirectly linked with other factors influencing access to inputs such as fertiliser.

Linked to patronage and access to political processes and networks, is access to information. Information regarding fertiliser, the prices, subsidies, and potential benefit is most often shared within social networks (Kaliba et al., 2018). As Aernout et al. (forthcoming) found in Tanzania, information sharing within social networks largely happens among women and among men, with little mixing of social networks between the two sexes. Similarly, Mudege et al. (2016) found that gender and cultural norms influence information sharing, negatively affecting women. Additionally, due to the gender-separated social networks, and village leaders most often being male (Aernout et al., forthcoming), women have less access to a social network with actors who have an influence on the distribution of subsidised fertiliser.

Although information sharing cannot be analysed within this study, as no social network analysis was done, some variables can possibly influence access to information and social networks. Education and (intention to) sell are two of these variables. As already discussed before, education increases awareness, and access to information. Additionally, participating in the market by selling one's produce can potentially extend one's social network by coming into contact with more people and actors. This, in turn, can increase access to information on quality and return of investment of fertiliser. The positive and statistically significant effect of (intention to) sell found in this study is in line with the literature (Kaliba et al., 2018). As Andersson Djurfeldt et al. (2019) explain, market participation and selling produce is often restricted for women through mobility constraints linked to unpaid household chores and social norms. Indeed, the data confirms that less female farm managers have the intention to sell their produce compared to male farm managers, in both Malawi and Tanzania. Additionally, Mdee et al. (2020) argue that "access to reliable and fair markets remains a challenge for small farmers" (p14). As discussed in the literature review, women focus more on subsistence farming due to their cultural and traditional responsibilities for providing nutrition for the family (Andersson Djurfeldt et al., 2018). This is also reflected in the data, with women on average having smaller cultivated plots of land compared to men.

Another factor widely discussed in the political economy of input subsidies literature is the problem of corruption, rent-seeking and elite capture (Cooksey, 2012; Mdee et al., 2020; Eriksen, 2018; Chinsinga & Poulton, 2014). It is argued that rent-seeking and elite capture of the subsidised fertiliser divert the fertiliser from the intended smallholder farmers to better-connected, better-off and/or larger farmers (Cooksey, 2012; Chinsinga & Poulton, 2014). This is also reflected in the statistical results, through the positive correlation of wealth and cultivated area of land. However, as indicated above, the data shows that the average area of land is smaller for female farm managers compared to male, and the average wealth of female farm managers is also lower compared to male in both countries. This shows that rent-seeking and elite capture have a negative bias against female farm managers.

On regional level, Iringa is Tanzania's main maize surplus region, reflected in it receiving nearly one fifth (19.5 percent) of the country's subsidised fertiliser in 2009 (Cooksey, 2012). This is also reflected in the data, with Iringa using on average 60 kg of fertiliser before and 67 kg after the subsidy introduction, while Morogoro used on average 0.3 kg before and 5 kg after the subsidy. The low fertiliser usage in Morogoro can be explained by the fertile soil in the region and the larger focus on rice production (Msuya et al., 2018). This is contrasted by Iringa, where in 2007, before the subsidy was introduced, only 37 percent of the farmers had never used fertiliser (Cooksey, 2012). This is a large difference with the 86 percent of farmers that had never used fertiliser in 2007 nation-wide. However, due to its large role in maize production, Iringa is also a politically important region, which has led to numerous reports of elite capture and corruption by community leaders and government officials both at the local and national level (Cooksey, 2012). Reportedly, a group of larger farmers mainly benefited from the subsidised fertiliser, however, this was not found in this study's results, as cultivated area has a negative coefficient. This could thus indicate that some larger farmers were excluded from the fertiliser scheme, in line with the targeting criteria. Nevertheless, the reports of fertiliser being diverted from poorer to better-off farmers can be confirmed by the data, as the coefficient for wealth is positive and statistically significant. Yet, it should be kept in mind that this does not necessarily mean that only rich farmers received subsidised inputs. It was expected that the wealth coefficient would be positive, due to the co-financing requirement of the subsidy, thus excluding poorer farmers. However, considering that the average wealth for male farm managers in Iringa (1.15) is larger than the average wealth for female farm managers (0.73), there could be a potential gender bias instigated by the co-financing requirement or political diversion to better-off farmers.

While there was no gendered effect found in the regression output for Tanzania, the Thiwi Lifidzi region in Malawi did show a statistically significant negative bias towards female farm managers. Yet, the other regions in Malawi, similarly to Tanzania, did not report a statistically significant gender bias. These results are in line with the literature on gender bias in fertiliser use, where some studies report a gender bias and others do not (Kilic et al., 2015; De Groote et al., 2002; Chirwa, 2005; Diiro et al., 2015). As Mdee et al. (2020) argue, simply adding women as a target group to input subsidy schemes, without tackling the underlying unequal gender relations and provision of basic services to lessen the burden of household responsibilities for women, will likely not lead to the transformations intended by the policy. This is in line with the feminist critique on the “add-and-stir” method often used by governments and institutions, creating mere ‘policy noise’ in the form of gender inclusivity instead of real change (Wallace, 2020; Mdee et al., 2020). As shown in this discussion, even though no statistically significant gendered effect was found through the econometric analysis, the variables influencing fertiliser use often have underlying unequal gendered effects. Furthermore, the political economy approach shows that unobservable variables such as political connections or elitism further influence the distribution of and access to subsidised fertiliser.

7 Conclusion

After their disappearance in the structural adjustment and liberalisation era of the 1980s and 1990s, fertiliser subsidies have made a comeback since the turn of the century. Though their effectiveness in increasing productivity is still up for debate, it is widely recognised that women are a key factor in sustainable agricultural intensification and increasing productivity to ensure food security (Sachs, 2012).

7.1 Research Aims and Objectives

The aim of this study was to analyse the gendered effect of the re-introduction of fertiliser subsidies in the context of increased gender bias due to the liberalisation measures in the 1980s and 1990s. To do so, the case studies of the NAIVS in Tanzania and the FISP in Malawi were used. The aim of this thesis can be summarised through the research question "*To what extent does gender bias impact access to fertiliser in the context of the re-introduction of fertiliser subsidies?*".

To answer this research question, an econometric analysis using the OLS and the Probit methods was performed, using two variants of fertiliser use (dummy and expressed in kilograms) as the dependent variable. The main independent variables were sex of the farm manager and a dummy variable for subsidy, which were also interacted for some estimations. The control variables were age, education, household members that are able workers, non-household workers, being a member of a farmer's organisation, wealth, (intention to) sell, and cultivated area of land. The econometric analysis was performed both on national and regional level. Next, a political economy approach was used to explain and contextualise the findings, allowing for a deeper analysis of the research problem.

Based on above analysis and discussion, it can be concluded that no direct gender bias (positive or negative) was found in the econometric analysis, though a positive effect for women was theoretically assumed. However, the discussion has shown that there are potential underlying negative gender biases through factors such as access to political networks, information, education, and market participation. The results of the analysis, thus, indicate that through the targeting criteria of the fertiliser subsidies, it is unlikely that the gender bias in access to fertiliser will be significantly reduced.

7.2 Implications

After the relatively unsuccessful era of structural adjustment and liberalisation for the agricultural sector, many governments and donors are once again exploring the option of input subsidies with the aim of agricultural intensification and increasing productivity. As part of this, women are, on paper, receiving a more central role in this aim. In this context, this study has practical implications for governments, policy makers, international donors as well as NGOs and organisations working with agricultural intensification. Based on the analysis, it can be said that increased attention is needed for the underlying obstacles facing women in accessing fertiliser and thus increasing their productivity. Being aware of these underlying gender biases uncovered in this study is important for policy makers to be able to introduce policies which can have a positive and real effect on closing the gender gap.

Through this analysis, this study contributes to several research gaps in the fields of gender equality in agriculture, gendered effect of input subsidies and by adding a gender perspective to the agriculture political economy literature. Additionally, the findings of this study are also relevant for policy makers, institutions and other actors working with gender equality in agriculture, input subsidies, and access to fertiliser, and the sustainability as well as inclusivity aspect of these topics.

7.3 Future Research

Although this study was able to find some factors through which the re-introduction of fertiliser subsidies affects gender bias, the context-specific nature of this analysis and the case studies used does not allow for generalisations. Policies and subsidy schemes will have different impacts in each country due to different social, cultural, and political situations as well as differences in the gendered obstacles which women are facing. However, when the context is taken into account, it is likely that similar results will be found for similar regions. This not only is interesting for policy makers but is also a possibility for future research. Additionally, the data had limitations, of which the major one was the large time difference in between datapoints. Though this was partly solved by using a dummy variable for fertiliser use to be able to include the second Afrint wave, the time difference between datapoints was still larger than ideal. This could be a potential explanation for why no direct gendered effects were found, and only indirect effects could be assumed. Not only a replication of this analysis with a dataset consisting of more datapoints per household, but also a further empirical analysis of these indirect gendered effects would be opportunities for future research.

While it is relevant to focus on specific case studies, future research repeating this analysis on different case studies would be needed to confirm the findings. Additionally, future research could also investigate different proxies for access to fertiliser as well as different control variables. Moreover, due to the indirect nature of gender bias, a more in-depth analysis would be needed to confirm the indirect effects assumed in this study through using a political economy approach. Furthermore, this study could inspire future political economy research on the relevance of a gender perspective when analysing input subsidies, as this is currently a gap in this literature.

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Appendix A

Table 1: Descriptive Statistics Independent Variables: reduced dataset

AFRINT 1 & 3

	Tanzania					Malawi				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Fertiliser use	412	37.049	92.459	0	650	498	61.723	110.474	0	1000
Sex farm manager	412	0.201	0.402	0	1	498	0.382	0.486	0	1
Subsidy	412	0.500	0.501	0	1	498	0.500	0.501	0	1
Sex farm manager*subsidy	412	0.112	0.315	0	1	498	0.185	0.388	0	1
Age farm manager	402	47.358	14.192	19	94	443	46.693	15.391	19	88
Education farm manager	408	5.404	3.140	0	14	495	4.075	3.237	0	14
Household member workers	412	2.556	1.431	0	15	493	2.590	1.344	0	10
Non-household workers	402	1.052	1.734	0	12	480	0.408	1.064	0	7
Member of farmer organisation	412	0.214	0.410	0	1	498	0.179	0.383	0	1
Wealth	412	1.180	1.021	0	5	166	0.723	0.857	0	4
(Intend to) sell maize	412	0.510	0.501	0	1	494	0.211	0.408	0	1
Cultivated area maize	371	0.994	0.905	0.1	9.9	496	0.505	0.909	0	16