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A cross-country summary of fertilizer subsidy programs in Sub-Saharan Africa

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EXECUTIVE SUMMARY

Both supply and demand constraints have long hindered the emergence of viable fertilizer markets in Sub-Saharan Africa. By the early 2000s, the urgency of arresting soil nutrient mining combined with rising fertilizer and food prices once again stimulated interest in ways to raise fertilizer use, which led to the re-introduction of input subsidy programs under a new "smart" guise. In this comparative summary of the literature, we first review the pros and cons of these input subsidies in a developing agricultural context. Then, we draw on a number of in-depth, informative reviews, comparing among Sub-Saharan countries, and also consulting additional case studies. The purpose of this paper is to situate our understanding of the fertilizer subsidy program in Mali within a broader policy context and to draw lessons on what might be done to improve it.

One of the most frequent justifications for input subsidies in Sub-Saharan Africa is that they can address missing or imperfect financial and insurance markets, easing risk for small-scale farmers. Pros include the notion that promoting affordable fertilizer use might "kick-start" the adoption of new technologies by farmers, allowing them to learn and demonstrating benefits. A long list of cons is reported, such as high fiscal cost and administration burdens, leakages into the commercial market and neighboring countries where price ratios have not changed, and displacement of commercial purchases by farmers who would otherwise pay the full price. Less commonly cited criticisms include misdiagnosed market failures—for example, the treatment with a fertilizer subsidy of a transport cost problem that would be better addressed by investment in infrastructure.

The design and implementation of the input subsidy programs directly influence the demand and supply for fertilizer as well as the macroeconomy. Across countries in Sub-Saharan Africa, designs are complex and have changed over time with experience. Objectives are often "vague" and "variable", with goals that are may not be "economic" in the strictest sense. "Universal" subsidies are in fact regressive, favoring those with more assets and more social standing. By restricting the subsidy to a particular crop or set of crops, a program is targeting an area, farming system, and group of households. Mechanisms for selecting beneficiaries vary widely by country program and year of program according to learning, evaluation findings, and the objectives of the programs. Presence of a monitoring and evaluation system, and recognition of an exit strategy are key features of "smart" subsidy design—but these have been largely absent.

All studies reviewed show positive effects on yield and production by the farm household. Crop planted has not always been investigated, but studies show mixed results. Incremental increases in crop production can, but do not necessarily lead to outcomes, such as higher farm incomes and greater food security. In most cases, with the exception of remote rural areas or those with poorer farmers, crowding-out is more likely to have occurred than crowding-in. There is relatively less information on the impact of fertilizer subsidies on intrahousehold equity, land use, labor use, market participation, and nutrition. Recent e-voucher programs have not yet received much attention.

With no exit strategy in place, the fertilizer subsidy program is likely to stay in the short to medium-term in Mali. There are key steps that should be followed in order to maximize the positive impacts and minimize the negative impacts of such a program. First, clear and non-contradictory program objectives (economic vs noneconomic) should be stated. Second, various

design and implementation approaches should be tested. Third, the targeting outcomes and program design and implementation should be aligned with each other and with the program objectives. Fourth, a strong monitoring and evaluation system should be installed. Finally, there is a strong need for more empirical evidence to better understand the intended and unintended impacts of the program, including the new e-voucher scheme.

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ACRONYMS

FISP	Farmer Input Support Programme
FSP	Food Security Programme
GDP	Gross Domestic Product
ISP	Input Subsidy Program
M&E	Monitoring and Evaluation
NAAIAP	National Accelerated Agricultural Inputs Access Program
R&D	Research and Development
US	United States

1. INTRODUCTION

Both supply and demand constraints have long hindered the emergence of viable fertilizer markets in Sub-Saharan Africa. Since nearly all fertilizer is imported, the cost of fertilizer is dependent on transport costs, and landlocked countries such as Mali are particularly disadvantaged with respect to this bulky input. Transport and logistics costs in Africa have been found to be three to four times higher than they are in the US, explaining the fact that in general farmers in Sub-Saharan Africa pay at least double the price for fertilizer relative to farmers in Asia and the US (Heisey and Norton, 2007; Morris et al., 2007). The marked seasonality of demand for fertilizer in rainfed systems and the bulkiness of the product lead to relatively slow stock turnover, considerable storage requirements, and high finance charges, resulting in risk for distributors and dealers. On the demand side, high cost, combined with low agronomic efficiency, has made the use of inorganic fertilizers unprofitable for many farmers in Sub-Saharan Africa. Much greater agronomic efficiency in fertilizer use is likely to be necessary in order to generate the incentives for sustainable increases in fertilizer demand. This problem is indicated by relatively low response rates to fertilizer estimated for maize across the continent (e.g., summary in Jayne et al. 2018 for maize in Kenya, Malawi, Tanzania, Ghana, Zambia and Ethiopia; Morris et al. (2007) for maize and other crops for the continent as a whole; for dryland cereals in Mali, Haider et al. 2018; for maize in Burkina Faso, Theriault et al. 2018a).

Confronted with such challenges, it is not surprising that most policymakers in Sub-Saharan Africa followed policies pursued in Asia and chose primarily state-led approaches from the late 1960s until the mid-1980s. Strategies to promote fertilizer use included government programs that supplied inputs with subsidized credit programs that linked inputs to outputs, large-scale demonstration programs such as Sasakawa Global-2000, and state-owned company models like those developed for export crops like cotton in Mali. Fiscal crises and donor pressures under structural adjustment eventually ended subsidies in a number of countries beginning in the late 1980s through the early 1990s.

By the early 2000s, the urgency of arresting soil nutrient mining combined with rising fertilizer and food prices once again stimulated interest in ways to raise fertilizer use. Input subsidy programs were re-introduced under a new, “smart” guise (Morris et al., 2007; World Bank, 2007; Minde et al. 2008; Dorward 2009). Noting then that there is no universally applicable “recipe” for a successful fertilizer promotion strategy, Morris et al. (2007) proposed guiding principles based on “recurring lessons” from previous experience. Generally adopted by the World Bank, these core principles require that subsidies be 1) focused to encourage incremental use by farmers who do not already use them; 2) market-supporting (not displacing of existing sales) in order to encourage the development of the private sector; 3) part of a broader development strategy, thereby avoiding the substitution of a subsidy for other public investments; and 4) temporary.

In this comparative summary of the literature, we first review the pros and cons of input subsidies in a developing agricultural context. Then, we draw on a number of in-depth, informative reviews, comparing among Sub-Saharan countries, and also consulting additional

case studies. The purpose of this paper is to situate our understanding of the fertilizer subsidy program in Mali within a broader policy context and to draw lessons on what might be done to improve it. We refer the reader to Theriault et al. (2018b) for a detailed description of the Malian fertilizer value chain with an analysis of subsidy impacts. The companion paper to this one, by Kone et al. (2018) focuses specifically on the origins and evolution of Mali's subsidy program.

2. THE PROS AND CONS OF INPUT SUBSIDIES IN DEVELOPING AGRICULTURAL CONTEXTS

If markets were perfectly competitive, conventional economic analysis would predict that subsidies result in inefficiencies and welfare losses (Druilhe and Barreiro-Hurlé 2012). Perhaps the most frequent justification for input subsidies in Sub-Saharan Africa is that they can address missing or imperfect financial and insurance markets, easing risk for small-scale farmers. The pros and cons, shown in Table 1, are often cited in the literature. Pros include the notion that promoting affordable fertilizer use might "kick-start" the adoption of new technologies by farmers, allowing them to learn and demonstrating its benefits. At the same time, the private sector might be enabled by helping actors to overcome start-up costs. A long list of cons is reported, such as high fiscal cost and administration burdens, leakages into the commercial market and neighboring countries where price ratios have not changed, and displacement of commercial purchases by farmers who would otherwise pay the full price. Less commonly cited criticisms include misdiagnosed market failures—for example, the treatment with a fertilizer subsidy of a transport cost problem that would be better addressed by investment in infrastructure.

Gautam (2015) places the advantages of subsidies in the context of welfare economics—which justifies subsidies in situations where social benefits of individual actions outweigh private benefits due to various types of market failure or externalities. He identifies four fundamental concerns about the implications of subsidies for sustainable agricultural development. The first is the opportunity cost. First, he cites evidence from studies in Latin America (Lopez and Galinato, 2007) and India (Fan, Gulati and Thorat, 2008) showing that expenditures on input subsidies contributed negatively to agricultural growth or yielded lower returns (in GDP) than investments in core public goods (irrigation, roads, education, agricultural R&D). A second is what Gautam (2015) calls "tonnage focus." That is, a policy-driven focus on raising the output of key food staples (e.g., cereals) could distort the incentives to diversify into higher-value crops. In general, subsidies focused on particular crops distort farmers' incentives to grow these as compared to other crops, with consequences for total factor productivity in agriculture. A third concern is waste other than that associated with leakage of subsidized fertilizer into commercial markets or corruption. Subsidies may contribute to use of fertilizer beyond optimal amounts. Subsidies are often also regressive. If wealthier farmers who would use fertilizer anyway receive the largest share of the benefits from the subsidy, then the subsidy merely transfers income to these as compared to poorer farmers who were the intended target. In general, transfers of the state to farmers yield low or negative returns to investment (Dorward and Chirwa 2011). Fourth, Gautam (2015) reports evidence of substantial, long-term, hidden costs arising from changed behavior of farmers and the "price-driven nutrient imbalance in fertilizer use"(p. 98). Dorward and Chirwa (2011) express concern for the agro-ecological as well as the economic sustainability of programs.

Short-term, observable outcomes or impacts are the immediate measures of program success. Dorward and Chirwa (2011) refer to these as indicators of effectiveness, while efficiency refers to whether these could have been achieved at lower cost—and is measured typically with cost-benefit analysis. Simple estimates of returns depend on reliable estimates of yield response to fertilizer, in order to convert the input quantities distributed to incremental

quantities produced. Fiscal returns are improved by reducing the displacement of commercial fertilizer demanded by farmers, and good program implementation. Dorward and Chirwa (2011) also caution that simple cost-benefit analysis ignores important distributional and dynamic elements of subsidy programs. Moreover, given the short-term payback period for subsides compared to other investments, and the complementarity of public investments in agriculture, they argue that the rate of return may not be the best criterion on which to compare investments.

We might even question whether an annual fertilizer subsidy should be considered as an investment per se. Reviewing input subsidy programs from the mid-2000s onward, Jayne and Rashid (2013) find that "the weight of the evidence indicates that the costs of programs generally outweigh their benefits." In their most recent review, Jayne et al. (2018) conclude that the overall production and welfare benefits are there but are smaller than expected, due to crowding out of demand for commercial fertilizer and lower than expected yield response to fertilizer. In fact, little is known about yield response to fertilizer in farmers' fields for staple crops other than maize, such as sorghum and millet.

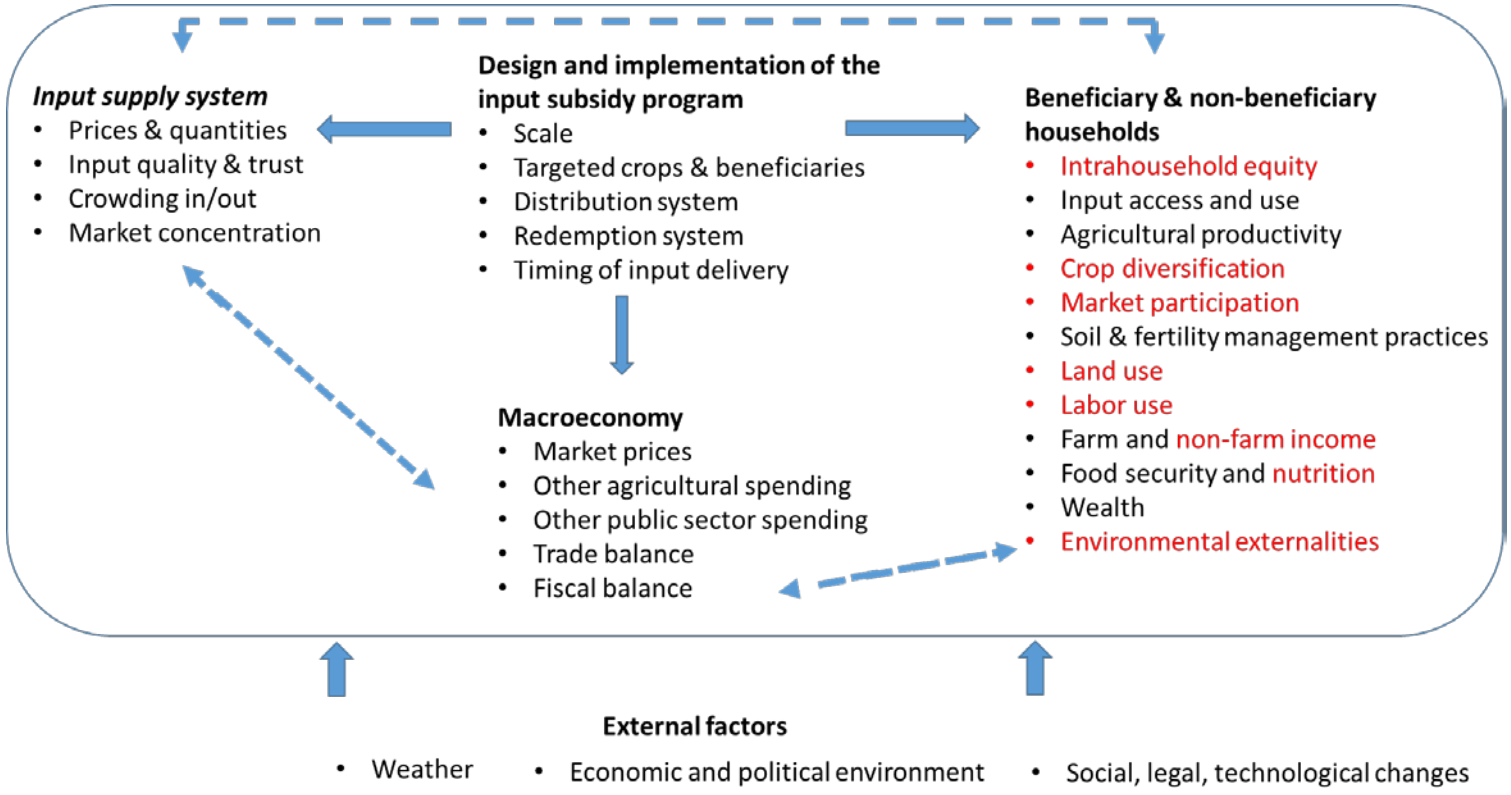
Informative reviews of the evidence concerning the outcomes or impacts (effectiveness) of the most recent generation of subsidies have been conducted by Druilhe and Barriero-Hurlé (2012), Jayne and Rashid (2013), Wanzala-Mlobela et al. (2013); Kato and Greeley (2016) and Jayne et al. (2018). Next, we summarize some of the key findings across these studies in tabular form, also consulting some additional literature not included in these reviews.

Table 1. Pros and cons of fertilizer subsidy programs in Sub-Saharan Africa

Pros	Cons
can raise food production in a single season, replacing imports	high fiscal cost, low returns to investment
kick-start innovation and stimulate rapid market development by a) encouraging farmer learning and demonstrating benefits; b) enabling fertilizer manufactureres and distributors to overcome start-up costs until they reach economies of scale	inefficiencies at farm level, such as incentives to shift crops, neglect other promising farm practices
can reduce food prices, benefiting consumers	crowd out other public investments
overcome missing and imperfect financial and insurance markets for farmers, risk	crowd out commercial fertilizers
correct for negative externalities that lead farmers to underutilize fertilizer relative to the social optimum (e.g. soil fertility depletion leading to deforestation, poor water quality, reduced carbon sequestration)	high administrative costs at local levels, late delivery to farmers
offset effects of output price distortions used to make food affordable	regressive distribution of benefits
more efficient that output subsidies to maintain low food prices	rent-seeking
non-economic': reducing poverty, providing a safety net through targeting	leakages other farmers, commercial markets, or neighboring countries
	creation of vested political interests and hard to remove

Source: Authors, adapted from Morris et al. (2007) and Jayne and Rashid (2013).

Figure 1. Direct and indirect effects of fertilizer subsidy program on developing agricultural economy



Source: Authors

3. COMPARATIVE SUMMARY OF SUBSIDY IMPACTS IN OTHER SUB-SAHARAN AFRICAN NATIONS

Figure 1 depicts the complexity and potential range of the impacts of fertilizer subsidies on a developing agricultural economy, including effects on demand (i.e., beneficiary and non-beneficiary households), supply (i.e., input supply system), and the overall economy (i.e. macroeconomy). First, it is important to highlight that the design and implementation of the program directly influences the demand and supply for fertilizer as well as the macroeconomy. These effects can be examined through different indicators. On the demand side, the most commonly analyzed indicators are input use and agricultural productivity. Quantities of fertilizer available and prices are examples of indicators examined on the supply side. Potential effects of the fertilizer subsidy program on the macroeconomy include changes in the share of the agricultural budget allocated to other programs as well as changes in the share of the national budget allocated to non-agricultural expenses. Second, the direct effects of the subsidy program on the beneficiary and non-beneficiary households can indirectly affect the input supply system and/or macroeconomy (and vice-versa). Third, external factors can influence both the direct and indirect effects of the fertilizer subsidy program.

Among direct effects, the indicators in red and bold font are the impacts that have received little or no attention from researchers and policymakers so far, such as effects on equity among household members and plot managers, allocation of land and labor resources, the diversity of crops produced and environmental externalities.

Tables 2 to 7 present a summary of findings derived from the reviews cited above, as well as some more recent studies not included in the reviews. The information is organized according to 1) objectives of the program; 2) features of program design; 3) impacts on rural households; 4) distributional impacts; 5) impacts on the macro-economy; 6) fiscal impacts. Extensive additional details are found in the reviews and the original studies cited by the authors. Our purpose here is to attempt to reduce detail, though tables 2 and 3, which refer to objectives, targeting and design elements, are large.

3.1 Program objectives and design features

There is some variation in presentation of government justification and program objectives by review source, which may reflect variation in the year of the review and time period covered by the reviewers (for example, see Appendix 1, Wanzala-Mlobela et al. 2013). A scan of Table 2 reveals that program objectives are often "vague and variable," with goals that are often not "economic" in the strictest sense. Even within the same program and time period, objectives are often "multiple and ill-defined" (Gautam 2015). Indeed, Kato and Greeley (2016) concluded that "unclear [programme] objectives [and implementation problems] may have prevented most input subsidy programs from being effective and efficient. According to Morris et al. 2007, "economic" objectives would include those related to improving the affordability of fertilizers, promoting fertilizer demand, increasing awareness of the benefits of fertilizer and the engagement of the private sector in marketing the product; poverty reduction and providing a

safety net to vulnerable populations are essentially "noneconomic (welfare)" objectives. As seen in Table 2, the Malian fertilizer subsidy program mixes both economic and noneconomic objectives.

At one extreme are the programs of Mali's nearest neighbors, Burkina Faso and Senegal, where neither claims an official name of its own and where objectives are strictly economic. In Senegal, local community committees are involved in distributing vouchers for subsidized fertilizer through the principle of "first-come, first-serve". The Senegalese program covers both cash and food crops grown by smallholder farmers and there is no apparent targeting scheme. In contrast, the fertilizer subsidy program in Burkina Faso targets farmers growing specific crops, such as irrigated rice, maize, and cotton (Druilhe and Barreiro-Hurle, 2012). However, given that demand for subsidized fertilizer exceeds supply (due to budget limitation), only a small proportion of eligible Burkinabe farm households do access it. The non-cotton growing farmers have to travel to the provincial agricultural office to collect and sign a beneficiary identification form based on planned crop area (Wanzala-Mlobela et al. 2013) while cotton growing farmers go through a similar process via their cotton farmer cooperatives (Theriault et al. 2018a). Burundi's 2012-2015 program appears to be similar to Senegal, with no crop or farm type targeted.

At the other extreme are the programs in Malawi and Zambia. As noted above, Malawi's programs began as long ago as 1998, with a developmental aim and a technological perspective—first for all smallholder farmers and later for poor farmers. From 2005, the program is clearly oriented toward welfare objectives. Nearby Zambia is related by colonial history, language, primary foodcrop (maize) and other factors to Malawi. While one of Zambia's programs addresses input affordability for small-scale maize farmers who are members of farmer organizations, the other clearly targets vulnerable populations and includes a range of crops. Similarly, Kenya has had two types of programs for maize farmers only—one targeting vulnerable and poorer farmers, and another that provides a 'one-stop shop' for affordable inputs and maize marketing at competitive prices. Among vulnerable groups, female-headed households, or those headed by children, terminally-ill or disabled farmers are targeted (Malawi, Zambia, Kenya).

As a final comment on Table 2, the term targeting is in some sense confusing. The literature uses "universal" even when subsidies are targeted to specific crops, as compared to types of farmers or administrative areas. Yet, crops are often grown by a specific type of farmer and in a specific agro-ecological zones (e.g., irrigated rice in Mali; cotton and maize in Burkina Faso and Mali). The terminology is crucial because subsidies distributed to all farmers ("universal" subsidies) are nonetheless socially regressive. They create rents for better-off producers who would have purchased them anyway, thus "displacing" non-subsidized sales (Druilhe and Barreiro-Hurlé 2012).

Designs are complex and often change over time with experiences. Design elements shown in Table 3 include procurement and distribution approaches, mechanisms for selecting beneficiaries, means of delivering and redeeming the subsidy. In most cases reported, governments have procured the input directly or through tenders to the private sector, as it has been the case in Mali (Theriault et al. 2018b).Overall, Wanzala-Mlobela et al. (2013) conclude that private sector engagement has been greatest in Ghana and Tanzania, including importation,

wholesaling, transport, warehousing and retailing functions. In Kenya, Nigeria and Zambia, retailing by agro-dealers has been a recent program feature. In Malawi, perhaps as a reflection of the welfare focus of the programs, the private sector has been engaged most in import or transport. In Rwanda, the private sector was involved in each phase of the program following bulk procurement of fertilizer by the government. In Mali, production, import, and wholesale of fertilizer are restricted to organizations that hold an official licencs, although the government remains very much involved in influencing the demand for and selling price of fertilizer (Theriault et al. 2018b).

Mechanisms for selecting beneficiaries vary widely by country program and year of program according to learning, evaluation findings, and the objectives of the programs. In some instances, the mechanism for selecting beneficiaries is affected by the funding available from the government's budget, as in Burkina Faso where all villages are classified into three groups and each group participates in the fertilizer subsidy program sequentially (Ouedraogo 2016; Theriault et al. 2018a). Over the course of the programs in Malawi, beneficiaries have been selected by traditional authorities, village committees, religious leaders, and by open meetings. This last approach was favorably reviewed by Dorward and Chirwa (2011). In the National Accelerated Agricultural Inputs Access Program (NAAIAP), Kenya utilized stakeholder forums, including farmers, other community members, and government representatives. In Zambia, different mechanisms were involved for the Farmer Input Support Programme (FISP) and Food Security Programme (FSP). The first, aimed at increasing fertilizer uptake, productivity and income, has relied on Camp Agriculture Committees, including representatives of the local chief, farmer organizations, other community-based organizations and public offices. The FSP, which focused on vulnerable farmers, has utilized Community Welfare Assistance Committees, or Area Food Security Committees. Nigeria's programs involved membership in farmers' organizations, but Liverpool-Tasie (2014) argues that these conveyed exclusive treatment of relatives of members. 'Elite capture' by locally influential persons (village officials) was found by Pan and Christiansen (2012). Research in Malawi, Zambia, Ghana and Kenya provides evidence of the politicization of programs (see country studies cied by Jayne et al. 2016). Self-selection, as an alternative to selection criteria that are applied artificially in order to meet a targeting goal, inherently tends to favor those farmers who can afford to pay their share, undertake the necessary travel, and complete the paperwork or other transactions that guarantee access to their inputs.

Vouchers and coupons have been a common means of delivering the subsidy, redeemed at government-run outlets in earlier years and with a few exceptions (Malawi, Zambia's FISP through 2015/16), by accredited agro-dealer shops more recently. Vouchers offer a "flexible and transparent" system for distribution subsidies, but their success depends on the extent of problems such as fraud and leakage resulting from resales, and they may involve substantial implementation costs (Druilhe and Barreiro-Hurle 2012).

Presence of a monitoring and evaluation system, and recognition of an exit strategy are other key features of "smart" subsidy design. We find references to full-scale monitoring and evaluation (M&E) systems in Malawi and Zambia from the outset of program design, and references to impact evaluations in the case of Kenya's NAAIAP program and Tanzania. Ghana's M&E system has been described as "poor." In Mali, the subsidy program has been characterized by the absence of a monitoring and evaluation system (Theriault et al. 2018b). We

find mention of expectations that programs will be temporary (three-year windows expected in Kenya and Tanzania), and notes of plans to scale down the program, but no explicit statements of an exit except for Tanzania (Kato and Greeley 2016). To our knowledge, Mali has no exit strategy in place. The crucial importance of a program for graduating program beneficiaries from a privileged status to commercially viable, small-scale farmers is emphasized in Dorward and Chirwa (2011) and Wanzala-Mlobela et al. (2013). As stated by Gautam (2015), "exits don't happen," and programs tend to grow or shift rather than come to an end.

Wanzala-Mlobela et al. (2013) scored programs by the extent to which hypothesized effects were actually achieved through design characteristics and implementation modalities. They rated programs in Tanzania and Rwanda highest, grouping them as the most market-friendly compared to the group composed of Malawi, Zambia, Senegal, Burkina Faso, Ghana, and Nigeria. They recommended private importation and distribution of subsidized fertilizer, but including a mechanism to address delays in payments to importers and agro-dealers. They noted that the use of tenders has had a negative impact on the development of fertilizer markets, recommending the development and application by governments of best practices and fair play procedures in the issue of tenders. The case of Rwanda demonstrated the importance of complementary services in the form a separate extension entity for increasing productivity. With respect to cost, since there is substantial cost associated with rigorous planning and administration of market-friendly programs, they suggest that it is also necessary to analyze whether the total costs of the subsidy program are less than the cost of importing food, and whether the extent of leakage justifies the costs of controlling it. Overall, they find that the evidence supports the hypothesis that agro-dealers are a more effective way of distributing fertilizer than government distribution systems.

Yet, Wanzala-Mlobela et al. (2013) conclude that "it is unlikely that program outcomes will be sustainable in the long term and continue after program termination" (p. 8). The reason for this is that most countries in Sub-Saharan Africa do not have the supportive macro and micro-economic conditions in place to allow for a competitive fertilizer market to support the implementation of an effective fertilizer subsidy program. This finding also has bearing on exit strategies.

Table 2. Input subsidy programs (ISPs) since structural adjustment in countries of sub-Saharan Africa: Comparison of objectives and targets

Country	Program name	Time period	Program Objectives	Targeted crop	Targeted beneficiaries (*)
Burkina Faso	"not officially recognized"	2008/9-	increase fertilizer use by reducing costs and facilitating farmer access to quality fertilizers	cotton, maize, rice, beans	no apparent targeting scheme; subsidy paid at source
Burundi	Programme Nationale de Subvention des Engrais du Burundi (PNSEB)	2012-2015	strengthen government-driven program by allowing private section participation in trade, a paper voucher, system-wide private-public partnership	all subsistence crops	no specific groups or geographical regions
Ghana	Fertilizer Subsidy Program	2008-13; 2015	enhance national food production and food security	maize or rice, soybean	smallholder food crop farmers
Kenya	National Accelerated Agricultural Inputs Access Program (NAAIAP)	2007/8-2013/14	"improve farm input access and affordability of smallholder farmers to enhance food security/availability at the household level and generate income from the sale of surplus produce"	maize	"resource-poor" farmers, 1-1.25 acres of land, "vulnerable members of society" (female- and child-headed households)
	National Cereals and Produce Board	2001-present	provide timely access to quality inputs at competitive prices at the point of maize sales	maize	any farmer with quantity determined by farm size
Malawi	Starter Pack	1998/99-1999/2000	jump-start' agricultural development; 'best-bet' technologies; national food self-sufficiency	maize, seed of other crops planned	all smallholder farm households
	Targeted Inputs Programme	2000/01-2004/05	jump-start' agricultural development; 'best-bet' technologies; reach poorest smallholders	maize	poorest smallholders
	Agricultural Inputs Subsidy Program/Farm Input Subsidy Programme	2005/06-present	improve resource-poor smallholder farmers' access to improved inputs in order to achieve household and national food self-sufficiency, and raise incomes	maize, legume seed from 2007/08, some other cash crops (tobacco, coffee, tea, cotton) in some years	full-time smallholder farm households, with female-headed households a priority; elderly, HIV-positive, child, orphan or physically challenged households or heads caring for elderly or physically challenged individuals also targeted
Mali	Initially called the “Initiative Riz”	2008-	Increase fertilizer use in order to increase production and productivity as well as improve food security and reduce output prices	Rice initially and cotton, maize, millet, sorghum, and wheat subsequently	no specific groups or geographical regions

Nigeria	Federal Market Stabilization Program	1999-2011	improve farmers' timely access to fertilizer in terms of both quantity and quantity	maize or rice, some cash crops grown by smallholder farmers	all smallholder farm households
	Targeted Fertilizer Subsidy Voucher Pilot Program	2009-2011	voucher pilot program to encourage private sector agro-dealers		state government programs (Kano, Taraba, Bauchi, Kwara); members of farmer organizations or less formal groups
	Group Enhancement Support Scheme	2012	promote fertilizer demand and private sector input market, "encourage critical actors in the fertilizer value chain to work together to improve productivity, household food security and income of the farmer"		resource-constrained farmers
Tanzania	National Agricultural Input Voucher Scheme	2008/09-2013/14	improve farmer access to inputs; create awareness about the benefits of fertilizer use; crop productivity to reduce poverty and household food insecurity as well as achieve economic growth and national food security	maize or rice	small-scale farmers (in early years, under 1 ha) able to pay for and use inputs; female-headed households and new users a priority
Rwanda	Crop Intensification Program	2007/8-	"raise productivity of the main food crops, boost food production and safeguard national food self-sufficiency"	maize, beans, rice, wheat, potatoes, bananas	at first, farmers agreeing to participate in land use consolidation in accordance with the requirements of crop regionalization strategy to shift from diversification to planting crops that are suited to agroclimatic and soil conditions
Senegal	under the National Agricultural Policy (NAP)	2000	facilitate timely access of farmers to adequate quantity and quality of fertilizer at competitive but affordable prices	most staple food crops and cash crops grown by smallholder farmers	"benefiting the largest number of farmers possible, regardless of financial means or planted area" ; vouchers assigned by local community committees

Zambia	Farmer Input Support Programme	2002/3-present	"improve the supply and delivery of agricultural inputs to small-scale farmers through sustainable private sector participation at affordable cost, in order to increase household food security and incomes"	maize; in some years, small amounts of rice, sorghum, cotton and groundnut seed	small-scale farmers cultivating less than 5 ha; registered and actively farming; members of a farmer organization selected to participate; not also benefiting from the Food Security Pack Programme; financial means to pay share of input costs
	Food Security Programme	2000/1-present	reach farmers not reached by FISP; includes also conservation farming and lime in acidic soils	varies by agro-ecological zone, including maize, rice, sorghum, millet, legumes, sweet potato or cassava	"vulnerable but viable" farmers with less than 1 ha of land, adequate labor, not in gainful employment, and having at least one of the following characteristics: female-, child/youth-, elderly- or terminally-ill headed, or caring for orphans or disabled.

Sources: Wanzala-Mlobela et al. (2013), Jayne et al. (2016); Kato and Greeley (2016); Smale and Jayne (2003); Dorward and Chirwa (2011); Kilic, Whitney and Winters (2015); Theriault et al. 2018b; Nahayo et al. 2017.

Table 3. Input subsidy programs (ISPs) since structural adjustment in countries of sub-Saharan Africa: Comparison of design

Country	Program	Time period	Procurement	Distribution	Mechanism for selecting beneficiaries	How was the subsidy delivered	How was the voucher redeemed?	Is there a monitoring and evaluation system?	Is there an exit strategy?
Ghana	Fertilizer Subsidy Program	2008-13; 2015	No tender issued; government procurement through private sector importers	distributed through private networks of registered agents and independent retailers	chosen by local authorities; extension officers; self-selection "as long as supplies last"	vouchers in one year only, followed by waybill systems	not applicable	"poor"	Expected to be temporary
Kenya	National Accelerated Agricultural Inputs Access Program (NAAIAP)	2007/8-2013/14	government tenders to private sector	agro-dealers	stakeholder forums, including farmers, other community members, government representatives ; districts selected based on maize production and poverty level	vouchers	accredited agro-dealer shops	evaluations have been conducted	originally expected to last 3 years only, still ongoing in 2017 but minimal
	National Cereals and Produce Board	2001-present	government procurement	NCPB depots	amounts determined by farm size	one stop shop	not applicable	not reported	justified as a temporary response to the food price crisis
Malawi	Starter Pack	1998/99-1999/2000	government procurement via private sector tender	state-owned enterprises	varies over time, including traditional authorities, village committees, religious leaders, open meetings for allocation led by Ministry of Agriculture and Food Security	varies over time, including coupons and vouchers (paper and electronic)	government-run outlets, including Agricultural Development Marketing Corporation (ADMARC) and Smallholder Farmer Fertilizer Revolving Fund of Malawi (SFFRFM)	yes, Malawi had a well-designed M&E system in place from the outset	long history of fertilizer subsidy in one form or another justified in terms of reducing the food import bill; no exit strategy reported, although graduation strategy discussed
	Targeted Inputs Programme	2000/01-2004/05							
	Agricultural Inputs Subsidy Program/Farm Input Subsidy Programme	2005/06-present							
Mali	Initially called “Initiative Riz”	2008-	Government and state-owned enterprises contract with private sector, based on a tender-bid to supply subsidized fertilizer	authorized private networks of wholesalers and retailers or advisory service (farmer organizations)	amounts determined by the number of hectares allocated to target crops	Paper voucher (the e-voucher system is being tested)	authorized agro-dealer shops or through advisory service (farmer organizations)	no	The subsidy program has evolved over time to include more target crops

Nigeria	Federal Market Stabilization Program	1999-2011	government contracts with private sector, based on a tender-bid to supply lots of subsidized fertilizer	distributed through public outlets at state and local levels	farmer registration	Agricultural Development Project or other outlets; no vouchers	not applicable	not reported, although there are analyses of targeting and impact evaluations in two states	changes in structure and increased involvement of private sector, but no exit strategy reported
	Targeted Fertilizer Subsidy Voucher Pilot Program	2009-2011			membership in farmer organization in Kano state, members of some sort of group or organization in Taraba	vouchers	in Kano state, one voucher per group; in Taraba, individuals who were members received vouchers		
	Group Enhancement Support Scheme	2012				e-voucher through phone	Redemption center (selected private agro-dealer)		
Tanzania	National Agricultural Input Voucher Scheme	2008/09-2013/14	private sector importers	distributed through private networks of registered and trained agro-dealers	village voucher committee	voucher		impact evaluations conducted	three-year exit plan reported
Rwanda	Crop Intensification Program	2007/8-	bulk procurement by government	auction to qualified private sector bidding companies by Ministry of Agriculture	Ministry working with local authorities to identify eligible farmers	voucher	agro-dealers, at harvest	not reported	changes in structure and increased involvement of private sector, but no exit strategy reported
Senegal	under the National Agricultural Policy (NAP)	2000	government contracts with private sector, based on a tender-bid to supply lots of subsidized fertilizer	Administrative authorities consisting of committees as national, regional, departmental and local levels who monitor sales	local committees at community level, assigned on a first-serve, first-come basis	voucher	at the relevant warehouse	not reported	not reported
Zambia	Farmer Input Support Programme	2002/3-present	government contracts with private sector, based on a tender-bid to supply lots of subsidized fertilizer	cooperatives and farmer associations until 2015/16, now agro-dealer network	Camp Agriculture Committees, which include representatives of local chief, farmer organizations, other community-based organizations and public offices	delivered through government systems entirely until 2015/16; now through e-vouchers	farmer organization through 2015/16; now at agro-dealers	yes, well-designed M&E system in place	plan to scale down over years

Food Security Programme	2000/1-present		agro-dealers	Community Welfare Assistance Committees or Area Food Security Committees	paper voucher, e-voucher	agro-dealers

Source: Kato and Greeley (2013), Jayne et al. (2016), Wanzala-Mlobela et al. (2013), Theriault et al. 2018b; Nicole Mason (pers. Comm. April 29, 2018). Burundi and Burkina Faso excluded due to more limited information.

3.2 Impacts

A synopsis of research on the impacts of fertilizer subsidies in Sub-Saharan Africa is distributed in Tables 4-7 and Figures 2-3. The information is organized according to 1) impacts on rural households; 2) distributional impacts; 3) impacts on the macro-economy; 4) fiscal impacts. Extensive, additional details are found in the reviews and the original studies cited by the authors. Our purpose here is to attempt to reduce detail.

A comparison of evidence on impacts on farming households is shown in Table 4. The first four columns address the primary and intended effects of fertilizer subsidies on productivity (crop yield), the area planted to the target crop, and the total production per form of the target crop. All studies reviewed show positive (in one case, statistically insignificant) effects on yield and production by the farm household. Crop area planted is not always investigated, but studies show mixed results. This is significant, since over the longer-term, changing trends in land allocation on farms can lead to changes in crop diversification across farming systems, with implications for soil nutrient balances, plant pests and diseases, on-farm consumption and sales patterns. Only two studies directly address this issue have been identified, and these, conducted in Malawi, focus on the seed component of the input package, with contradictory results (Snapp and Fisher 2015; Chibwana, Fisher and Shively 2012). In some cases, programs such as those undertaken in Malawi and Zambia, where maize is by far the dominant starchy staple, have sought to diversify through also offering the seed of legumes and other crops, and also providing complementary extension services on soil fertility or management practices. So far, a few studies have shown mixed effects. According to Jayne et al. (2016), work by Holden and Lunduka (2012) found no effects on use of organic manure or intercropping in Malawi; in Zambia, Mason, Jayne, and Mofya-Mukuka (2013) found reduced fallowing and intercropping, a rise in continuous maize production on the same plot, and no effect on use of organic manure (as reported in Jayne et al. 2016). Alia's (2017) study found a negative effect of the fertilizer subsidy in Burkina Faso on use of organic manure.

"Crowding (in) out" effects on the sales of commercial fertilizers has been a major focus of studies conducted in Zambia, Malawi, Nigeria, and Kenya. Derived through mathematically differentiating the subsidy effect on total quantity of fertilizer demanded by the household, "where there is crowding out (in), a 1-kg increase in subsidized fertilizer acquired by a household leads to a less (more) than 1-kg increase in total fertilizer use by that household through the negative (positive) effect on the commercial fertilizer use" (Jayne et al. 2016: 25, based on Xu et al. 2009). If the change in fertilizer use is 0, then the total change in fertilizer use is induced by the subsidy. Crowding-in refers to drawing in farmers who would not otherwise be applying commercial fertilizer, or would be using less of it, through the fertilizer subsidy. The term has also been used conceptually to refer to reaching farmers who otherwise would not have access to fertilizers through the subsidy program. Crowding-out describes the reduction in commercial fertilizer use that occurred as a consequence of substitution by subsidized fertilizer. In most cases, with the exception of remote rural areas or those with poorer farmers, crowding-out is more likely to have occurred than crowding-in.

Incremental increases in crop production on farms can, but do not necessarily lead to outcomes such as higher farm incomes, reduction in the likelihood a household will fall below the poverty line, greater food security, or change in nutrition. The evidence is much sparser concerning these second-tier impacts. Other factors held constant, researchers have generally found positive or statistically insignificant effects of fertilizer subsidies on income or poverty reduction, food security and diet quality. Nutritional aspects are understudied. Reviewers have found only one or two published studies that have tested whether subsidies affect shares of the production sold on markets (market participation).

In some farming systems such as the dryland systems of Mali and Burkina Faso, households are organized under the leadership of a senior family member (most frequently male), and crops are produced on a combination of collective and individual fields. Production on the collective fields addresses the staple food needs of the extended family as a group, while the output on individual fields can be utilized to meet the more personal needs of family members. Even in more nuclear farm households plot responsibilities and rights may be distributed among family members. We have found only two studies that examine the intrahousehold aspects of fertilizer subsidies (Haider 2018 and Chirwa et al. 2011).

However, because of the emphasis in some programs on targeting female heads of household, a larger set of studies has explored the extent to which subsidies have favored female- as compared to male-headed households. These are indicated in Table 5, which summarizes distributional impacts, or the extent to which targeted beneficiary groups were reached through the fertilizer subsidy program, according to studies. Overall, the evidence suggests that targeting of female-headed households has not been successful. In Malawi and Zambia, targeting of smaller-scale farmers appears to have been achieved, though programs in Kenya and Ghana appear to favor larger-scale farmers and results for Tanzania show no significant effect. Results concerning assets and wealth indicate that most of the programs had no or a greater focus on less wealthy households (again, Malawi and Zambia), but a positive association with assets in Kenya and one study in Malawi. As is explored in greater depth in a number of studies, the socio-political dimension of fertilizer subsidy programs is pronounced. For example, there are often linkages between election activities, village or official leadership roles, and subsidy incidence in rural areas. In Ghana, by contrast, the party that initiated the program lost the election.

Macro-economic impact studies appear to be less common than micro-economic impact studies, and are based on partial equilibrium or computable general equilibrium models. A summary is presented in Table 6. In the aggregate, fertilizer subsidy programs increase total fertilizer use and total crop production, contributing to national self-sufficiency with respect to the target crop. With the supply shift outwards, prices are expected to fall and evidence is that the do—or that the effect is not great enough to induce a significant change. Evidence from Malawi shows a rising in the agricultural wage as a consequence of greater demand for labor. Rising aggregate incomes in rural areas have been shown in Burkina Faso and Malawi, with reductions in poverty rates.

Returning to Figure 1, our tabular summary of reviews and more recent studies indicates that there is relatively less information on intrahousehold equity, land use (including crop diversification), labor use, market participation (commercialization) and nutrition. In none of the

reviews have we seen a discussion of the intervening factor of counterfeit fertilizer or fertilizer of low quality, a problem acknowledged to be widespread (e.g., Bold et al. 2015; Fairbairn 2017; Masso et al. 2017; Theriault et al. 2018b). Variable quality of fertilizer would most certainly affect impact measurement. As noted especially in the most recent review by Jayne et al. (2018), and in a body of published agronomic research as well, blanket recommendations and fertilization that has focused on nitrogen in particular, followed by phosphorus and potassium, has largely ignored secondary and micro-nutrients, organic amendments and lime supplements needed to manage acidic soils. Depending on the specific agro-ecology, any one of these may function as the binding constraints to productivity. With the heavy focus on urea, the Mali subsidy program might not be addressing the more limiting factor, which has been found to be phosphorus rather than nitrogen in some instances (Kihara et al. 2016 and Smale et al. 2019).

We also note that virtually all of the studies reviewed focus on maize because maize has been most frequently the major target crop. While those conducted in Nigeria would have included both maize and rice, crop was not specifically mentioned. Recent e-voucher programs have also not yet received much attention in the published literature. Wossen et al. (2017) examined Nigeria's mobile-phone based fertilizer (and seed) subsidy program found large productivity and welfare benefits, and no biases related to gender and size of landholding. They suggest that targeting to food insecure and poor households might improve the contribution of the program to national development goals. Druilhe and Barreiro-Hurlé conclude that fertilizer subsidies do not represent a suitable, long-run policy option for because they do not address the underlying causes of low fertilizer use. Echoing the early work on Malawi's Starter Pack in 1998, which was based on agroecology-specific maize research recommendations, they recommend targeting agro-ecologies, combined with complementary services (extension) to raise farmer demand. Likewise, Theriault et al. 2018a) found that the economically optimal rates of nitrogen differ across agroecological conditions, with the greater rates on plots characterized by the presence of soil and water conservation practices.

Finally, the fiscal burden of fertilizer subsidies was one of the foremost criticisms of the first generation or programs that followed independence in many countries of Sub-Saharan Africa. Jayne et al. (2016; 2018) assembled data from various sources to document the expenditures on subsidies and their share of agricultural and national budgets over a four-year period (2011-2014), using a consistent methodology. These are averaged over the four years and shown graphically in Figure 2. The range of the average is between only about 10% in Tanzania, to almost one-third (31-32%) in Malawi and Ghana. The average masks a much broader range among individual years, of course—only 2% in Tanzania in 2012, compared with 44% in Malawi in 2014. The overall average over four years and all countries is 18%. Figures reported for Mali, Burkina Faso and Senegal are similar (11-13%), closer to Tanzania's average, and well under the overall average. According to Theriault et al. (2018b), the share of the rural and agricultural budget allocated to the fertilizer subsidy programme constantly increased over the period, accounting for less than 10% in 2008 to about 25% in 2014.

The share of the agricultural budget represented by expenditures on the fertilizer subsidy gives an incomplete picture of the extent to which these expenditures compete with other public investments in agriculture. Figure 3 shows the ratio of the subsidy costs to other times in the agricultural budget. The average over all countries and years is 0.25 to 1—subsidy costs (which

arguably are not investments) represented a quarter of every dollar spent on other agricultural investments from 2011-2014 in 9 countries of Sub-Saharan Africa. In Ghana, at the extreme, they represented nearly 60 cents of every dollar spent elsewhere in the agricultural budget. At the other extreme is Tanzania, at 11 cents per dollar. Again, Mali, Burkina Faso, Nigeria and Senegal lie closer to Tanzania on a comparative scale (14, 13, 12, 16, respectively). Zambia and Malawi lie closer to Ghana (37, 47).

To what extent can expenditures on subsidies be supported by public investments in agricultural that take advantage of linkages and complementarities? Reviewers agree that subsidies should be considered within the framework of the national strategy for food security and in full consideration of the portfolio of other public investments in agriculture (Druilhe and Barreiro-Hurlé 2012; Jayne et al. 2018). As one example, Liverpool-Tasie et al. (2015) argue that reducing transportation costs are likely to have a much larger effect on the profitability of fertilizer use than fertilizer subsidies in Nigeria. As another example, Theriault et al. (2018a) find that, in Burkina Faso, transaction costs diminish the benefit of the subsidy and conclude that investing in road infrastructure and removing illicit tax collection could lead to significant cuts in transaction costs while freeing up resources from the agricultural budget to enable the provision of services. It is estimated that transactions costs in Burkina Faso, due in part to poor road infrastructure and illicit tax collection, reduce the effective subsidy by 28 and 23% of the market price for urea and NPK (Holtzman et al. 2013).

Table 4. Input subsidy programs (ISPs) since structural adjustment in countries of sub-Saharan Africa: Comparison of evidence on household impacts

Country	"Crowding" commercial fertilizer use (in, out)	Crop yield	Crop area planted	Crop production	Income	Poverty reduction	Food security	Nutrition or diet quality	Soil fertility management practices*	Crop diversif-ication	Intra-household equity	Market participation
Burkina Faso										-	-	
Ghana		**0**					+		**0**			
Kenya	out	+	**0**	+	**0**	+						
Malawi	out	+	**+,-**	+	**+,0,-**			+	**0**	**+,-**	+	+
Mali		+										
Nigeria	In	+	**0**									
Tanzania		+	**0**	+	**0**		**0**	**0**				+
Zambia	in, out	+	+	+	+	**+, 0**			**0,-**			

Note: + denotes a positive impact, - denotes a negative impact, 0 denotes no impact

Source: Summarized from Jayne et al. 2016 for multiple countries; Chirwa et al. (2011) for Malawi, Gine et al. (2015) for Tanzania; For Burkina Faso, Alia (2017, Haider (2018). Theriault et al. 2018b for Mali. Wiredu, Zeller and Diagne (nd) for food security in Ghana.

* includes fallow, manure, intercropping, forests and trees (see Snapp and Fisher 2015, Chibwana et al. 2012 for crop diversification, but focused more on seed than on fertilizer)

Table 5. Input subsidy programs (ISPs) since structural adjustment in countries of sub-Saharan Africa: Comparison of distributional impacts (targeted beneficiaries)

Country	Socio-political factors favoring receipt	Female household head	Landholding size	Assets, Wealth
Ghana	party that initiated the program lost	**0**	**-**	**+**
Kenya	some evidence of electoral factors	**0**	**-**	**0,-**
Malawi	household heads originating within district	**0, -**	**+**	**+,'-**
Nigeria	district of origin of state governor; relatives of farm group leaders	**0, -**	**+**	**0**
Tanzania	elected officials and village voucher committee members	**0,-**	**0**	**0**
Zambia	constituencies in areas were ruling party won in last election	**0**	**+**	**0,+**

Source: Summarized from Jayne et al. 2016 for multiple countries; Gine et al. (2015) for Tanzania.
Note: + denotes a positive relationship, - denotes a negative relationship, 0 denotes no relationship

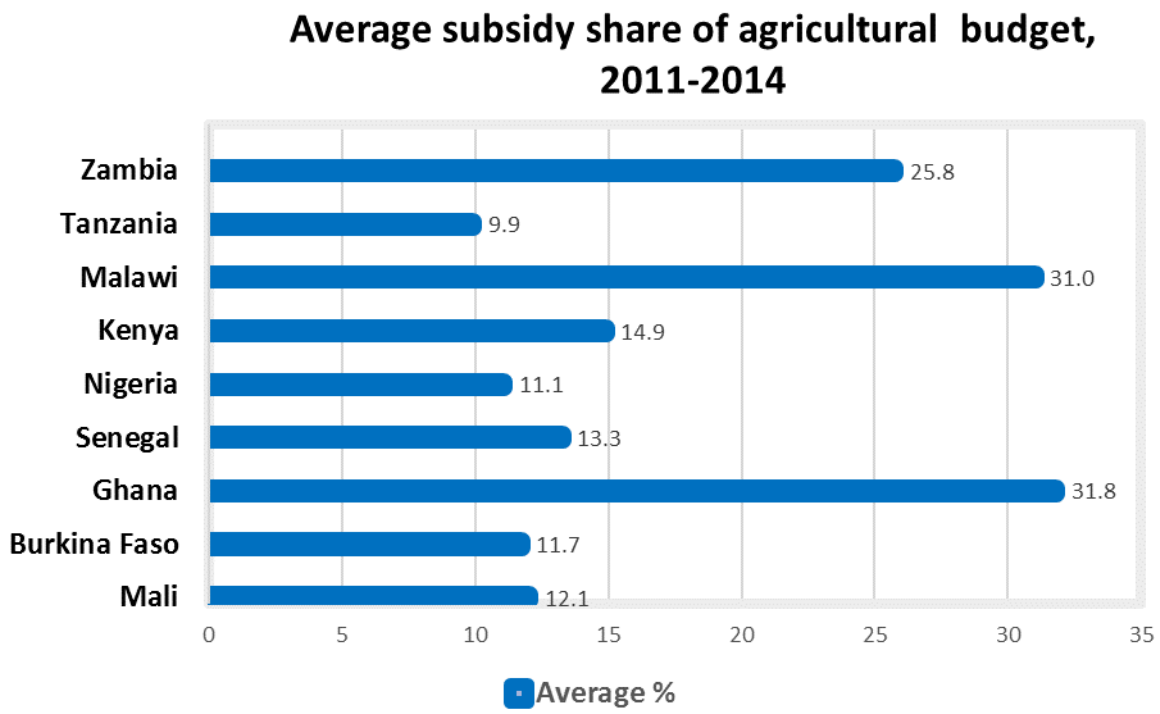
Table 6. Input subsidy programs (ISPs) since structural adjustment in countries of sub-Saharan Africa: Comparison of macro-economic impacts

Country	Total fertilizer use	Total crop production	Food prices	Agricultural wage rate	Aggregate rural income	Poverty rate
Burkina Faso		+			+	-
Ghana						
Kenya	+					
Malawi	+	+	-	+	+	-
Nigeria			**0**			
Tanzania		+				
Zambia	+		-			

Source: Summarized from Jayne et al. 2016. For Burkina Faso, Sabo, Siri and Zerbo (2010).

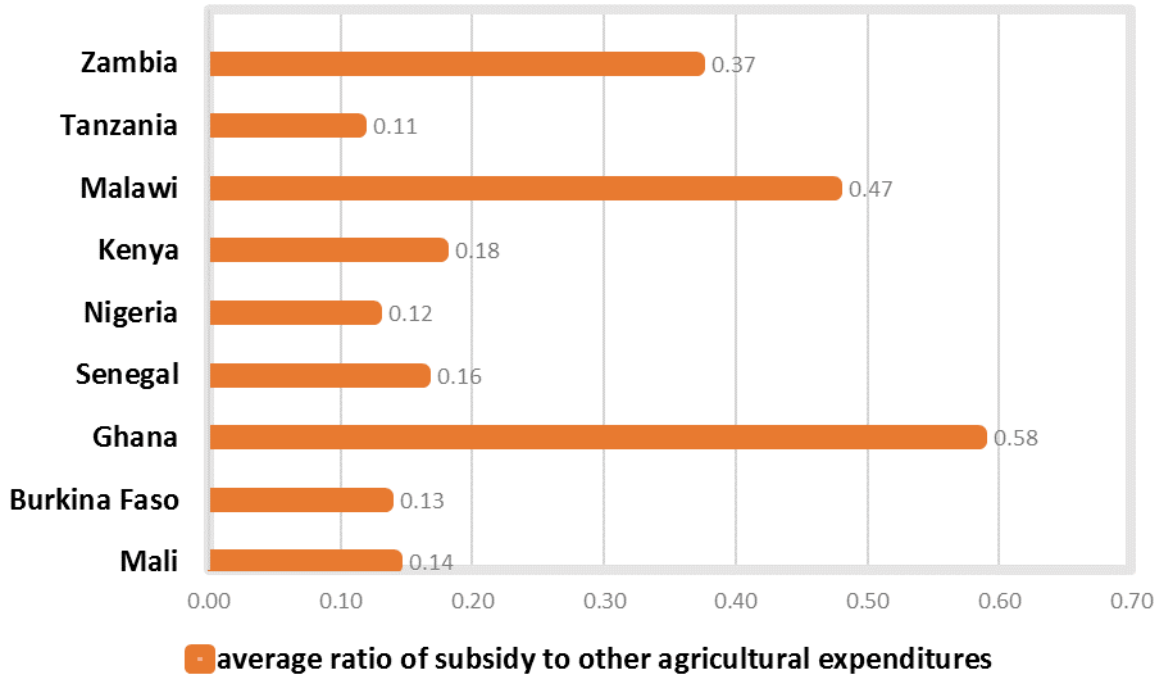
Note: + denotes a positive impact, - denotes a negative impact, 0 denotes no impact

Figure 2. Average subsidy share of agricultural budget, 2011-2014



Source: Authors

Figure 3. Average ratio of subsidy costs to all other agricultural expenditures from 2011-2014



Source: Authors

4. TARGETING OR NOT?

Dorward and Chirwa (2013) propose a conceptual framework for examining alternative targeting objectives, targeting methods, and applicability in a given context. They define targeting as the process of "directing" inputs to particular areas or households. We have argued that 1) by restricting the subsidy to a particular crop or set of crops, a program is in fact targeting an area, farming system, and group of households; 2) as shown by experience in other countries, and cited by multiple authors above, "universal" subsidies are in fact regressive, favoring those with more assets and more social standing. Thus, they effectively target this farming stratum.

Table 7 is excerpted and adapted from a table Dorward and Chirwa (2013) use to illustrate relationships among program objectives and targeting objectives, with implications for program design. Examples of objectives include national food self-sufficiency, household food security or social protection for beneficiaries, and poverty reduction combined with broad-based growth. Each implies a specific design. Another noteworthy objective they include is program graduation. When conceptualized by area, program design would depend on development of the private sector to supply inputs and market products; when targeting by household type, it involves provision of financial mechanisms for saving or credit.

Dorward and Chirwa (2013) explain that targeting impacts are affected for four issues: 1) displacement; 2) input productivity; 3) economy-wide effects; and 4) graduation (exit). They note that even when program objectives have a simple focus on national food self-sufficiency, targeting generates trade-offs such as high displacement rates and higher productivity growth among wealthier beneficiaries. In Malawi, applying an advanced econometric model, Asfaw et al. (2017) find efficiency trade-offs. About 60% of vouchers were allocated to households in the lowest three quintiles of efficiency, and more vouchers were destined for districts with less efficient production. They ask whether it makes more sense to target the more efficient producer, treating the poorest producers instead with social safety nets and other policy mechanisms.

In Ghana, Houssou et al. (2017a) found larger-scale and wealthier farmers continued to benefit more despite the stated program goal of targeting smallholder farmers. Noting the high transactions costs of targeting, they question whether it is feasible to improve it. Houssou et al. (2017b) then propose a targeting approach based on proxy means tests. The proxy means test employs poverty correlates to select beneficiary farmers. They suggest that the method may improve capacity to identify poorer farmers more cost-effectively.

In Zambia, the analysis by Mason et al. (2013) demonstrates a political dimension to targeting. Households in constituencies won by the ruling party in the last presidential election received more subsidized fertilizer than those in areas lost. As of 2010/11, the program also disproportionately allocated subsidies to households with income above the $1.25 poverty line.

By contrast, Mather and Minde (2016) concluded that the input subsidy program in Tanzania over the 2008-2010 period had largely reached its goal of targeting maize growers with less than a hectare who had not used fertilizer in the preceding five seasons. Unlike in Kenya, Zambia, and Malawi, they found that targeting this group resulted in more rather than less use of

commercial fertilizer ("crowding-in"). This result held even when taking into account that over a quarter of voucher recipients did not redeem their vouchers ("leakage"). They attributed this positive result to the fact that such a low percentage of targeted farmers had used fertilizer previously. In other words, the targeting objective was to reach the bottom of the farm size distribution and those with no prior experience with fertilizers. Such a targeting objective would not be consistent with a program objective of national food self-sufficiency, but with one that focus on a particular social group.

Table 7. Examples of program objectives, targeting objectives, and implications for design

Program Objectives	Targeting Objectives	Design implications
1. increased production or national food self-sufficiency	maximize incremental input use (minimize displacement) and productivity of incremental input use	identify geographical areas and household types with low displacement (i.e. unable to buy unsubsidized fertilizer) and high input use efficiency
2. beneficiary household food self-sufficiency	target food deficit households in productive growing areas who are able to redeem coupons and use the inputs effectively	identify such households
3. social protection for beneficiaries	target most vulnerable households in productive growing areas who are able to redeem coupons and use the inputs effectively	identify such households; complementary safety nets to aid financing of redemption
4. poverty reduction from broad-based growth	some combination of 1, 2, 3 above	combination depends on relative effectiveness of direct impacts on beneficiaries and indirect impacts benefiting the poor more generally
5. program graduation of households	consider adding complementary safety nets to aid financing of redemption to (2) above for poor households	mechanisms to help beneficiaries save or afford access to inputs upon graduation
6. environmental protection	as in (1)	together with focus on fragile or degraded soils, in combination with soil and water conservation practices

Source: Authors, adapted from Dorward and Chirwa (2013).

5. CONCLUSIONS AND IMPLICATIONS FOR MALI

Several relevant lessons can be drawn from the synopsis of the various fertilizer subsidy programs in sub-Saharan Africa. Fertilizer subsidies are not an investment per se. Costs of subsidy programs tend to exceed benefits. The rate of returns on subsidy expenditures is lower than on investments in core public goods. The benefit of the subsidy can even be eroded by high transaction costs, including transport costs. There is a general consensus that reducing transaction costs (e.g., transport costs), through investment in public goods (ex., road infrastructure) would have a greater positive impact that the subsidy on fertilizer.

The impacts of participating in an input subsidy program on rural households have been mixed. Significant and positive impacts on production, productivity, and market participation have been found in most empirical studies conducted across sub-Saharan countries. The impacts of subsidized fertilizer on increasing income, reducing poverty, and improving food and nutrition security have been either positive or null. In many instances, the fertilizer subsidy program has contributed to crowding out commercial (unsubsidized) fertilizer use. Until now, less than a handful of impact studies have been conducted in West African Sahelian countries, including Mali. Given the mixed impacts found in the literature, it is imperative to investigate the impacts of the fertilizer subsidy programs on various outcomes in Mali.

Many of the fertilizer subsidy programs in sub-Saharan Africa face four fundamental problems: 1) opportunity costs; 2) "tonnage focus"; 3) waste; and 4) hidden costs. The fertilizer subsidy program in Mali is not immune to these. Funds allocated to the subsidy program cannot be invested in public goods that generate greater rates of returns. This is particularly true given that the share of the subsidy program in the Malian agricultural budget has been increasing over time, in part due to the inclusion of more target crops. Under the current program design, all Malian farmers of the target crops (i.e., rice, cotton, maize, millet, sorghum, and wheat) are eligible to access subsidized fertilizer at a quantity that is proportional to the number of hectares devoted to those target crops. Such a "hectare focus" can distort the incentives to allocate land to non-target crops, affecting farm diversification and intensification. Given the lack of monitoring and evaluation system in Mali, no data is available to assess the possible "waste" issues-crowding out of commercial fertilizer use and targeting of the wealthier farmers, who would have use fertilizer anyway, rather than the intended target of poorer farmers. There are also hidden costs related to the environmental as well as economic sustainability of the subsidy program. Empirical evidence from other countries shows that that the use of subsidized fertilizer has either no impact or even a negative impact on the adoption of soil fertility management practices, which are practices clearly needed on the degraded and aged soils of Mali. With a heavy focus on nitrogen, many subsidy programs, including in Mali, might not be addressing the most limiting factor.

With no exit strategy in place, the fertilizer subsidy program is likely to stay in the short to medium-term in Mali. There are key steps that should be followed in order to maximize the positive impacts and minimize the negative impacts of such a program. First, clear and non-conflictual program objectives should be stated. Second, various design and implementation approaches should be tested. Third, the targeting outcomes and program design and implementation should be aligned with each other and with the program objectives. Fourth, a

strong monitoring and evaluation system should be installed. Finally, there is a strong need for more empirical evidence to better understand the intended and unintended impacts of the program.

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