

# **Initial Conditions and Changes in Commercial Fertilizers under the Farm Input Subsidy Programme in Malawi: Implications for Graduation**

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December 2011

## Abstract

The government of Malawi has been implementing agricultural input subsidies since 2005/06 as an intervention aimed at improving food security among resource poor smallholder farmers. Although the issue of graduation is not articulated in the design of the programme, this study investigates the determinants of changes in the demand for commercial fertilizers in the presence of the subsidy programme. The increase in purchase of commercial fertilizers by subsidized households may indicate prospects of graduation from the subsidy programme in future. Using panel data between the 2004/05 and 2008/09 seasons, we find that 6 percent of households that did not purchase commercial fertilizer in 2004/05 could afford to purchase fertilizers commercially in subsidy years. Relative to those that never purchase fertilizers, these households tend to have higher per capita expenditure and higher values of durable assets. The econometric results show that initial conditions matter, with initial household size, per capita expenditure, agricultural output, and existence of business enterprise all playing a positive role in the changes in demand for commercial fertilizer. We also find that commercial fertilizers decreases with initial commercial fertilizers, land holdings and existence of ADMARC. The results suggest that the poor may have low prospects of graduation and less involvement of ADMARC and greater participation of the private sector can help in improving the 'potential graduation conditions'.

## 1. Introduction

Since the 2005/06 agricultural season, the Government of Malawi (GOM) has been implementing an agricultural input subsidy, the Farm Input Subsidy Programme (FISP), targeted at poor smallholder farmers. The main objective of the programme is to raise the income and household food security of smallholder farmers through improvements in agricultural productivity. The programme targets smallholder farmers who have land but cannot afford to purchase fertilizers and seeds at market prices. The programme targets about 2.8 million farming households out of an estimated 3.4 farming households in Malawi. The volume of subsidized fertilizer in the FISP increased from 132,000 tonnes in 2005/06 to 216,000 tonnes in 2007/08, but reduced to 160,000 tonnes in 2009/10 agricultural season (Dorward et al. 2010; Dorward and Chirwa 2011). Due to the high poverty rate among Malawi's rural population, agricultural input subsidies apart from being an instrument of promoting agricultural growth can also be seen as a social protection instrument, by ensuring access to and availability of food to vulnerable groups (Dorward et al. 2006). In the medium-term investment plan for the agricultural sector drawn up by the Government of Malawi, the agricultural input subsidy, although the scope and the scale may change, is identified as the main strategy for revitalizing the performance of the agricultural sector and reducing poverty in Malawi (GOM 2007).

The FISP has been evaluated since the 2006/07 programme using the 2004/05 Integrated Household Survey as the baseline (ICL et al. 2007; SOAS et al. 2009; Dorward and Chirwa 2008; Dorward et al. 2010). This has generated three panels of households at a national level with about 1,400 households being followed in all the three surveys. Since 2005/06, several changes have taken place in the scope, scale and implementation of the programme, including the use of open meeting community-based targeting of beneficiaries, from a focus on multiple crops to only maize inputs, and variations in involvement of the private sector (Dorward and Chirwa 2008). Although vulnerable groups are specifically preferred in the targeting criteria, studies find that the non-poor with better asset endowments are more likely to receive subsidy coupons. It has also been shown that over time, the displacement of commercial sales has fallen, suggesting that smallholder farmers are increasingly purchasing fertilizers at market prices to supplement their subsidized fertilizers (Ricker-Gilbert and Jayne 2010). Chirwa et al. (2011a) also find that some households in the panel have had access to subsidized fertilizers since the programme started while others have had only intermittent access. There is also evidence that indicates that although each household is expected to receive 2 fertilizer coupons, some households receive less or more than the expected number (Dorward et al. 2010). This means that the scale of subsidies at household level, initial household endowments and repeated access to subsidized inputs, may have implications on the potential pathway to graduation from the subsidy programme. The differential access and multiple access to safety net programmes, and the size of benefits have important implications for livelihood promotion and sustainable graduation from social protection (Chirwa et al. 2011b). Questions have also been raised by different stakeholders on the sustainability of the subsidy programme and whether some of the targeted households are graduating from subsidization.

The issue of graduation from the subsidy programme is not articulated in the programme documents and has therefore not received adequate attention as a policy issue. In the medium-term plan of the farm input subsidy programme, there is no mention of prospects of graduation at different levels (GOM 2010). There are no critical benchmarks articulated that are necessary to enable households to graduate from the programme. The absence of issues of graduation suggests that policy-makers envisage the subsidy to continue indefinitely, or as a political pragmatic way of maintaining popularity using a programme that has been perceived to be hugely successful in dealing with food security problems in Malawi. The FISP as an agriculture-based social protection programme benefits households with different endowments, repeated and multiple access to safety nets, and size of benefits among households. This implies that agricultural social protection programmes are likely to have different scale effects on poverty and rural livelihoods, which in turn may affect the extent of graduation.

The main issue in this paper is to investigate whether access to subsidy leads to increased demand for commercial fertilizers among subsidized smallholder farmers. Chirwa et al. (2011b) note that one of the 'potential graduation conditions' in the context of input subsidies is its ability to raise incomes that improve working capital for farmers that enables them to afford commercial inputs. It can be argued that households that never purchased commercial fertilizers but are able to purchase after accessing subsidized fertilizers demonstrates potential to graduate from the subsidy programme. Previous studies in Malawi such as Ricker-Gilbert et al. (2010) estimated the commercial demand for fertilizers but paid little attention to the role initial conditions play in the presence of a subsidy programme. This paper attempts to address this by assessing the effects of initial conditions such as poverty, assets, household and market characteristics, in the presence of subsidies, on the purchase of commercial fertilizers. We hypothesize that initial household characteristics, assets, access to subsidized fertilizers and economic activities influence the extent to which households afford commercial fertilizers. The paper is organized into four sections. The next section provides a review of literature on graduation from social protection in general, and agricultural input subsidies in particular. Section 3 outlines the methodology and the estimation techniques. Section 4 presents the statistical and the econometric analysis. Finally, section 5 provides concluding remarks.

## 2. Graduation from Input Subsidies and Role of Initial Conditions<sup>1</sup>

The concept of graduation from input subsidies derives from the conceptualisation of graduation in social protection. The concept of graduation in social protection is recent and has been linked to issues of impact, dependency, exit and sustainability in the social protection discourse. It is typical in social protection interventions to raise issues of the extent to which the financial transfers to beneficiaries enable them to exit from the programme of assistance and hence reduce the scope of social protection over time. The issue of graduation from social protection also arises due to the need to avoid 'dependency syndrome' among the beneficiaries (Devereux 2010). There are two ways of conceptualising graduation in social protection: threshold graduation and sustainable graduation. Traditionally, graduation from social protection has been conceptualized as threshold graduation which is concerned with assisting the poor and vulnerable households to move out of poverty by enabling them to cross some sought of income or asset thresholds. As Sabates-Wheeler and Devereux (2011) note, this concept of graduation has preoccupied development discourse on the role of social protection programmes in poverty reduction. The literature on poverty traps emphasize the importance of accumulation of assets as one way to sustainable mobility out of poverty (Carter and Barrett 2006; Carter

and May 2001; Adato et al. 2006). Barrett et al. (2006) argue that because assets generate incomes for households, asset dynamics underpin structural income dynamics. Carter and Barrett (2006) argue that with low assets households earn low returns on their asset holdings, which perpetuates their poverty because they earn less investible surplus after meeting their immediate consumption needs. It is argued, therefore, that for sustainable poverty reduction the poor need to accumulate assets beyond certain 'thresholds'. Sabates-Wheeler and Devereux (2011) argue that this implies that thresholds for achieving independent sustainable livelihoods cannot be defined in terms of (essentially arbitrary) income poverty lines, but by the crossing of asset and income thresholds associated with poverty traps. Nonetheless, the 'traditional' definition of graduation – crossing some threshold level – is inadequate as it does not consider issues of resilience against shocks (Sabates-Wheeler and Devereux 2011). For instance, some households cross the threshold level, but their livelihood activities cannot withstand moderate shocks, thereby pulling them back into eligibility for social protection. This suggests that crossing a threshold of income or assets is a necessary but not sufficient condition for sustainable graduation from social protection programmes linked to livelihoods.

An alternative view is to conceptualize graduation from social protection as sustainable graduation that focuses on resilience to shocks. Several definitions of sustainable graduation exist in the literature. Holmes and Slater (2008), for instance, define graduation from social protection as 'the movement of households from a state of high vulnerability to shocks and stresses to one of increased resilience to such shocks and stresses, increased investment in productive assets and subsequent improved livelihood security'. Devereux (2010) further notes that graduation should be a dynamic concept, sustainable graduation, which embodies increased capacity to generate future streams of income and resilience against future shocks. Slater (2009) also argues that the broad concept of graduation involves poor households moving out of poverty and away from dependency on social protection, to more independent and sustainable livelihood activities. All of these concepts emphasize movement of households to a livelihood that is also resilient to various shocks. Dorward et al. (2011) argue that another useful way of conceptualising graduation is the use of social protection transfers to achieve a shift in livelihood activities with 'stepping up' (intensification and increased productivity in existing activities) and 'stepping out' (into new more productive activities), and reduced emphasis on 'hanging in' (avoidance of 'falling down and out').<sup>2</sup> This is related to shifts in emphasis in social protection programmes from welfare oriented safety nets to insurance and resilience based instruments. Graduation is, therefore, viewed as the potential to embark on livelihoods that avoid 'hanging in' without social protection. The expectation is that with the level of assistance, beneficiaries may begin to engage in new livelihood activities by investing some of the transfers in productive activities. It is the incomes earned from these productive investments that will enable

beneficiaries to graduate from social protection. Chirwa et al (2011b) distinguish between potential graduation – a process of being able to pursue an independent sustainable livelihood and actual graduation – in which support is terminated for those that were unable to pursue independent livelihood but households continue successful pursuit of independent livelihoods.

The concept of sustainable graduation can be useful in understanding the potential of the input subsidy programme in promoting sustainable independent livelihoods. Dorward and Chirwa (2011) building on SOAS (2008) characterise the Malawian economy as suffering from a 'low maize productivity trap' whereby large inter-year maize price instability means that fear of low maize prices deter less poor, potential maize surplus farmers from investing in high yielding seeds and inputs for surplus maize production, while fear of high maize prices forces poor, maize deficit farmers to grow as much maize as they can, even though they cannot afford to purchase high yielding seeds and fertiliser. The result is that large amounts of cultivated land in Malawi are used for maize production with very low yields, and this depresses land and labour productivity across the agricultural sector and indeed across the whole economy. Consequent low farm incomes lead to poverty, tie resources into the agricultural sector, and depress both supply and demand for non-agricultural goods and services.

Hence, given high levels of poverty in rural Malawi and high prices of agricultural inputs, the introduction of the agricultural input subsidy programme addresses affordability issues of agricultural inputs among smallholder farmers. SOAS et al. (2008) and Dorward and Chirwa (2011) note that use of inorganic fertilizers on maize among smallholder farmers is constrained by profitability and affordability, due to the experiences of a hungry gap and limited agricultural credit opportunities. With high prices of fertilizers and low maize prices, it becomes unprofitable to grow maize for sale even if efficiency in fertilizer use were to be improved. Higher maize prices may be one way of improving profitability, but such high prices are also bad for most smallholder farmers who are net buyers of maize. Input subsidies, in such cases, by lowering the cost of fertilizers, can address the problems of profitability and affordability.

Agricultural input subsidies are likely to have different impacts on different types of households. In order to assess the graduation potential from agricultural input subsidies, it is important to understand the impacts of subsidies over time. SOAS et al. (2008) presents a framework for understanding the different direct and indirect impacts of input subsidies on different households in a rural economy, which include increased real incomes which in turn lead to greater farm and non-farm investment. For example, growing real incomes in rural areas are likely to lead to increased demand for locally produced goods and services. However, depending on the type of households, input subsidies can lead to resale of subsidy vouchers from those who are unlikely to redeem them or to use in their farming activities by households that can afford the redemption fees. In

addition, some coupons can be mis-targeted to farmers that can afford commercial fertilizers and this can lead to displacement. However, in either case, subsidized fertilizers can lead to increased income and incremental use of fertilizers can lead to increased production. Moreover, real incomes can also lead to increased demand for commercial fertilizers, other agricultural inputs, investments and other goods and services in the rural economy.

Chirwa et al. (2011b) argue that the core requirement for graduation from the subsidy programme is that removal of access to the subsidy programme does not reduce land, labour and capital productivity in maize production. There are a number of 'potential graduation conditions' which are required in some combination as a result of and during the implementation of the FISP for subsequent graduation. These comprise (1) fall in unsubsidised input prices compared to pre-programme prices, (2) reduced requirements for purchase of previously subsidised inputs due to increased efficiency in use, (3) reduced requirements for purchase of previously subsidised inputs due to substitution by cheaper inputs, (4) increase in working capital among poor beneficiary households for cash purchase of previously subsidised inputs, (5) poor beneficiary households' diversification out of maize production through either transfer of land to other high value production use (diversification or stepping out of maize within agriculture) or transfer of land to other user with diversification or stepping out of agriculture into non-farm activities, and (6) access to low cost credit by poor beneficiary households for purchase of previously subsidised inputs (Chirwa et al. 2011b).

The extent to which social protection interventions enable beneficiaries to graduate from social protection programmes depends on many factors including targeting of transfers, the value of the benefits, the duration of access, access to other complementary interventions and initial conditions. Holmes and Slater (2008) argue that 'the prospects for graduation from social protection depend on the conditions in which the poor live, the form and the value of the benefits from social protection'. Sabates-Wheeler and Devereux (2011) also assert that the extent of social protection programmes in reducing poverty are likely to vary with household initial conditions, socio-economic and cultural context and with complex interactions between the different forms of capital. For example, focusing on the fourth 'potential graduation condition' above, the subsidy can help households in increasing their working capital which in turn enables them to buy inputs commercially, but this may largely depend on the initial position of households such as initial household endowments, initial market orientation and experience with productivity-enhancing technologies. The role of initial conditions in explaining changes in economic variables is common in cross-country economic growth regressions (Temple 1998; Booth 1999; Deininger and Okidi 2003; Balisacan and Fuwa 2004; Son and Kakwani 2004; Godoy and Stiglitz 2006; Matita and Chirwa 2011). This literature though has focused on the macro level and has highlighted the importance of initial human capital

(education and health), initial wealth or resource endowments and access to public goods such as road infrastructure in explaining growth.

### 3. Methodology

The potential for graduation in the agricultural input programme is determined by the extent to which access to subsidized fertilizers has contributed to the increase in households' income that enables them to buy commercial fertilizers as an investment in their farming activities. We investigate the differential performance in purchase of commercial fertilizers, given different initial conditions and household commercial purchase positions in the subsidy years. The initial conditions include initial poverty or consumption expenditure, initial household assets and initial purchase of commercial fertilizers. For example, access to subsidized fertilizers by poor households, who initially did not purchase fertilizer, should on average lead to increased purchase of commercial fertilizers (investment in agriculture) through the increased incomes. Our approach is to use both statistical and econometric analysis. In the statistical analysis, we categorize households into different commercial fertilizer purchase positions and establish the links between selected initial conditions and commercial purchase positions for different types of households. In the econometric analysis, we adapt Devereux et al. (2006) and Giesbert and Schindler (2010) models and evaluate how the subsidy impacts on changes in the demand for commercial fertilizers. We specify the following econometric model:

$$\Delta CF_i = \alpha_0 + \alpha_1 QCOF05_i + \sum_j \beta_j POV05_{ij} + \lambda FISP_i + \sum_k \gamma_k X_{ij} + \varepsilon_i \quad (1)$$

where  $CF_i$  is the change in the demand for commercial fertilizers for household  $i$ ,  $QCOF05_i$  is the initial quantity of commercial fertilizer in 2005 for household  $i$ ,  $POV05_{ij}$  is the wealth indicator including initial poverty or assets or income of household  $i$  in initial income group  $j$  in 2005,  $FISP_i$  is a dummy variable representing receipt of subsidized fertilizers by household  $i$  in 2008,  $X_{ij}$  is a vector of initial household level conditions and time-varying policy variables including sex of household head, education of household head, land size, participation in labour market, operation of business enterprises and access to infrastructure.

Our indicator of potential graduation from the subsidy programme is the increase in the purchase of commercial fertilizers, measured as the change in the amount of commercial fertilizer purchased by households. The changes in commercial purchase of fertilizers are computed as the difference between commercial fertilizer purchased in 2008/09 season and the total fertilizer used by the household in 2004/05 season, measured in kilograms. In 2004/05, there was no subsidy programme and it can be assumed that all the fertilizers used by households in the season were from commercial sources. Chirwa et al. (2011b) argue that one of the 'potential graduation conditions' from the subsidy programme is an increase in working capital among poor beneficiary households for cash purchase of previously subsidised

inputs; hence understanding participation in the commercial fertilizer market is important in making judgements about prospects of graduation from the subsidy programme.

We group initial conditions into household composition, wealth characteristics, market characteristics and access to infrastructure. The household composition variables include dummy variable for sex of the household head, number of adult equivalents as a measure of household size and number of years of schooling of the household head in 2005. Since purchase of fertilizer is a technology choice, we expect older household heads to be reluctant to adopt technologies and educated households to be more receptive to increasing their use of fertilizers. The number of adult equivalents also represents the available family labour resource that can be used in management of farming activities.

The wealth characteristics in the model include expenditure per capita or poverty status, value of crops grown in 2005 representing initial agricultural output, value of household assets in 2005, land size in hectares in 2005 and quantity of fertilizers in kilograms used in 2005. Expenditure per capita and value of household assets are measured in US dollars. Higher initial per capita expenditure or being non-poor and value of household assets are expected to be associated with an increase in purchase of commercial fertilizers, other things being equal. However, higher initial use of fertilizer may be consistent with the negative convergence in the growth literature where we expect the increase in the use of the factor at higher levels to be lower than when resources are initially low.

We include four variables representing participation in various markets. First, we identify four types of households based on their participation in the commercial fertilizer input market. Type 1 households are those that did not purchase fertilizer in 2005, 2007 and 2008. Type 2 households did not purchase in 2005 but purchased either in 2007 or 2008. Type 3 households purchased in 2005 but did not purchase either in 2007 or 2008. Type 4 households purchased commercial fertilizers in all three seasons. Secondly, some of the households receive remittances which can be used to purchase fertilizers. We capture receipt of remittances by a dummy variable equal to 1 for households that received remittances in 2005. Thirdly, participation in the labour market is represented by a dummy variable equal to 1 if the household had at least one member who participated in the labour market in 2005. On one hand, labour earnings may enhance affordability for commercial fertilizers but on the other hand, participation in the labour market may imply that the household does not rely on agricultural production to derive livelihoods. Fourthly, we include the operation of business enterprises, represented by a dummy variable equal to 1 if the household had at least one member who operated a business enterprise in 2005. Similar to labour participation, business income can be used to invest in agricultural production thereby enhancing affordability of commercial fertilizers, but it may also be an indicator of

non-participation in agricultural production, hence stepping-out of agriculture.

We also control for access to public goods and services with implications for agricultural development. Access to public goods and services is also important in the extent to which households purchase commercial fertilizers. This category of variables includes access to subsidized fertilizers in 2008 measured as the predicted probability that a household received subsidized fertilizers<sup>3</sup>, access to extension services in 2005, distance to a tarmac road from the community in 2005, availability of an ADMARC market in the community in 2005 and availability of a public phone in the community in 2005. Access to subsidized fertilizers can either reduce purchase of commercial fertilizers for households that could afford (crowding out commercial purchases) or can introduce the technology to farmers who have not used fertilizer before and start purchasing commercial fertilizer from increased agricultural incomes. We expect access to extension services to be positively related to the change in purchase of commercial fertilizers, with better farm management leading to higher productivity thereby providing incentives for further investments in inputs. Availability of ADMARC is expected to reduce the purchase of commercial fertilizer since ADMARC has only been distributing subsidized fertilizers in the subsidy years and given that the private sector input suppliers have rarely participated in the retail of subsidized fertilizers (Dorward and Chirwa, 2011). We introduce interaction variables of predicted access to subsidized fertilizer with household commercial fertilizer buying positions in order to control for differential effects of household behaviour. Thus, we investigate whether access to subsidies by different household types affected their purchase positions compared to households without access to subsidized fertilizers within the same types of households. We also control for district level variation in purchase of commercial fertilizers by including district level dummies.

The analysis in this study uses quantitative data from a panel of households that have been surveyed since 2004/05. Quantitative data are available from three panels of households that have been followed from 2004/05, 2006/07 and 2008/09 agricultural seasons. The 2004/05 season is taken as the baseline year, a season prior to the implementation of the agricultural input

subsidy programme. The sub-sample for 2008/09 survey was drawn from the 2004/05 sample, implying that we have a good number of matched panel households. The quantitative analysis therefore exploits panel data for 2004/05 and 2008/09 agricultural seasons consisting of 1,223 households.

## 4. Results and Discussion

### 4.1 Descriptive Analysis

One of the constraints that the subsidy programme addresses is affordability of commercial fertilizers by smallholder farmers. It is expected that the increase in agricultural output should enable some of the smallholder farmers to afford commercial fertilizers. However, with the possibility of poor targeting, subsidized fertilizers may also lead to low demand for commercial fertilizers where households that could afford are targeted for subsidized inputs. In order to analyse the household fertilizer purchasing position and their transitions, we divide households into four groups. We investigate the relationship between household's initial commercial fertilizer purchase position and the demand for commercial fertilizers in subsidy years. Table 1 characterizes different households into four categories on the basis of their initial commercial fertilizer buying behaviour and their behaviour in the subsidy years. We find that 28 percent of households have never bought commercial fertilizers, 6 percent did not buy fertilizer in 2005 but subsequently bought commercial fertilizer in 2007/08 and 2008/09, 51 percent bought commercial fertilizer in 2004/05 and intermittently bought commercial in 2007/08 and 2008/09 season, and 14 percent have consistently bought commercial fertilizers between 2004/05, 2007/08 and 2008/09 seasons. In the first type of households that did not buy any fertilizers in all three seasons, 45 percent and 55 percent of households received subsidized fertilizers in 2007 and 2008, respectively. There is also an increase in the average amount of subsidized fertilizer received in 2008 by 25 percent from the amount received in 2007. The second group never bought commercial fertilizers in 2005 but bought fertilizer either in 2007 or 2008. For this group, the amount of commercial fertilizers purchases has been increasing since 2005. At the same time, the proportion of households receiving subsidized fertilizers and the

**Table 1 Household Commercial Fertilizer Position 2005 – 2008 (All Households)**

Household Commercial Fertilizer Position	N	Mean Quantity of Commercial Fertilizer (kg)			Proportion Receiving Subsidy (%)		Mean Quantity of Subsidy Fertilizer (kg)	
		2005	2007	2008	2007	2008	2007	2008
Never bought in 2005, 2007 & 2008	346	0.0	0.0	0.0	45.09	55.49	34.1	42.5
Never bought in 2005 but in 2007 or 2008	72	0.0	89.6	127.1	47.22	61.11	36.5	50.0
Bought in 2005 & in 2007 or 2008	628	154.0	5.3	15.1	67.04	75.16	51.3	58.7
Bought in 2005, 2007 & 2008	177	485.3	238.0	212.2	71.19	81.36	57.3	63.6
<b>All households</b>	<b>1,223</b>	<b>149.3</b>	<b>42.5</b>	<b>45.9</b>	<b>60.26</b>	<b>69.66</b>	<b>46.4</b>	<b>54.3</b>

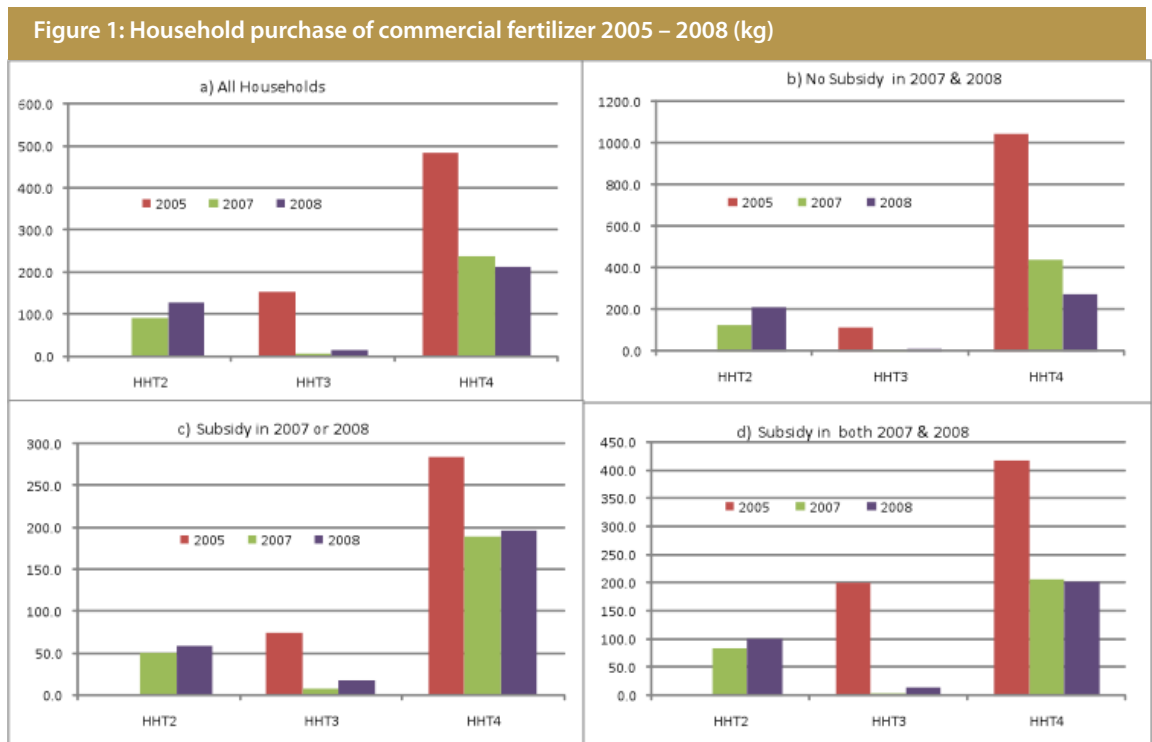
amount of subsidized fertilizers also increased between 2007 and 2008. This second group tends to buy more commercial fertilizer than their receipt of subsidized fertilizers.

The third group bought fertilizer in 2005 and bought fertilizer either in 2007 or 2008 – hence bought one in the two seasons – intermittent buyers of commercial fertilizers. They initially start with about 3 bags of 50 kilograms, but their purchase of fertilizers in the subsidy years dramatically falls although the amount received from subsidy remains less than their initial purchase position. Similarly, the proportion receiving subsidies and the amount of subsidized fertilizer between the two subsidy years increases.

The fourth group constitutes households that have always been buying fertilizers in 2005, 2007 and 2008. The average amount of fertilizer prior to the subsidy is about 9 bags of 50 kilograms fertilizers, but their commercial purchases dramatically fall in the subsidy

This is consistent with earlier findings such as SOAS et al. (2008) and Chirwa et al. (2011a).

Figure 1 presents the household commercial fertilizer purchase position by receipt of subsidized fertilizers in 2007 and 2008. Households that never received subsidies in both years are presented in (b), those that had access to subsidized fertilizer either in 2007 or 2008 in (c) and households that had access to subsidies in both years (2007 and 2008) in (d). It is interesting to note that households not subsidized with zero initial fertilizer, their purchasing position of commercial fertilizers has increased while for those that initially purchased fertilizer in 2005 their purchasing position has substantially declined in the subsidy years. Looking at the intermittent buyers of commercial fertilizers, there is a marginal improvement for household type 2 but a substantial decline for household type 3 and 4. Similar results are obtained for households that always bought fertilizer before and during fertilizer subsidisation.



**Note:** HHT2 = Never bought in 2005 but in 2007 or 2008, HHT3 = Bought in 2005 and either in 2007 or 2008 (intermittent buyers) and HHT4 = Bought in all years.

years to 4 bags of 50 kilograms, although they tend to complement this with about 1 bag of 50 kilograms. Both the proportion of households receiving subsidized fertilizers and the amount of subsidized fertilizers has increased between 2007 and 2008. More generally, we observe that the more commercial orientation of fertilizer purchases in the period prior to subsidization, the higher the proportion of households receiving subsidized fertilizers and the higher the average amount of subsidized fertilizer received by households. This suggests that the better-off, those that could afford commercial fertilizers were more likely to receive subsidized fertilizers.

Figure 2 shows the household commercial fertilizer purchases by the NSO (2005) categorisation of households into non-poor and poor. Among households that were poor in 2005 and never bought fertilizer in 2005, there is a marginal increase in their purchase of fertilizer to 50 kilograms. There is also a substantial reduction in commercial fertilizer for households that bought fertilizer in 2005 and have continued to buy commercially in the subsidy years. For households that were not poor in 2005, we see a similar pattern to those that did not purchase fertilizers in 2005 (HHT2), purchased and increased the commercial volumes in the subsidy years, while for the intermittent buyers and regular buyers the purchased

Figure 2: Household commercial and subsidy fertilizer by poverty status 2005 – 2008 (kg)



**Note:** HHT1 = Never bought fertilizer in all years, HHT2 = Never bought in 2005 but in 2007 or 2008, HHT3 = Bought in 2005 and either in 2007 or 2008 (intermittent buyers) and HHT4 = Bought in all years.

Table 2: Initial conditions by household fertilizer purchase behaviour

Initial condition variables	HHT1	HHT2	HHT3	HHT4	All
Poor in 2005 (0/1)*	0.5260	0.5139	0.4952	0.3390	0.4824
Ultra poor in 2005 (0/1)*	0.1821	0.2361	0.1863	0.1073	0.1766
Marginal poor in 2005 (0/1)*	0.3439	0.2778	0.3089	0.2316	0.3058
Log per capita expenditure in 2005 (\$)	3.8844	4.8611	4.3710	6.6384	4.5904
Household head years of schooling in 2005	4.4239	4.3157	4.4073	4.6092	4.4358
Log of agricultural output in 2005 (MK)	8.4345	7.6728	9.3002	10.144	9.0816
Burley tobacco produced in 2005 (kg)	185.63	160.67	305.98	791.75	453.61
Commercialisation index in 2005	0.1557	0.1869	0.1612	0.2312	0.1713
Number of adult equivalents in 2005	3.8878	4.3407	4.1589	4.6895	4.1697
Log of value of durable assets in 2005 (\$)	1.4557	2.3103	1.8867	3.6602	2.0464
Log of land size in hectares in 2005 (hectares)	-1.1171	-2.1063	-0.0315	0.2999	-0.4128
Received extension advice in 2005 (0/1)*	0.1040	0.1389	0.1736	0.1921	0.1545
Household received remittances in 2005 (0/1)*	0.7254	0.7361	0.7548	0.7627	0.7465
Household participated in labour market in 2005 (0/1)*	0.1590	0.0972	0.1592	0.2090	0.1627
Household operated enterprise in 2005 (0/1)*	0.9942	1.0000	0.9952	1.0000	0.9959
Distance to the nearest tarmac road in 2005 (km)	16.317	25.671	19.161	25.586	19.669
Existence of permanent ADMARC market in 2005 (0/1)*	0.0954	0.2361	0.1688	0.0734	0.1382
Existence of a public phone in community in 2005 (0/1)*	0.0809	0.1111	0.1338	0.1695	0.1226
Number of observations	346	72	628	177	1,223

**Note:** HHT1 = Never bought fertilizer in all years, HHT2 = Never bought in 2005 but in 2007 or 2008, HHT3 = Bought in 2005 and either in 2007 or 2008 (intermittent buyers) and HHT4 = Bought in all years.

\* (0/1) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category.



volumes decline in subsidy years. As noted above, the intermittent buyers and regular buyers also tend to have higher average volumes of subsidized fertilizers, suggesting some displacement of commercial sales.

The graphical analysis above has shown that households under type 2 have made substantial investment in commercial fertilizers although initially they did not buy fertilizers, while households in type 1 have never bought commercial fertilizers. Households that bought commercial fertilizers in 2004/05 have experienced a decrease in commercial fertilizers and their annual fertilizer use (subsidized and commercial) fall short of what they used in 2004/05. So what explains the increase in the purchase of fertilizer among households in type 2 compared to other groups of households? Table 2 presents the means of initial conditions by type of initial commercial fertilizer purchase position. Relative to households in type 1 and 3, we note that households in type 2 have higher per capita expenditure; higher values

of durable assets; higher commercialisation index (proportion of crops sold) and have more access to a permanent ADMARC market. However, we also find that households that have increased purchase of commercial fertilizers had initial small land holdings; lower agricultural and burley tobacco production; had a smaller proportion of households with members that participated in the labour market and were much further away from a tarmac road.

## 4.2 Econometric Results

Table 3 presents the descriptive statistics of the variables included in the model. Overall, there was an average decrease of 103 kilograms in commercial fertilizer purchases between 2004/05 and 2008/09 agricultural season by smallholder farmers in Malawi. The data also shows that 75 percent of the households are headed by male members and the average age of household heads is 45 years. Most of the household heads did not complete

**Table 3: Descriptive statistics of variables in the model**

Variable	Mean	Std. Dev	Min	Max
Change in commercial fertilizer (kg)	-103.4	542.5	-5200.0	3400.0
Male headed household in 2005 *	0.7482	0.4342	0.0000	1.0000
Age of household head in 2005 *	45.1733	17.1437	18.000	96.000
Age of household head squared in 2005 *	2334.3	1749.9	324.00	9216.0
Number of adult equivalents in 2005	4.1697	2.0773	1.0000	15.0400
Number of years of schooling of household head in 2005	4.5904	4.0067	0.0000	23.0000
Log per capita expenditure in 2005 (\$)	4.4358	0.6086	2.7194	6.3308
Poor in 2005 *	0.4824	0.4999	0.0000	1.0000
Log of agricultural output in 2005 (MK)	9.0816	1.6888	3.3346	13.1164
Quantity of commercial fertilizer in 2005 (kg)	149.3	571.9	0.0000	5300.0
Household commercial purchase Type 2 *	0.0589	0.2355	0.0000	1.0000
Household commercial purchase Type 3 *	0.5135	0.5000	0.0000	1.0000
Household commercial purchase Type 4 *	0.1447	0.3520	0.0000	1.0000
Log of value of durable assets in 2005 (\$)	2.0464	2.7870	-4.7745	8.0327
Log of land size in hectares in 2005 (hectares)	-0.4128	2.0897	-8.5172	6.9326
Household received remittances in 2005 *	0.7465	0.4352	0.0000	1.0000
Household participated in labour market in 2005 *	0.1627	0.3693	0.0000	1.0000
Household operated enterprise in 2005 *	0.9959	0.0638	0.0000	1.0000
Predicted receipt of subsidized fertilizer in 2008/9*	0.6860	0.4643	0.0000	1.0000
Household Type 2 x Received subsidy in 2008/9 *	0.0335	0.1801	0.0000	1.0000
Household Type 3 x Received subsidy in 2008/9 *	0.3876	0.4874	0.0000	1.0000
Household Type 4 x Received subsidy in 2008/9 *	0.1120	0.3155	0.0000	1.0000
Received extension advice in 2005 *	0.1545	0.3616	0.0000	1.0000
Distance to the nearest tarmac road in 2005 (km)	19.669	25.167	0.0000	137.0
Existence of permanent ADMARC market in 2005 *	0.1382	0.3452	0.0000	1.0000
Existence of a public phone in community in 2005 *	0.1226	0.3282	0.0000	1.0000

**Note:** \* (0/1) indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category.

primary education as reflected by an average 4.6 years of schooling. The average per capita expenditure is MK84 and about 48 percent of households were classified as poor in 2005. There is an increase in the average quantity of subsidized fertilizers received by the household from 46 kilograms in 2007 to 54 kilograms in 2008. About 75 percent of households received remittances in 2005 while only 16 percent had members that participated in the labour market. Nearly all households had members that operated some business enterprise in 2005, indicating diversification of livelihoods among farming households. Access to public goods and services is problematic for most households; only 15 percent had access to extension

services, 13 percent lived in a community with a permanent ADMARC market and only 12 percent lived in an area accessible to a public phone.

Table 4 presents results of ordinary least squares regression on the determinants of absolute changes in commercial fertilizers between 2004/05 season and 2008/09 season. We estimate two models, model 1 and 2, using per capita consumption expenditure and poverty status as initial wealth indicators, respectively. The models explain 91.5 percent of the variations in changes in commercial fertilizers based on R-squared and the F-statistic shows that we reject the null hypotheses that

**Table 4: Determinants of change in purchase of commercial fertilizers**

Dependent Variable: Absolute Change in Commercial Fertilizer (kg)	Model 1		Model 2	
	Coeff.	t-ratio	Coeff.	t-ratio
Male headed household in 2005 *	-0.2510	-0.03	-1.1760	-0.15
Age of household head in 2005 *	-2.2197	-2.12 <sup>b</sup>	-2.1023	-1.98 <sup>b</sup>
Age of household head squared in 2005 *	0.0173	1.79 <sup>c</sup>	0.0161	1.64
Number of adult equivalents in 2005	10.3900	2.53 <sup>b</sup>	9.0588	2.36 <sup>b</sup>
Number of years of schooling of household head in 2005	0.3580	0.25	0.4925	0.34
Log per capita expenditure in 2005 (\$)	23.0538	2.47 <sup>b</sup>	-	-
Poor in 2005 *	-	-	-20.3601	-1.72 <sup>c</sup>
Log of agricultural output in 2005 (MK)	11.3035	1.73 <sup>c</sup>	11.9872	1.83 <sup>c</sup>
Quantity of commercial fertilizer in 2005 (kg)	-0.9272	-29.3 <sup>a</sup>	-0.9270	-29.2 <sup>a</sup>
Household commercial purchase Type 2 *	86.3389	3.35 <sup>a</sup>	82.2296	3.23 <sup>a</sup>
Household commercial purchase Type 3 *	-1.0355	-0.14	-1.2668	-0.17
Household commercial purchase Type 4 *	156.497	3.18 <sup>a</sup>	157.378	3.21 <sup>a</sup>
Log of value of durable assets in 2005 (\$)	-0.1317	-0.09	0.0784	0.06
Log of land size in hectares in 2005 (hectares)	-10.9124	-4.09 <sup>a</sup>	-11.3325	-4.20 <sup>a</sup>
Household received remittances in 2005 *	-16.5048	-1.17	-16.1476	-1.13
Household participated in labour market in 2005 *	-20.8126	-2.12 <sup>b</sup>	-20.4330	-2.02 <sup>b</sup>
Household operated enterprise in 2005 *	36.5396	2.14 <sup>b</sup>	34.0500	2.06 <sup>b</sup>
Predicted receipt of subsidized fertilizer in 2008/9*	-10.4110	-1.34	-8.7375	-1.13
Household Type 2 x Received subsidy in 2008/9 *	52.9995	0.72	54.9475	0.74
Household Type 3 x Received subsidy in 2008/9 *	4.8578	0.56	3.2415	0.39
Household Type 4 x Received subsidy in 2008/9 *	-7.8238	-0.13	-10.2241	-0.17
Received extension advice in 2005 *	6.6310	0.45	7.3590	0.50
Distance to the nearest tarmac road in 2005 (km)	0.5494	2.02 <sup>b</sup>	0.5566	2.03 <sup>b</sup>
Existence of permanent ADMARC market in 2005 *	-26.0149	-2.60 <sup>a</sup>	-24.7344	-2.52 <sup>b</sup>
Existence of a public phone in community in 2005 *	-7.9699	-0.79	-9.2356	-0.90
District Dummies	Yes	-	Yes	-
Constant	-222.038	-3.61 <sup>a</sup>	-111.991	-1.91 <sup>c</sup>
Number of observations	1223		1223	
F( 32, 1190)	114.16		114.39	
Prob > F	0.000		0.000	
R-squared	0.9234		0.9232	

**Note:** The estimates use heteroscedasticity-consistent standard errors. Superscripts a, b and c denote statistically significant at 1%, 5% and 10% level, respectively. \* indicates dichotomous variable equal to 1 for the included category, otherwise equal to 0 for the base category.

the coefficients are all equal to zero. The results from the two specifications are similar and we focus our analysis on the first model.

Of the initial household composition variables, we find age of household head and number of adult equivalents as important determinants of changes in commercial fertilizer purchases. With respect to age of household head the coefficient of age is negative and that of age squared is positive and statistically significant at the 5 percent and 10 percent levels, respectively. This shows that as the initial age of household head increases commercial purchases of fertilizers decline. Ricker-Gilbert et al. (2010) also found a similar negative relationship although statistically insignificant. One argument for this negative relationship is that older household heads might have traditionally been farming without fertilizers and have little incentive to invest in commercial fertilizer other than use of fertilizers provided under the subsidy programme. The coefficient of the number of adult equivalents is positive and statistically significant at the 5 percent level. There may be two forces driving this relationship. First, large family sizes require more productive agriculture in environments of land scarcity, thereby motivating households in investing in productive ways of agriculture such as purchase of commercial fertilizers. Secondly, since most of the farming among smallholder farmers uses family labour in Malawi, larger households may have the necessary labour to manage farming activities that maximize returns from fertilizer applications, such as timely weeding and application of fertilizers.

Most of the wealth indicators are significant determinants of absolute changes in purchases of commercial fertilizers. First, per capita expenditure and poverty status show that high initial incomes are positively related to changes in commercial purchases of fertilizers. The coefficient of per capita consumption expenditure is positive and statistically significant at the 5 percent level. This shows that an increase in per capita consumption by about \$2.7 leads to an increase of 23 kilogram of commercial purchase of fertilizers. Similarly, in model 2, the results show that being poor decreases commercial purchase of fertilizers by 20 kilograms. Secondly, initial agricultural output also matters with the coefficient being positive and statistically significant at the 10 percent level. Thirdly, the quantity of commercial fertilizers in 2005 is negatively associated with changes in commercial purchases of fertilizers and the coefficient is statistically significant at the 1 percent level. This relationship may be consistent with the convergence in endogenous growth theories, in which greater changes in input use may be expected at lower levels than at higher levels of output. Finally, the coefficient of land size is negative and statistically significant at the 1 percent level, with households with higher initial land holding reducing their purchase of commercial fertilizers.

With respect to market participation variables, the results show that initial participation in the labour market and enterprise operation are significant determinants of changes in commercial purchase of fertilizers. On one

hand, initial participation in the labour market is negative and the coefficient is statistically significant at the 5 percent level. The results show that participation in the labour market reduces purchase of commercial fertilizers by 20 kilograms. These may be households that might have been diversifying away from agricultural production. On the other hand, households that had members operating a business enterprise were more likely to increase their purchase of commercial fertilizers. Given that almost all farming households in the sample are engaged in business activities, it can be argued that the incomes from business operations enhance affordability of commercial fertilizers. With respect to households' participation in the commercial fertilizer market, type 2 and type 4 households have higher average changes in commercial fertilizer compared to type 1 households, with the coefficients being statistically significant at the 1 percent level.

In terms of access to public goods and services, the results show that access to fertilizer subsidy in 2008/09 season, distance to tarmac road and existence of a permanent ADMARC market in 2005 are important initial factors affecting the purchase of commercial fertilizers. The coefficient of predicted access to subsidized fertilizer in 2008 is negative but statistically insignificant. There is also no statistically significant evidence that different types of households that had access to subsidized fertilizers behaved differently from those without access to subsidized fertilizers. These results are consistent with recent findings that displacement of commercial fertilizer sales declined in 2008 (Ricker-Gilbert 2010) compared to the 20–30 percent noted in 2006/07 (SOAS et al. 2008; Ricker-Gilbert et al. 2010). The distance to tarmac road from the community is positively associated with purchase of commercial fertilizers and the coefficient is statistically significant at the 5 percent level. This is rather surprising since distance should lead to high cost of fertilizers due to high transaction costs, and these results are contrary to the finding by Ricker-Gilbert et al. (2011). However, it may also be the case that communities far away from all weather roads are poorly serviced by the state-owned retailer of subsidized fertilizers – ADMARC – but we speculate that these areas far from the tarmac road are serviced by small scale agro-input traders excluded from the subsidy programme.<sup>4</sup>

The results show that the presence of ADMARC in the community tends to reduce commercial purchase of fertilizers by 26 kilograms. ADMARC only sells subsidized fertilizers and in areas where there are no private retail input suppliers, households that would have bought commercial fertilizers do not have access to such markets.<sup>5</sup> With the exception of the 2006/07 and 2007/08 seasons, the private sector which sold both subsidized and unsubsidized fertilizers, has been excluded in the retailing of subsidized fertilizers. The results suggest that the policy of restricting retailing of subsidized fertilizer to state-owned retailers that only carry subsidized fertilizers, and exclusion of the private sector in the subsidy programme, is detrimental to the development of private input market development and to promoting demand for commercial fertilizers. Due to absence of commercial

fertilizers in ADMARC markets, those with coupons requiring additional fertilizers have to face extra costs of procuring commercial fertilizer in private input outlets that are usually in areas with better access, such as peri-urban areas.

## Conclusion

Malawi started implementing a national agricultural input subsidy programme in the 2005/06 agricultural season, targeted at resource poor smallholder farmers using a voucher system. The main objective of the programme is to improve agricultural productivity, particularly maize productivity, in order to raise the incomes and food security in Malawi. The programme reaches more than two-thirds of rural farming households, in which each targeted farmer gets two fertilizers vouchers to purchase 2 bags of 50 kilograms of fertilizers mainly for maize at a reduced price equivalent to less than one third of the commercial price of fertilizers. Some of the farmers also receive 2 to 3 kilograms of improved maize seeds. However, the concept of graduation from the input subsidy programme has been silent in the design and implementation, with some households receiving the subsidy once (termination) while other receiving every year but with benefits deeply diluted with the average receipt of one coupon per household.

This paper set out to investigate the role of initial conditions on changes in commercial purchases of fertilizers. Commercial purchases of fertilizers is one of the indicators of conditions that can enable farmers graduate from the subsidy programme through increase in working capital, as they improve productivity and incomes through participation in the subsidy programme. Using panel data between 2004/05 season and 2008/09 season, we distinguish households into four groups based on fertilizer purchasing position, we find that 28 percent of households have never bought commercial fertilizers, 6 percent did not buy fertilizer in 2005 but subsequently bought commercial fertilizer in 2007/08 and 2008/09, 51 percent bought commercial fertilizer in 2004/05 and intermittently bought commercial in 2007/08 and 2008/09 season, and 14 percent have consistently bought commercial fertilizers between 2004/05, 2007/08 and 2008/09 seasons. We also find that households that have always participated in the commercial fertilizer market are highly subsidized (81 percent) compared to households that have never participated in commercial fertilizer market (55 percent) in 2008/09 season. One interesting observation is that the group that never bought in 2005 but bought in 2007/08 and 2008/09 show improvements in purchase

of commercial subsidies in subsidy years, while for those that initially bought fertilizer commercially in 2004/05 their commercial fertilizer purchases have been declining after participation in the subsidy programme. Compared to the group that has never participated in the commercial fertilizer market, the group that subsequently participates in the commercial market tends to have higher initial incomes, higher initial assets, low participation in the labour market and lives in a community with a permanent ADMARC market.

The econometric results of changes in commercial fertilizers among rural households in Malawi reveal that initial conditions matter in stimulating demand for commercial fertilizers and these have implications for creating conditions for potential graduation from subsidies. The results reveal that older farmers and those located in communities with a permanent ADMARC market are unlikely to purchase more commercial fertilizers. There is also negative convergence between changes in commercial fertilizers, and land size and initial commercial fertilizers. However, changes in commercial fertilizers are positively associated with a larger pool of initial family labour, higher initial income and distance to a tarmac road from the community. We also find that households that did not initially purchase but subsequently purchased commercial fertilizers and those that have always purchased commercial fertilizers tend to increase their purchase of commercial fertilizers. However, we find no statistically significant evidence that subsidies reduce commercial fertilizers and receiving subsidies does not have significant effects on households' commercial fertilizer purchase position.

The results point to several policy implications and on prospects of graduation from the subsidy programme. First, targeting subsidies at elderly-headed households may have little prospects of graduation from the subsidy programme as commercial demand is unlikely to be stimulated. Hence, such households may have lower prospects of graduation from such a social protection instrument. The current targeting criteria encourage the targeting of elderly headed households. Secondly, the poor and those with low per capita expenditures are also unlikely to graduate from subsidies as they are unlikely to be able to afford commercial fertilizers. This suggests that it may be the middle and more productive households that have high prospects of graduation from a subsidy programme. Thirdly, the study suggests that stimulation of private marketing through reduction in the presence of state-owned marketing agencies or through allowing the participation of the private sector in retailing of subsidized fertilizers can stimulate more commercial purchases and therefore create better conditions for graduation from the subsidy programme.

## End Notes

- <sup>1</sup> This section draws heavily on Chirwa et al. (2011b).
- <sup>2</sup> See Dorward et al. (2006) and Dorward (2009) for a detailed discussion of 'hanging in', 'stepping out' and 'stepping up' concepts.
- <sup>3</sup> Ricker-Gilbert et al (2010) notes that subsidized fertilizers are likely to be endogenous to commercial fertilizers purchases partly due to substantial variations in targeting criteria. In order to deal with endogeneity, we instrumented access to subsidy by the community variable of open system of allocating subsidized coupons in the first stage probit model. We created a dummy variable equal to 1 if the predicted probability of obtaining subsidized fertilizer was greater or equal to 0.5, otherwise equal to zero.
- <sup>4</sup> The 2004/05 data do not have information on the presence of private sector input suppliers in the community. The presence of such data could have allowed us to explore this issue further in our analysis.
- <sup>5</sup> We interacted distance to the tarmac road and presence of ADMARC in the community; distance to tarmac road remained significant and positive while presence of ADMARC was not significant and the interaction variable was negative but weakly significant at the 10 percent level.

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This **Working Paper** was written by **Ephraim W. Chirwa, Andrew Dorward and Mirriam Matita** for the **Future Agricultures Consortium**. The series editors are **Beatrice Ouma and Elaine Mercer**. Further information about this series of Working Papers at: **[www.future-agricultures.org](http://www.future-agricultures.org)**

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FAC appreciates the support of the  
UK Department for International Development (DFID)

