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Who Is Vouching for the Input Voucher?

Decentralized Targeting and Elite Capture in Tanzania

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Abstract

Input subsidy programs carry support as instruments to increase agricultural productivity, provided they are market-smart. This requires especially proper targeting to contain the fiscal pressure, with decentralized targeting of input vouchers currently the instrument of choice. Nonetheless, despite clear advantages in administrative costs, the fear of elite capture persists. These fears are borne out in the experience from the 2008 input voucher pilot program in Kilimanjaro, Tanzania, examined here. Elected village officials received about 60 percent of the distributed vouchers, a factor that significantly reduced the targeting performance of the program, especially in more unequal and remote communities. When targeting the poor, greater coverage and a focus on high trust settings helped mitigate these concerns. The findings highlight the continuing need for scrutiny when relying on decentralized targeting. A clearer sense of purpose (increasing productivity among poorer farmers versus increasing aggregate output) could also enhance the targeting performance.

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Who Is Vouching for the Input Voucher? Decentralized Targeting and Elite Capture in Tanzania

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1 The Challenge of Targeting

Following the widely acclaimed success of Malawi's large scale agricultural input subsidy program,[2] input subsidies are now also endorsed by the donor community as a way to boost smallholder productivity, provided the programs are "market-smart" (World Bank, 2007; Dorward, 2009). Market-smart input subsidies are part of a broader productivity enhancement program, have clear exit strategies, and most importantly, they are carefully targeted at overcoming market failures.[3] Especially credit and insurance markets are often absent or incomplete, but input markets may also need an initial (demand) push to help input providers overcome high initial distribution costs and achieve economies of scale.

There are many ways to target transfers (Coady, Grosh, Hoddinott, 2004). When it comes to targeting input subsidies, it is the decentralized distribution of input vouchers that has become the vehicle of choice. Vouchers entitle farmers to buy modern inputs (usually fertilizer and improved seeds) from participating input retailers at a subsidized price. Distribution of the vouchers to the beneficiary farming households is delegated to different levels of government, whereby geographic targeting—the selection of districts and villages within districts based on their agro-ecological potential—is often combined with community based targeting—the selection of beneficiaries within the village by the community.

Decentralized targeting is also frequently applied in anti-poverty interventions and safety net programs (Grosh, del Ninno, Tesliuc, and Ouerghi, 2008). It seeks to exploit the privileged knowledge local governments and communities have about the conditions of the beneficiaries to reduce the administrative cost of targeting. It assumes that local leadership is

[2] See Dorward and Chirwa (2011) for a comprehensive review.

[3] Universal input subsidies, popular from the mid 70s to the early 90s, have not only proven to be fiscally unsustainable, larger farmers, who usually already have the know how and finance to use and purchase inputs, do not need them to adopt modern inputs. Subsidizing them would likely only outcrowd demand for commercial fertilizer (Rickert-Gilbert, Jayne, and Chirwa, 2011) and come at a particularly high opportunity cost, including investments in public goods such as research and development and rural infrastructure.

more likely to act in the interest of the beneficiaries than central governments, as local leaders are likely to be held more accountable by their local constituencies, who have difficulties monitoring a distant central government.

Nonetheless, elite capture of the benefits of poverty programs remains a real concern and the empirical evidence so far has been mixed (Mansuri and Rao, 2004). Alderman (2002) and Faguet (2004) report that decentralization of development programs improved the targeting toward the poor in Albania and Bolivia respectively, while in Bangladesh's decentralized Food-for-Education Program, within village allocation of funds appears more pro-poor than allocation across villages (Galasso and Ravallion, 2005). Park and Wang (2010) on the other hand find that China's community based development program—its flagship poverty alleviation program—only increased the incomes of the better off in each village, and not these of the poor and Platteau (2004) shows that the local elite took control of social fund expenditures in West Africa.

Several factors have been advanced to explain the likelihood of elite capture in different contexts, including political factors such as the local power structure (Bardhan and Mookherjee, 2006) and levels of awareness (Bardhan and Mookherjee, 2000), economic factors such as income level and poverty (Galasso and Ravallion, 2005), social factors such as community homogeneity (Seabright, 1996) as well as design features of the program such as the size of the program (Galasso and Ravallion, 2005), the official eligibility criteria and whether the program concerns distribution of public or private goods (Araujo et al., 2008). Yet, no clear-cut insights have emerged so far about the conditions under which decentralized targeting is likely to be more successful.

Clearly, the popularity of decentralized targeting of input vouchers contrasts with the continuing concerns about elite capture reported in the literature and the poor understanding of the conditions under which it is likely to work better. Whether these concerns are also

valid when targeting input vouchers, and if so, under which conditions, is an important empirical question for the input voucher debate as well as for the decentralized targeting literature more broadly, which has so far featured few studies from African settings and has largely focused on studying targeting performance with respect to reaching the poor. This study contributes to filling this void and empirically examines the targeting performance of the input voucher program introduced in Kilimanjaro by the Government of Tanzania in the 2008/9 farming season.

As Wiggins and Brooks (2010) highlight, input voucher programs (implicitly or explicitly) often pursue a dual objective—boosting aggregate output and raising incomes among poor smallholders.[4] To increase agricultural productivity among poor smallholders input vouchers should be aimed at poorer farmers who are most likely to meet market failures in the credit and insurance markets (Dercon and Christiaensen, 2011). However, to boost aggregate output vouchers should be directed to farmers with the highest marginal productivity. Both groups do not necessarily coincide and the performance of community based targeting may well depend on the yardstick used. If so, this would bring an important additional insight to the broader literature on decentralized targeting. Elite capture may for example deteriorate the targeting performance of community based targeting if poverty is the criterion, but not necessarily so when marginal productivity is the yardstick.

Overall, in this study, elected village officials, who can be seen as members of the local elites, receive about 60 percent of the distributed vouchers and multivariate analysis confirms that being a member of the local elite, significantly increases the likelihood of receiving a voucher. Follow up analysis of the targeting performance, shows that local elite

[4] The former can also finds its justification in a market failure, i.e. the failure by the individual to capture the economy wide effects of lower food prices. If implemented at a sufficiently large scale, input subsidies can substantially increase production. Where staples are non-tradable, this can reduce staple crop prices and induce another round of income growth off the farm, given strong linkage effects through back and forward linkages (Haggblade, Reardon, and Dorosh, 2007). Such linkage effects have been documented to be still important in Africa (Henderson, Storeygard, and Weil, 2009).

capture substantially reduces the targeting performance of the program, irrespective of the targeting criterion used (poverty, marginal productivity or induction of new input users). This lends credence to the lingering concerns in the literature on decentralized targeting about elite capture and its negative effects on targeting performance. These tendencies of elite capture are more pronounced in more unequal and remote communities, while program coverage, as well as trust levels in the village, emerge as important counteracting factors, at least when poverty is the targeting criterion. Overall, the voucher distribution in this study is not fundamentally different from what would have been observed under random/uniform distribution, highlighting the continuing need for scrutiny and selectivity when relying on decentralized targeting in practice. Larger singularity in objective could further help in making input subsidies also market smart on the ground.

The paper proceeds in section 2 by describing how input vouchers are distributed in principle and practice in Tanzania and our sample study, and by characterizing who is more or less likely to receive them. Section 3 begins by introducing the metric to analyze targeting performance, followed by an analysis of the key factors correlated with this performance. Section 4 concludes.

2 Distribution in Practice

The Input Voucher Program in Tanzania

Following the 2007/8 food crisis, the Government of Tanzania launched an input voucher pilot program in 56 districts to increase the production of two of its major staple crops—maize and rice—and enhance its national food security. The program was geographically targeted to areas most suitable for maize and paddy rice production, while also taking into account the number of agricultural households who cultivated less than one hectare of maize or rice. As food prices remained high and volatile in the aftermath of the

crisis, the program was expanded in 2009 to 65 districts to reach 2.5 million households in 2012 (World Bank, 2009). The target areas are concentrated in the Southern Highlands, the Northern Highlands, and the Western Region and focused on agro-ecological zones suitable for the target crops.

The input package distributed consisted originally of three vouchers: 1) one for two bags of urea, 2) one for one bag of Di-ammonium Phosphates (DAP) or two bags of Minjingu Rock Phosphate (MRP) with nitrogen supplement, and 3) one for 10 kilograms of hybrid or open-pollinated maize seeds or 16 kilograms of rice seeds, sufficient for half a hectare of maize or rice. Vouchers for each input had a face value equivalent to 50 percent of the market price of the respective input. The remaining 50 percent was to be paid by the farmers.[5]

The central government allocates the vouchers to the target regions,[6] taking into consideration the total area of maize and rice under cultivation, the regional maize and rice output as well as the soil and rainfall patterns. To distribute the vouchers further voucher committees were established in the seat of the different local government councils.[7] The Regional Voucher Committees estimate the demand for inputs using historical production data and allocate the vouchers to the districts. The District Voucher Committees (DVC) are responsible for the distribution of the vouchers to the villages. They collect and review information about their maize and rice production, their input use, and other related information. Vouchers are then allocated to the selected villages based on the number of farmers who grow maize and rice and the average land size per farmer. The village council, in consultation with the village assembly, organizes the election of the Village Voucher Committee (VVC), which draws up a list of beneficiary farmers for approval by the village assembly.[8] After approval, the VVC

[5] Co-financing posed a problem at times and since 2009/2010, the voucher for urea was reduced to one bag.
[6] In addition to the central government, there are four levels of local government: regions, districts, wards and villages.
[7] See Mniwasa and Shauri (2001) for more details on the government structure in Tanzania.
[8] The village assembly consists of all persons aged 18 and above, while the village council comprises of 15 to 25 members elected by the village assembly. The council consists of a chairperson, all chairpersons of the sub-

issues the vouchers to the approved farmers and also monitors the use of inputs by voucher recipients.

The purported objective of the program is dual: 1) increase overall maize and rice output, and 2) increase access to modern inputs among poor and vulnerable smallholders. Yet, as indicated above, conflicting targeting rules may derive from these dual objectives. To reduce poverty, subsidized inputs should be targeted to the poorer smallholders. If increasing aggregate output is the objective, subsidies should be targeted to those with the highest marginal input productivity. These often include non-users (Rickert-Gilbert, Jayne, and Black, 2009), and may or may not coincide with the poorer farmers.

During the pilot, which forms the basis for our empirical analysis here, the villages were advised to target literate farming households willing to use the input vouchers for the purported crops and able to meet the co-financing requirement. Application of these criteria in most villages would lead to an exclusion of the poorest (those considered unable to co-finance input purchases). However, the rules were not formally presented and enforced, and actual implementation was left to the discretion of the VVC and the village assembly.

They were however further refined and more formally introduced during the expansion of the program in 2009,[9] when it was also formally established that village leaders had to be excluded from the VVCs and that the VVCs needed to have equal representation of men and women. The fertilizer voucher was further reduced to one bag of urea to reduce the required top up and facilitate participation by poorer farmers. Use of the pilot data thus presents an opportunity to analyze how communities identify beneficiaries in less prescribed environments, the extent to which the advice was adhered to, and whether the adjustments in the targeting rules were well advised.

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villages within its area and other members elected by the village assembly. The term of office for all councillors is five years.

[9] One important adjustment was the requirement that the beneficiaries should not be cultivating more than one hectare of maize and rice.

Voucher Beneficiaries in Kilimanjaro

The data used here are from the Vulnerability Household Panel conducted in the Kilimanjaro region of Tanzania in 2003, 2004 and 2009.[10] Kilimanjaro is a well-connected and dynamic coffee growing region located in the Northern Highlands, where maize is an important staple (in addition to bananas). It consisted of 5 districts in 2003 (one district was split up later on) and the sample was designed to be representative for all agricultural households in rural Kilimanjaro. In the first round, conducted in November-December 2003, 954 households were surveyed in 45 villages selected using the probability proportional to size procedure, or about 21 households per village. Households were revisited in November-December 2004 and 2009, with little attrition in 2004 (915 households surveyed), though a significant loss of households in 2009 (772 households interviewed).[11] To correct for under-representation due to attrition of households with certain characteristics, the sampling weights of the remaining households were adjusted, as outlined in more detail in Appendix A1.

Each round the survey comprises a comprehensive community and household survey with most of the modules identical across rounds.[12] The data in the third round capture the results of the 2008/9 agricultural season, which coincides with the input voucher pilot. A special module about the input voucher was added to the household questionnaire, including questions about whether households were determined as eligible, their actual uptake as well as the kinds of vouchers received. The total number of vouchers received by the village was recorded in the community survey.

[10] See Christiaensen and Sarris (2007) for a detailed description of the survey and sampling design.
[11] Some households with only one elderly were lost due to the death of the person. Some households moved out of the village, and some households were not surveyed because they were working far away on their farms.
[12] The community survey collects information about the village governance structure and the demographic, geographical, agro-ecological and socio-economic conditions in the village. The household survey provides information on household demographic characteristics, including educational status and health, agricultural production and sales, non-farm activities and income, consumption, shocks, assets, access to credit and perceptions on trust and empowerment.

Vouchers were distributed in 39 out of the 45 villages and in each of these villages about a quarter of the households received at least one voucher. To shed a first light on the criteria used in practice to identify the beneficiaries, Table 1 divides the sample in three groups: 1) those the village determined non-eligible for the input vouchers; 2) those determined eligible, but who declined the vouchers; and 3) those determined eligible who also took up the voucher. The middle group contains a rather small number of households (18 households), so the statistics from this group need to be treated with caution.

To help organize the discussion, the factors posited in the literature to affect eligibility are grouped under different headings including 1) politically oriented factors such as being (or being associated with) local elite, being informed, feeling empowered; 2) economic factors such as efficiency (having high marginal productivity for input use) and equity (poverty); 3) social factors such as community homogeneity, trust, gender and ethnicity; 4) village characteristics to explore geographic targeting criteria and 5) program design factors such as cropping patterns, education levels, and ability to co-finance. Where appropriate (and available), information preceding the voucher uptake is used i.e. the value of the indicator from the second (2004) as opposed to from the third survey round (2009).

The table begins by examining the likelihood of eligibility among the local elites (and those closely associated with them). Much of the literature on decentralized targeting has derived conclusions about elite capture based on indirect evidence inferred from the estimated relation between within community inequality and targeting performance (Bardhan and Mookherjee, 2005, 2006; Galasso and Ravallion, 2005).[13] Here we explore more directly whether certain groups of people, likely to belong to or being associated with the local elites, are also more likely to receive the input voucher. In particular, we look at differences in

[13] Another indirect way of inferring the role of elite capture followed by Araujo et al. (2008), is to compare the link between community inequality and the adoption of projects which do and do not benefit the rich. Studying social investment fund projects in Ecuador, they find that more unequal communities are less likely to adopt projects that provide excludable goods to the poor.

eligibility between households with members who 1) hold elected positions in the village[14], and 2) have a member in the village voucher committee.

Looking across the first two rows of Table 1, the likelihood of having received a voucher is much larger among households with elected village officials (20 percentage points) and among voucher committee members (10 percentage points). This would suggest that being a member of the local elite may indeed affect voucher reception.

Indeed, while the average proportion of households receiving (at least) one voucher in a village is 26 percent, the average proportion of households with an elected household member receiving a voucher increases to 35 percent and the average proportion of households with a VVC member receiving a voucher increases to 47 percent (figures not reported in the table). On average, 60 percent of all vouchers distributed goes to households with elected officials and 16 percent to those who are members of the VVC. Yet, most VVC members are also elected officials and together they receive 61 percent of all vouchers.

Obviously, these are just bi-variate comparisons and they may well reflect other associated factors favouring eligibility. For example, elected officials and members of village organizations are usually better "plugged in" in village politics and better informed about new initiatives, etc. Indeed, the better informed, i.e. those who access public media more frequently and those who interact more frequently with public institutions have a higher likelihood of being eligible (by 10 to 15 percentage points), suggesting that awareness matters as well.

Turning to the dual objective of most input voucher programs (increasing overall output and improving poor smallholders' productivity and income), the second panel looks at the targeting performance based on smallholders' marginal productivity of modern input use and based on their (2004) income and poverty status. The marginal productivities (in value)

[14] Elected positions in a village include village chairman, sub-village chairs, 10-cell leaders, members of village council and village execution officer.

of inorganic fertilizers and seeds are derived for each household from the empirical Cobb-Douglas production functions estimated with household fixed effects using the 2003 and 2004 surveys (see Table A2-1 in Appendix A2 for details).[15] The marginal productivities for each input are calculated both for total crop production and maize and rice production only.

Contrary to the optimal targeting rule for increasing aggregate production, vouchers are going disproportionately to households with a lower marginal productivity for modern input use. The difference is substantial, with the marginal productivity among households that receive vouchers 50 to 320 percent lower than among households that are not eligible for vouchers.[16] Voucher recipients are also more likely to have used inputs before, i.e. vouchers appear not aimed at pulling in non-users, and they also tend to be less poor, with more land. In other words, the decentralized targeting does not appear to perform well on either criterion for optimal targeting.

A review of the social factors suggests that male headed households tend to have a slight advantage (5 percentage points more likely to receive vouchers). Similarly, Chagga households (who are more prevalent in the richer northern districts) are more likely to receive vouchers than Pare households (who are more prevalent in the poorer southern district), though there is no discernable difference based on religion. More trusting individuals on the other hand, see themselves left with less vouchers (7 percentage points). Slightly fewer vouchers might have been distributed in more remote villages and villages where extension agents were present, though none of the differences is statistically significant.

Finally, consistent with the guidelines, voucher recipients were more educated and less likely to be illiterate. They were also more likely to have planted maize/rice and had more land allocated maize/rice cultivation in the past. As they derived similar shares of

[15] The marginal productivities are equal to the exponent of the fitted value in the production function multiplied by the coefficient of log of the variable in the household fixed effeccts estimation and divided by the value of the variable.

[16] Only when comparing the marginal productivity of improved seeds for maize/rice cultivation is the difference not statistically significant.

income from non-farm activities, this was however not because they were less engaged in off-farm activities. More of the voucher recipients were coffee growers. Recipients were also more likely to have the necessary matching funds as suggested by their larger membership in financial institutions. The large need for credit and limited formal membership in financial institutions[17] of eligible households who eventually did not take up the voucher suggests that access to matching funds has been an issue for some.

This bi-variate analysis suggests that while targeting on the ground appears in broad compliance with the guidelines on paper, the resulting targeting performance is far from optimal from an economic perspective. It is not effective at disproportionately reaching the poorer farmers, if direct poverty reduction or fostering equity were the target. Nor is it effective at disproportionately reaching those with higher marginal productivity, if boosting aggregate supply were the target. In addition, members of the local elite or those closely associated with it are receiving a disproportionate share of the vouchers, suggesting that local politics may play an independent role. Disproportionate reception of vouchers by the local elite does not automatically follow from the application of the guidelines, but through interaction with prevailing community dynamics, it may be well an unintended consequence.

Local Elites and the Voucher Committee Members

To further explore whether belonging to or being associated with the local elite as such affects the reception of a voucher, as suggested by the bi-variate analysis, or whether it merely reflects other factors that simultaneously affect eligibility and belonging to the local elite, a multi-variate analysis is pursued. In particular, let

$$V_{vh} = P(\alpha E_{vh} + \beta H_{vh} + \gamma M_{v} + C + \varepsilon_{vh}), \quad (1)$$

[17] A SACCO is a Savings and Credit Cooperative.

with V a dummy variable indicating whether household h in village v received vouchers, $P(.)$ the cumulative distribution function of a standard normal distribution, E a set of variables indicating whether a household holds elected office or belongs to the VVC, considered proxies for belonging to or being closely associated with the local elite, H a set of household characteristics reflecting other political, economic, social and program design factors that are considered to affect eligibility and may also affect being part of the local elite (such as education), M a set of village dummies that control for village characteristics that may affect voucher distribution within village as well as those that may affect voucher distribution across villages, C a constant and ε the error term. A positive statistically significant coefficient α on E would indicate that local elites are more likely to receive vouchers as such, irrespective of the guidelines or whether they are more likely to meet the economic criteria, pointing to an independent role in the distribution. The results from estimating equation (1) using probit estimation are in Table 2.

Strikingly, after controlling for awareness and empowerment indicators, economic, social and program design factors, as well as village characteristics that may affect within village distribution, holding elected office, and being a member of the voucher committee, are still strongly associated with voucher reception. Ceteris paribus, members of the village voucher committee are 22 percent more likely to receive a voucher, and those holding elected office 11 percent.

The economic targeting criteria on the other hand do not appear to be followed, with the marginal productivities of fertilizer and seeds on maize/rice not affecting voucher reception, while being poor has no effect and income a positive one. Most of the social factors and the program design factors are also not statistically significant or with the wrong sign (those with more maize land in the past and more education being more and less likely respectively to get vouchers). The other political factors on the other hand (awareness and

empowerment) are also highly correlated with voucher reception with those feeling empowered to make important decisions being 7 percent more likely and those regularly participating in official meetings 10 percent more likely to receive a voucher.

As village voucher committee members appear to have such a head start in receiving vouchers, correlates of being a VVC member are further explored. As before, the probit estimator is deployed (Table 2).[18] Elected officials are 7 percentage points more likely to be VVC member, giving them an additional edge to be eligible for the voucher (over and above their direct advantage). VVC membership is slightly higher among those participating in the meetings and among male headed households. Finally, Pare households appear slightly disadvantaged in being VVC members.

Clearly, being a VVC member gives an important head start in receiving a voucher. Yet, the task of being a VVC member is unfunded, and reception of a voucher is likely seen as a form of compensation (Coady, Grosh, and Hoddinott, 2004). If this is the case and given that they take up 16 percent of the vouchers, the composition of the VVC becomes important. From this perspective, the adopted adjustment of the VVC rules to exclude village leaders and increase female participation seems warranted, provided their replacements are more likely to meet the economic targeting criteria (either being more likely to be poor or being more efficient at the margin in using modern inputs).

In addition, the large independent effect of being (associated with) local elite on voucher eligibility suggests a pre-occupation with serving one's own group first. And once the elected officials have been served, more selectivity may be introduced. This would suggest that the more vouchers there are in a village for distribution, the better the targeting performance will be.

[18] Village level effects were not included this time as in some of the voucher receiving villages there were no VVC members in our sample, which would then be automatically dropped from the sample.

The bi-variate and multi-variate analyses of voucher eligibility have given a good description of who is more likely to receive a voucher and the extent to which this is correlated with the targeting criteria either derived from economic theory or those given by the guidelines. To enable a more explicit analysis of targeting performance, an explicit targeting metric is introduced in the next section, the targeting differential, which is subsequently used to explore the different factors that affect the targeting performance across and within villages.

3 Targeting Performance

Methodological Considerations

Following Galasso and Ravallion (2005), three measures of targeting are defined:

$$G^p = \frac{s_{11}}{H}, G^n = \frac{s_{12}}{1-H}, T = G^p - G^n \quad (3)$$

where H is the proportion of all households in the targeted group, s_{11} is the proportion of all households in the targeted group that receive the program, s_{12} is the proportion of all households who are not in the targeted group that receive the program. G^p and G^n therefore measure the proportions of households in the targeted group that receive the program and the proportion of households not in the targeted group that receive the program respectively. The difference between the two measures is the targeting differential, T.

If the program is perfectly targeted to the ones in the targeted group, the untargeted group receives none, and the targeted group is completely covered, then $T=1$; if the program only, but fully, reaches the non-targeted group, then $T=-1$; a uniform allocation (no targeting) implies $T=0$. If proportionately more of the targeted than the untargeted group is reached, then 1>T>0; if the program reaches proportionately more of the untargeted than the targeted group, then $0>T>-1$.

In addition, Ravallion (2000) shows that the targeting differential at the region level can be decomposed into an "intra-village" and an "inter-village" component using the following equation:

$$\overline{T} = \underbrace{\frac{\sum_v \sum_h (G_{hv} - G_v)(H_{hv} - H_v)}{\sum_v \sum_h (H_{hv} - H)^2}}_{(\text{intra-village})} + \underbrace{\frac{\sum_v N_v (G_v - G)(H_v - H)}{\sum_v \sum_h (H_{hv} - H)^2}}_{(\text{inter-village})}, \quad (4)$$

where h is a household index, v is a village index, and N_v is the number of households in village *v*. G_{hv}, G_v, G is the percentage of households reached by the program in each household,[19] village and the region respectively. H_{hv}, H_v, H is the percentage of households in the targeted group in each household, village and in the region respectively. This decomposition enables us to measure which component is dominant in the targeting of the program.

The relation between village characteristics and the village level targeting differentials is then explored using the following equation:

$$T_v = \pi X_v + C^T + \varepsilon_v^T, , \quad (5)$$

where T_v is the targeting differential at the village level, X is a set of village level political, economic, social and program design factors explored in the literature as affecting targeting performance (Bardhan and Mookherjee, 2000; 2005; 2006; Galasso and Ravallion, 2005; Chavis, 2010; Park and Wang; 2010), C^T is a constant and ε_v^T is the error term.

Rather Limited Targeting after All

As both equity and efficiency concerns could drive smart input voucher programs, the targeting performance of the Kilimanjaro input voucher program is evaluated based on the three following criteria: 1) whether the voucher program targets the poor, 2) whether it

[19] G_{hv} =100% if the household is reached and 0 otherwise.

targets those with high marginal productivity of input use, and 3) whether it reaches households that did not use improved seeds and inorganic fertilizers before. The latter category is an important target group for market smart subsidies, as it is likely to meet both criteria, i.e. being constrained in the financial markets (as reflected in their poverty) and displaying high marginal productivity (Ricker-Gilbert, Jayne, and Black, 2009). Potential displacement of commercial input purchases, a continuous concern with input subsidies (Ricker-Gilbert, Jayne and Chirwa, 2011) is also a non-issue for this latter group, thereby increasing additionality of the voucher. It renders this group particularly attractive from an efficiency perspective.

To analyze the targeting performance based on poverty, two measures of poverty are used—the poverty measure calculated in Christiaensen and Pan (2010) and a poverty measure using region median consumption per capita level as the poverty line. About half the population would be eligible for a voucher each time.[20] For targeting based on efficiency, the median values in each village of the households' marginal productivity of improved seeds and fertilizer on maize/rice (as observed in the previous survey round) are used as cut-offs. This implies that about half of the population is considered as target population. The third targeted group are the non-users of improved seeds and fertilizers, which made up about 50 and 67 percent of the households in the previous survey round.[21]

Broadly speaking, and quite strikingly, the targeting differentials hover all around zero irrespective of the targeting criterion (first column, Table 3). This suggests that decentralized distribution of the input vouchers does not deviate much from what would have been obtained from a random/uniform distribution of these vouchers. Nonetheless, there are some nuances to this overall observation. The targeting performance appears slightly better

[20] Note that only 26 percent of all households received (at least) one voucher. Consequenlty, the targeting differential T for the whole sample ranges between [-0.52, 0.52].
[21] By way of comparison, in 2003, 32% of the households used inorganic fertilizer, in 2004 35% and in 2009 39%.

when considering marginal productivity as criterion, though it is slightly worse when it comes to targeting the poor or the non-users, especially non-users of inorganic fertilizers. Within village targeting performance based on marginal productivity (the intra village targeting differential displaying a positive sign) is slightly better than across village targeting (the between village targeting differential being negative). Yet, both within and across villages the targeting differentials are all slightly negative for the other targeting criteria (poverty and non-use). Finally, the substantial standard deviation (around 0.2) in the within village targeting differential across villages (Table 3, column 4) suggests substantial differences in performance across villages.[22] Table 4 explores the correlates associated with these differences in performance.

Elite capture undermines targeting efficiency, but this can be mitigated

In exploring which correlates affect the within village targeting performance, the focus is on a limited set of political, social, program design and service provision factors (Table 4). The choice of these village level correlates was guided by the (limited) literature on decentralized targeting reviewed above and deliberately kept to a minimum given the relatively small number of villages in the sample.

To examine the potential role of elite capture, both the number of vouchers received by elected officials and VVC members and the Gini measure of within village (land) inequality (Bardhan and Mookherjee 2006; Araujo et al., 2008) are included, further complemented with a proxy of awareness (Bardhan and Mookerhjee, 2000; Park and Wang, 2010), which is usually hypothesized to counteract potential elite capture. Across villages, the number of vouchers received by (sample) households with elected officials and VVC

[22] As the targeting differential ranges between -0.52 and 0.52, this implies that some villages are close to perfect targeting .

members ranges between 0 and 10, with the median situated around 2.4.[23] When expressed in terms of shares of vouchers received by elected officials and VVC members, it ranges from 16 percent for the 10th percentile village to 100 percent for the 75th percentile village. [24]

The within village (land) Gini, which also varies considerably, is included to facilitate comparison with the literature, which has often used inequality to reflect power structures. Awareness is proxied through the proportion of households regularly using public media. This is relatively high, with in each of the sample villages more than half the village population (57 percent) consulting public media at least once a month.[25]

Education levels, here proxied by illiteracy levels among household heads, are regularly considered in examining targeting performance (Galasso and Ravallion, 2005). While illiteracy is generally low (quasi non-existent in almost half the villages), it still reaches 42 percent in the most illiterate village. In a novel addition to the targeting literature, the level of trust households in a village have in others is further included as a correlate of social cohesion. The proportion of households in a village who (somewhat or strongly) agree that most people can be trusted (arguably a rather demanding measure of trust) ranged between zero and 33 percent with the median situated around 17 percent. Clearly, trust levels are higher in some communities than others.

An important program design feature that has been reported to affect performance is the scale of the program (Galasso and Ravallion, 2005; Bardhan and Mookherjee, 2005). This is proxied by the number of (attrition corrected sample) households receiving a voucher, which ranges between 1 and 15, with half of the villages receiving more than 4.7 vouchers

[23] These have been corrected for potential attrition bias using the inverse of the probability of being selected in round 3 (appendix A1).

[24] While the share could also have been used as proxy, the number of vouchers in a village received by elected officials and VVC members and the number of vouchers received in a village, which together define the share, are introduced separately in the regression, not to constrain their coefficients to be the same.

[25] The degree of participation in meetings and associations was also considered as a proxy for awareness. It was not statistically significant in the regression analysis reported in Table 5 and given its correlation with the use of public media (ρ=0.26) and the limited degrees of freedom it was not retained.

and half less. Finally, given the important role of extension agents in the distribution of the vouchers, whether there is an extension agent in the village is also controlled for in the regression. Extension agents are located in about three quarters of the villages.

The relation between the intra-village targeting differential and these village level factors is estimated for the targeting differentials based on poverty, marginal productivity and new input usage (Table 5). As the targeting differential is truncated at -1 and 1, the tobit estimator is used. Clearly, the targeting performance is significantly affected by the number of vouchers received by elected officials and VVC members (controlling for the amount of vouchers received in the village). In particular, the larger is the number of vouchers going to elected village officials and VVC members, the worse is the targeting performance. In other words, not only are elected village officials much more likely to receive vouchers, as demonstrated before, this also substantially reduces the targeting performance. As expected, the effects are most detrimental when targeting by poverty—elected village officials tend to be less poor. But targeting effectiveness also tends to decline when efficiency is the overriding concern, in particular for seeds when targeting based on marginal productivity or for fertilizer when aimed at bringing in new users. At the margin, village elected officials are usually not the most efficient input users.

After controlling for voucher reception by elected officials, no relation is found between land inequality and targeting performance, except when it comes to reaching those with high marginal productivity for seeds, where it only has a significantly weak, positive effect.[26] As will be shown below (Table 6), intra-village inequality is highly correlated with the number of vouchers received by elected officials, supporting the notion advanced in the literature that intra-village inequality negatively affects the performance of decentralized targeting through elite capture. Contrary to what has been hypothesized in the literature, in

[26] There is also no relation between inequality and targeting performance when measuring within village inequality based on consumption as opposed to land.

this sample, awareness, as proxied through use of public media, does not always results in better targeting. Better informed villages appear to be better at targeting vouchers to increase marginal efficiency, but also tend to target existing (as opposed to new) users and don't help in disproportionately reaching the poor.

Both voucher coverage and trust, on the other hand, appear to counteract the negative effects of elite capture, when reaching the poor is the criterion. This holds irrespective of the poverty line chosen, with the negative effect of elite capture neutralized when the number of vouchers is 28 to 62 percent larger than those received by the elected officials and the VVC, according to these estimates.[27] It suggests that the poverty targeting performance can be improved given sufficient coverage. However, this does not hold universally when it comes to targeting by efficiency or non-use, both important insights for a voucher program design.

Communities, where trust levels are higher, also tend to be better at reaching the poor (Table 5).[28] While no causality is purported here, it is worth highlighting that it is unlikely that reverse causality drives this result. Trust takes long to build, but little to break, not the other way round (Williamson, 2000). The trust levels observed are thus unlikely the consequence of the experience with the input voucher program only. With the exception of targeting by marginal productivity of seeds, illiteracy levels were not found to affect the targeting performance.

Finally, the targeting performance by efficiency declines in villages where agricultural extension agents are present. They seem to be steering vouchers away from households with high marginal productivity of fertilizer use and non users of modern inputs, maybe guided by the perception that many of the newcomers are ill placed to productively

[27] This can be obtained by dividing the coefficients on the number of vouchers received by elected officials by the coefficients on the number of vouchers received (i.e. -0.068/0.053-1=-0.28 or (-0.078/0.048)-1=0.62, depending on the poverty line chose.

[28] The coefficients on the trust variable were not statistically significant in any of the marginal productivity or new user regressions and the trust variables were no longer retained as regressors.

use such inputs. This suggests another area for attention in designing future voucher programs and their implementation modalities.

The findings bear out the lingering concerns in the literature about elite capture in decentralized targeting, with voucher coverage and allocation in high trust environments emerging as counteracting forces when overcoming poverty related market constraints, while the presence of extension agents may further exacerbate targeting inefficiencies, when increasing volume is the objective. To further see how the political, social and other factors indirectly affect targeting performance through the channel of elite capture, the number of vouchers received by elected officials and VVC members is regressed directly on these factors in Table 6, again using the tobit estimator. First, elite capture increases with the number of vouchers distributed, but at a rate of less than one to one, consistent with the earlier observation that voucher coverage *can* increase targeting performance (at least among the poor). Second, elite capture of the vouchers also increases when intra-village land inequality goes up, providing support for the use of within village inequality indicators as proxy for elite capture. Finally, the further away from the rural towns, the more prone the local political dynamics are to elite capture.

4 Concluding remarks

Input subsidy programs have once again become a popular instrument in the policy toolbox to increase agricultural productivity across Sub-Saharan Africa. Given that their fiscal burden can be high and typically trends upward over time, they only carry broad support to the extent that they address market failures, such as credit and insurance market failures, and to the extent that they generate multiplier effects by increasing aggregate output and reducing staple food prices. This presumes proper targeting, with decentralized targeting of input vouchers currently the preferred tool of choice.

Decentralized targeting systems are attractive because they lower the cost of targeting by tapping into local knowledge. Yet, they have also been reported to suffer from elite capture. Using the experience from an input voucher pilot program in Kilimanjaro, Tanzania, this study examined whether the dangers of elite capture are also real when distributing private goods such as input vouchers, if so, whether elite capture reduces the targeting performance of the program, and whether there are mitigating circumstances.

The results suggest that members of the local elite have indeed a higher likelihood of receiving a voucher, partly through their disproportionate membership in the village voucher committee, instituted to propose the voucher allocation list within each village. About 45 percent of the VVC members received a voucher, compared with 34 percent of the elected village officials and 26 percent of all villagers. The VVC members and the elected village officials received together about 61 percent of the vouchers distributed among the villagers. While this ought not to be a problem as such, it was also found that this "pre-allocation" of the vouchers to the local elite had a strong negative effect on the targeting performance.

Analysis of the correlates of intra-village targeting performance and elite capture indicated that the occurrence of elite capture was more pronounced in villages with more unequal land distributions and in those villages further away from the rural towns. Somewhat surprisingly, villages with extension agents were found to disproportionately steer vouchers away from new input users or households with higher marginal productivity in fertilizer use, in effect exacerbating the targeting inefficiencies induced by elite capture. When the focus was on fostering production among poor farmers, targeting performance improved when coverage increased and the decentralized targeting systems also tended to work better in villages where trust levels were higher.

Together these different factors resulted in a distribution of vouchers that was not fundamentally better (if not worse) than what random allocation would have yielded, despite

the substantial efforts dispensed by both district and community committees. This relatively poor targeting performance undoubtedly also reflects the program's simultaneous pursuit of multiple objectives (raising aggregate output versus raising poor farmers' income), which each yields different targeting rules (targeting farmers with highest marginal productivity versus targeting poor farmers). This leads to a targeting practice focused on the lowest common denominator that tries to serve all in theory, but serves none well in practice.

Three core insights emerge for the future design and implementation of input voucher programs. First, the findings lend credence to existing concerns about elite capture under decentralized targeting schemes, thereby reducing its effectiveness. Second, they suggest that these tendencies can be counteracted with enhanced coverage and a greater focus on higher trust settings when poorer farmers are targeted, and that greater selectivity and/or scrutiny is advised in relying on community based targeting in unequal and remote communities. In addition, extension agents deserve more explicit attention as important factors in influencing the program's targeting performance. Finally, clearer focus in objective could help enhance the targeting performance of input voucher programs. This would also require the development of better proxies to target households with high marginal productivity. While there is a longstanding literature on the development of proxy indicators for poverty, it is poorly understood which variables would be good at proxying marginal productivity in smallholder settings.

Appendix A1: Dealing with attrition

A significant amount of households were lost in the third round of the household survey and there are some differences between the interviewed and lost households (Table A1-1). For example, households whose fields are further away or who lived in remote villages were less likely to be interviewed in round 3. Smaller households are more likely to be dropped from the sample. Male headed households and households whose members are elected officials or member of a social or economic group are more likely to remain in the sample.

Table A1-1:Characteristics of the interviewed and dropped households

	Attrition round2		Attrition round3	
	Not interviewed	Interviewed	Not interviewed	Interviewed
Household size (# of persons)	5.010	5.343	4.957	5.410
Dependency ratio	0.511	0.540	0.542	0.538
Gender household head (% male)	0.857	0.875	0.791	0.893
Age household head (year)	47	54	49	54
Percentage of illiterate household members	0.070	0.070	0.073	0.069
Member of hh has elected position in village	0.189	0.271	0.166	0.290
Member of hh is a relative of people with elected positions in village	0.083	0.080	0.048	0.088
Member of hh is a member in a primary society, or other economic group	0.116	0.353	0.239	0.365
Member of hh is a member in a religious, youth, women or other social group	0.363	0.374	0.304	0.389
Time spent on agricultural (month)	5.121	7.553	6.218	7.716
Time spent on non-farm (month)	0.948	0.627	0.708	0.627
Maximum distance to land (km)	2	3	2	3
Land owned (ha)	0.810	0.810	0.607	0.810
Whether plant maize	0.877	0.830	0.812	0.836
Whether plant coffee	0.442	0.588	0.435	0.614
Whether plant beans	0.684	0.671	0.661	0.674
Whether plant bananas	0.637	0.787	0.629	0.814
Per adult equivalent household income (1000Tsh)	106	109	105	111
Value of houses and compound (1000Tsh)	300	1000	600	1000
Belong to Chagga group	0.568	0.753	0.685	0.758
Belong to Pare group	0.300	0.172	0.179	0.178
Christian	0.817	0.875	0.835	0.881
Distance to town (km)	16	12	16	12
Village has a market (%)	0.205	0.279	0.282	0.274
Village can receive cell phone signal (%)	0.662	0.836	0.814	0.831
Whether there is extension agent in village (%)	0.625	0.627	0.549	0.644
Village has dispensary, health centre or hospital (%)	0.636	0.517	0.538	0.518

Note.- Medians of variables maximum distance to land, per adult equivalent household income, value of houses and compound, distance to town are reported. Means of all other variables are reported.

To correct for such uneven attrition, consider a household which represents N households in the region. Its sampling weight is N, usually the inverse of the probability of the household being selected into the survey. Now some of the households selected in the survey design in the first round were not interviewed in the second and third round. If the attrition is random, then no correction is needed. If not, a correction needs to be done. For example, if households whose head is old are less likely to be interviewed in the third round than households whose head is young, the ratio between households with old head and households with young head will decrease from round 1 to round 3. To correct for this bias against households with an older head, a higher weight must be given to households with an older head in round 3. This is the intuition behind the correction for sample selection bias due to attrition followed here (Giles, 2006).

In particular, if a household interviewed in round 1 has a high probability to be interviewed in round 3, its original sampling weight (N) is multiplied by a correction factor to lower its weight in round 3[29]. If a household interviewed in round 1 has a low probability to be interviewed in round 3, its original sampling weight (N) is multiplied by a higher correction factor in round 3. The correction factor is defined as the inverse of the probability of being interviewed in round 3.

Table A1-2 shows the results of the Probit regressions used to calculate the probabilities. The dependent variables are dummy variables indicating whether the household was also interviewed in round 2 or round 3. Even though it was reported during the survey by the enumerators that households living far away from their plots were more likely to drop out, both the average and the maximum distance to land are not significant in the regressions. The age of the household head and household size are important in explaining attrition.

[29] No reweighting is needed for round 1 data since all sampled households were interviewed in round 1.

Households with only one old person in the first round were more likely to drop out from the survey due to death. Big households were less likely to drop out from the survey. Female headed households are more likely to drop out in round 3. Village officials' households are more likely to be interviewed in round 2.

Table A1-2: Results of the probit regressions of being interviewed

	Interviewed in round 2	Interviewed in round 3
Household size (# of persons)	0.056	0.047*
	(0.044)	(0.025)
Dependency ratio	0.007	-0.405
	(0.422)	(0.248)
Gender of household head	0.105	0.347**
	(0.233)	(0.145)
Age of household head	0.012*	0.011**
	(0.007)	(0.004)
Percentage of illiterate household members	-0.321	0.012
	(0.477)	(0.339)
Member of hh has elected position in village	0.224	0.364**
	(0.213)	(0.129)
Member of hh is a relative of people with elected positions in village	0.047	0.309
	(0.277)	(0.218)
Member of hh is a member in a primary society, or other economic group	0.555**	0.213*
	(0.198)	(0.119)
Member of hh is a member in a religious, youth, women or other social group	-0.057	0.110
	(0.164)	(0.108)
Time spent on agricultural (month)	0.012	0.003
	(0.009)	(0.006)
Time spent on non-farm (month)	-0.017	-0.002
	(0.022)	(0.017)
Max distance to land (km)	0.010	0.001
	(0.013)	(0.008)
Amount of land owned (ha)	0.021	0.019
	(0.040)	(0.023)
Whether plant maize	-0.234	0.097
	(0.257)	(0.167)
Whether plant coffee	-0.215	0.156
	(0.210)	(0.146)
Whether plant beans	-0.123	-0.203
	(0.203)	(0.134)
Whether plant bananas	0.278	0.436**
	(0.199)	(0.154)
Per adult equivalent household income (1000000Tsh)	0.091	0.002
	(0.138)	(0.127)
Value of houses and compound (1000000Tsh)	-0.011*	-0.002
	(0.006)	(0.006)
Belong to Chagga group	0.285	-0.091
	(0.297)	(0.218)

Table A1-2: Results of the probit regressions of being interviewed

	Interviewed in round 2	Interviewed in round 3
Belong to Pare group	0.238	0.232
	(0.312)	(0.227)
Christian	0.085	0.085
	(0.231)	(0.168)
Distance to town (km)	-0.005	-0.009***
	(0.003)	(0.002)
Market place in village	0.042	-0.193
	(0.220)	(0.133)
Cell phone coverage in village	0.353	-0.304*
	(0.235)	(0.175)
Agricultural extension agent in village	0.194	0.419***
	(0.211)	(0.122)
Dispensary, health services in village	-0.480**	-0.128
	(0.186)	(0.114)
Constant	0.358	-0.304
	(0.627)	(0.417)
R-squared	0.14	0.12
N. of Obs.	949	949

Appendix A2. The determinants of agricultural productivity

Standard Cobb-Douglas production functions are estimated here based on the data from all three survey rounds. This permits estimation of the marginal productivities of fertilizers and seeds (in value). The specification includes the standard input variables: land, labor, capital, traditional and modern seeds (in value) and organic and inorganic fertilizer (in value). As the effectiveness of fertilizer use is affected by the timely supply of water, they are further interacted with the percent of land irrigated. Household demographics and education level, land quality, crop portfolio and access to credit were further added as controls affecting total factor productivity.

Table A2-1 shows the estimation results. In the first two columns the log of total crop income is used as the dependent variable and in the last two columns the log of maize and rice income. Where necessary a small number is added to the log of asset, fertilizer and seed variables to enable inclusion of observations with zero values. Given the specification in double logs, the estimated coefficients on the input variables can be interpreted as elasticities. The other variables serve as control variables. Their coefficients are the marginal productivities. Two estimates are reported: the OLS estimate and the household fixed effect, which mitigates against omitted variable bias from unobserved household heterogeneity.

Land, agricultural assets, livestock have a significant effect on crop production. The estimates of the elasticity of both traditional and improved seeds are significant, and so are the elasticities of inorganic fertilizer, with irrigation increasing the effect of fertilizer on maize and rice plots. Male headed households and better educated households tend to be more productive. Especially households planting bananas see their crop income systematically increase.

Using the results in Table A2-1, the marginal productivity of improved seeds and inorganic fertilizer are calculated using the marginal productivities for maize/rice production

obtained from the fixed effect estimates. The marginal productivity of improved seeds is equal to the exponent of the fitted value in the production function (using column 4) multiplied by the coefficient of the variable "Log (improved seeds +1) in kg" and divided by the value of "improved seeds +1". The marginal productivity of inorganic fertilizer is equal to the exponent of the fitted value in the production function (using column 4), multiplied by the summation of the coefficient of the variable "Log (inorganic fertilizer +1) in kg" and the multiplication of the coefficient of the variable "Log (inorganic fertilizer +1) in kg*%land irrigated" and the variable "%land irrigated", and divided by the value of "inorganic fertilizer +1".

Table A2-1:Results of the production function estimation

	Log (crop income)		Log(maize rice income)	
	OLS	FE	OLS	FE
Log (land owned +0.1) in ha	0.259***	0.250***	0.208***	0.207***
	(0.050)	(0.070)	(0.047)	(0.060)
Log (adult equivalent)	0.026	-0.005	0.065	0.070
	(0.071)	(0.141)	(0.078)	(0.143)
Log (agr assets +1) in 1000Tsh	0.050**	0.012	0.034*	0.008
	(0.019)	(0.032)	(0.019)	(0.034)
Log (livestock +1) in 1000Tsh	0.105***	0.119***	0.047**	0.059**
	(0.018)	(0.025)	(0.019)	(0.025)
Log (traditional seeds +1) in kg	0.168***	0.168***	0.170***	0.160***
	(0.027)	(0.034)	(0.030)	(0.037)
Log (improved seeds +1) in kg	0.147***	0.077*	0.200***	0.117**
	(0.032)	(0.044)	(0.038)	(0.049)
Log (organic fertilizer +1) in kg	-0.026**	-0.007	-0.009	0.012
	(0.011)	(0.013)	(0.013)	(0.014)
Log (organic fertilizer +1) in kg*%land irrigated	0.050**	0.015	0.032	-0.009
	(0.020)	(0.025)	(0.026)	(0.028)
Log (inorganic fertilizer +1) in kg	0.064**	0.071**	0.160***	0.107**
	(0.025)	(0.032)	(0.029)	(0.034)
Log (inorganic fertilizer +1) in kg*%land irrigated	0.012	-0.007	0.060	0.132**
	(0.049)	(0.054)	(0.060)	(0.065)
Gender of household head	0.136	0.350**	0.154	0.393**
	(0.100)	(0.173)	(0.106)	(0.186)
Education of household head	0.030**	0.017	0.042**	0.016
	(0.012)	(0.021)	(0.013)	(0.023)
Percentage of illiterate household members	-0.179	-0.467	0.066	0.292
	(0.246)	(0.375)	(0.221)	(0.368)
Age of household head	0.002	0.006	-0.003	0.000
	(0.002)	(0.005)	(0.002)	(0.005)
Dependency ratio	-0.032	0.193	-0.027	0.065
	(0.135)	(0.194)	(0.144)	(0.197)
Whether plant maize	0.007	0.122	0.957***	0.904***
	(0.087)	(0.104)	(0.100)	(0.119)
Whether plant rice	1.505***	0.483	2.439***	1.308
	(0.338)	(0.668)	(0.365)	(0.822)

Table A2-1:Results of the production function estimation

	Log (crop income)		Log(maize rice income)	
	OLS	FE	OLS	FE
Whether plant beans	0.235**	0.255**	0.275**	0.258**
	(0.074)	(0.087)	(0.092)	(0.102)
Whether plant coffee	0.081	-0.180	-0.368***	-0.548***
	(0.089)	(0.127)	(0.097)	(0.136)
Whether plant banana	0.706***	0.599***	0.048	0.018
	(0.108)	(0.151)	(0.114)	(0.142)
Belong to SACCO	0.120	0.167	-0.040	0.030
	(0.103)	(0.122)	(0.116)	(0.138)
Has a bank account	0.121	-0.029	0.125	-0.060
	(0.104)	(0.141)	(0.117)	(0.154)
Constant	2.324***	2.069***	0.524	1.035**
	(0.366)	(0.456)	(0.352)	(0.452)
Time-varying village dummies included				
R-squared	0.418	0.342	0.502	0.413
F-statistic	9.493	5.845	23.104	12.955
N. of Obs.	2,592	2,271	2,618	2,296

References

Alderman, H. 2002. “Do Local Officials Know Something We Don’t? Decentralization of Targeted Transfers in Albania.” *Journal of Public Economics* 83: pp. 375-404.

Araujo, M. C., F. Ferreira, P. Lanjouw, and B. Ozler. 2008. “Local Inequality and Project Choice: Theory and Evidence from Ecuador.” *Journal of Public Economics* 92: pp.1022-1046.

Bardhan, P. and D. Mookherjee. 2000. “Capture and Governance at Local and National Levels.” *American Economic Review*, 90: pp.135–139.

Bardhan, P., and D. Mookherjee. 2005. “Decentralizing Antipoverty Program Delivery in Developing Countries.” *Journal of Public Economics* 89: pp.675-704.

Bardhan, P., and D. Mookherjee. 2006. “Pro-poor Targeting and Accountability of Local Governments in West Bengal.” *Journal of Development Economics* 79: pp.303-327.

Chavis, L. 2010. “Decentralizing Development: Allocating Public Goods via Competition.*” Journal of Development Economics* 93: pp.264-274.

Christiaensen, L., and A., Sarris, 2007. Eds. “Household Vulnerability and Insurance Against Commodity Risks: Evidence from Rural Tanzania” *FAO Commodities and Trade Technical Paper No. 10*: Rome.

Christiaensen, L., and L. Pan. 2010. “*Poverty Evolution and the Input Voucher program in Kilimanjaro and Ruvuma, Tanzania 2004-2009*.” Report, DFID Tanzania.

Coady, D., M., Grosh, and J., Hoddinott. 2004. Targeting of Transfers in Developing Countries: Review of Lessons and Experience. World Bank and International Food Policy Research Institute: Washington D.C.

Dercon, S., and L., Christiaensen. 2011. Consumption Risk, Technology Adoption and Poverty Traps: Evidence from Ethiopia. *Journal of Development Economics* forthcoming.

Dorward, A., 2009. *Rethinking Agricultural Input Subsidy Programmes in Developing Countries*, in Elbehri, A. and A., Sarris, eds., Non-distorting Farm Support to Enhance Global Food Production, FAO: Rome.

Dorward, A., and E., Chirwa. 2011. The Malawi Agricultural Input Subsidy Programme: 2005-6 to 2008-9, *International Journal of Agricultural Sustainability*: 9-1.

Faguet, J. 2004. “Does Decentralization Increase Government Responsiveness to Local Needs? Evidence from Bolivia.” *Journal of Public Economics* 88: pp.867-893.

Galasso, E. and M. Ravallion. 2005. “Decentralized Targeting of an Antipoverty Program.” *Journal of Public Economics* 89: pp.705-727.

Giles, J. 2006. “Is Life More Risky in the Open? Household Risk-coping and the Opening of China’s Labor Markets.” *Journal of Development Economics* 81: pp.25-60.

Grosh, M., C., del Ninno, E., Tesliuc, and A., Ouerghi. 2008. *For Protection and Promotion: The Design and Implementation of Effective Safety Nets.* World Bank: Washington D.C.

Haggblade, S., Hazell, P., Dorosh, P. 2007. *Sectoral Growth Linkages Between Agriculture and the Rural Nonfarm Economy*, in Haggblade, S., Hazell, P., Reardon, T., eds., Transforming the Rural Nonfarm Economy—Opportunities and Threats in the Developing World, John Hopkins University Press: Baltimore.

Henderson, V., Storeygard, A., Weil, D., 2009. *Measuring Economic Growth from Outer Space*. NBER Working Paper 15199.

Mansuri, G., and V. Rao. 2004. "Community-based and –driven Development: A Critical Review." *World Bank Research Observer* 19: pp.1-39.

Mniwasa, E. and V. Shauri. 2010. "*Review of the Decentralization Process and It's Impact on Environmental and Natural Resources Management in Tanzania."* Lawyers' Environmental Action Team, Tanzania.

Park, A, and S. Wang. 2010. "Community-based Development and Poverty Alleviation: An Evaluation of China's Poor Village Investment Program." *Journal of Public Economics* 94: pp.790-799.

Platteau, J. 2004. "Monitoring Elite Capture in Community-driven Development." *Development and Change* 35: pp.223-246.

Seabright, P. 1996. "Accountability and Decentralization in Government: An Incomplete Contracts Model." *European Economic Review* 40: pp.61-89.

Ravallion, M. 2000. "Monitoring Targeting Performance When Decentralized Allocations to the Poor are Unobserved." *World Bank Economic Review* 14: pp. 331-345.

Ricker-Gilbert, J., T.S., Jayne, and J.R., Black. 2009. *Does Subsidizing Fertilizer Increase Yields? Evidence from Malawi*. Paper presented at 2009 AAEA annual meeting, July 26-28, Milwaukee, Wisconsin.

Ricker-Gilbert, J., T., Jayne, and E., Chirwa, 2011. "Subsidies and Crowding Out: A Double-Hurdle Model of Fertilizer Demand in Malawi." *American Journal of Agricultural Economics*, forthcoming.

Wiggins, S., and J., Brooks. 2010. *The Use of Input Subsidies in Developing Countries*, paper presented at the Global Forum on Agriculture, 29-30 November 2010: OECD: Paris.

Williamson, O. E. 2000. "The new institutional economics: Taking stock, looking ahead." *Journal of Economic Literature* 38: 595-613.

World Bank 2007. "*World Development Report 2008: Agriculture for Development*." Washington DC: World Bank.

World Bank. 2009. "*Accelerated Food Security Program of the United Republic Of Tanzania under the Global Food Crisis Response Program*." Program description, World Bank Office Tanzania.

Table 1: Political, economic, social, village and program design factors affect input voucher distribution.

	Not eligible	Eligible, not accept	Received
No. of obs.	602	18	152
Political factors			
Member of hh has elected position in village (%)	0.375	0.440	0.575***(1)
Member of hh is in village voucher committee (%)	0.037	0.049	0.145***
Listen to/read/watch radio, TV, newspaper, internet(2)	0.817	0.805	0.914***
Participate in public meetings, farmer's association, talk to govt officials(3)	0.492	0.720	0.647***
Have the power to make important decisions of life(4)	0.479	0.422	0.619***
Economic factors			
Marginal productivity of improved seeds in 2004 (1000 Tsh/kg)	3.539	1.658	2.358*
Marginal productivity of inorganic fertilizer in 2004 (1000 Tsh/kg)	4.332	0.634	1.021***
Marg. productivity of improved seeds in 2004 (maize &rice) (1000 Tsh/kg)	0.699	0.514	0.472
Marg. productivity of inorganic fertilizer in 2004 (maize&rice) (1000 Tsh/kg)	0.854	0.665	0.428**
Whether used improved seed in 2004 (%)	0.499	0.604	0.686***
Whether used inorganic fertilizer in 2004 (%)	0.303	0.604	0.559***
Total income per adult equivalent in 2004 (1000 Tsh)	119	104	168
Land cultivated in 2004 (acre)	1.016	1.228	1.251
Poor in 2004	0.52	0.49	0.38***
Social factors			
Gender of household head (1=male)	0.844	0.817	0.891*
Belongs to Chagga	0.728	0.528	0.841***
Belongs to Pare	0.202	0.228	0.081***
Christian	0.876	0.592	0.903
Trust(5)	0.170	0.114	0.107**
Village characteristics			
Distance to town (km)	13	17	12
Whether there is bus to town (%)	0.563	0.285	0.502
Whether there is market in town (%)	0.292	0.285	0.248
Whether there is agr input shop in village (%)	0.265	0.046	0.240
Whether there is extension agent in village (%)	0.872	0.948	0.833
Program design factors			
Land used for maize/rice in 2004 (acre)	0.333	1.000	1.000
Crop income/total income	0.284	0.359	0.285
Whether plant coffee 2009 (%)	0.376	0.357	0.494***
Whether planted maize/rice in 2004 (%)	0.551	0.730	0.745***
Years of education household head (year)	4.911	3.529	5.088
Household head is illiterate	0.142	0.042	0.108
Age of household head	58	56	58
Belongs to Sacco	0.184	0.206	0.312***
Has a bank account	0.138	0.087	0.231**
Need credit to buy agriculture inputs in 2009	0.135	0.227	0.180***

Note.- For the variables of marginal productivities, total income per adult equivalent, land used for maize and rice, distance to town, medians are reported. For all other variables, means are reported. (1) ***, **, * The hypothesis Mean(Not eligible)=Mean(Received) is rejected at the 1%, 5%, 10% level respectively. (2) Dummy variable, 1= Listen to/read/watch radio, TV, newspaper, internet at least once a month. (3) Dummy variable, 1= Participate in public meetings, farmer's association, talk to government officials at least once a month. (4) Dummy variable, 1=Somewhat or mostly able to make important decisions of life. (5)Dummy variable, 1=Strongly or somewhat agree that most people can be trusted.

Table 2: Local elites more likely to receive vouchers and to belong to the voucher committee.

	Eligible for vouchers Coef./S.D.	Village voucher committee Coef./S.D.
Political factors		
Belonging or being associated with local elite		
Member of hh has elected position in village	0.1115**	0.0678***
	(0.0398)	(0.0195)
Member of hh is in village voucher committee	0.2230**	
	(0.0942)	
Awareness and empowerment		
Listen to/read/watch radio, TV, newspaper, internet	0.0321	-0.0145
	(0.0534)	(0.0193)
Participate in public meetings, farmer's association, talk to government officials	0.1012**	0.0272**
	(0.0378)	(0.0108)
Have the power to make important decisions of life	0.0676*	0.0090
	(0.0373)	(0.0091)
Economic factors		
Marginal productivity of improved seeds on maize/rice in 2004	0.0065	-0.0021
	(0.0054)	(0.0037)
Marginal productivity of inorganic fertilizer on maize/rice in 2004	0.0078	0.0000
	(0.0090)	(0.0023)
Total income per adult equivalent in 2004/1000	0.0228**	0.0011
	(0.0108)	(0.0009)
Poor household (1 if yes)	-0.0448	-0.0049
	(0.0370)	(0.0088)
Social factors		
Gender household head (1 if male)	-0.0099	0.0216**
	(0.0568)	(0.0091)
Age household head	-0.0007	-0.0001
	(0.0013)	(0.0003)
Chagga	-0.0348	0.0041
	(0.1029)	(0.0151)
Pare	-0.0941	-0.0284**
	(0.0904)	(0.0102)
Christian	-0.0980	
	(0.0850)	
Trust	-0.0706	0.0106
	(0.0457)	(0.0159)
Program design factors		
Land used for maize/rice in 2004	0.0511**	-0.0011
	(0.0158)	(0.0035)
Whether planted maize/rice in 2004	-0.0120	-0.0135
	(0.0462)	(0.0125)
Whether used improved seed in 2004	0.0496	0.0099
	(0.0442)	(0.0139)
Whether used inorganic fertilizer in 2004	0.0615	0.0035
	(0.0561)	(0.0131)
Whether plant beans in 2009	0.0788**	0.0047
	(0.0389)	(0.0100)
Whether plant coffee in 2009	0.0220	-0.0081

	Eligible for vouchers Coef./S.D.	Village voucher committee Coef./S.D.
	(0.0584)	(0.0106)
Whether plant banana in 2009	-0.0243	-0.0135
	(0.0511)	(0.0126)
Years of education household head	-0.0139**	0.0007
	(0.0064)	(0.0016)
Household head is illiterate	-0.0492	-0.0130
	(0.0625)	(0.0129)
Belong to SACCO	-0.0017	0.0090
	(0.0479)	(0.0146)
Has a bank account	0.0860	-0.0031
	(0.0641)	(0.0109)
Village dummies	Yes	No
Pseudo R-squared	0.25	0.22
N. of Obs.	642	642

Note.- Marginal effects are reported, and standard deviations are reported in the brackets. Weights calculated in Appendix A1 are used in all regressions. *Denotes significance at 10% level; ** at 5% level and *** at 1% level.

Table 3: Decentralized targeting does not differ much from uniform distribution of vouchers, irrespective of the targeting criterion.

	$\overline{T}$	$\overline{T}_{intra}$	$\overline{T}_{inter}$	T_v
Targeting by poverty				
FEI poverty line[(1)]	-0.090	-0.055	-0.034	-0.049
				(0.193)
Regional median cons as poverty line	-0.089	-0.051	-0.038	-0.050
				(0.197)
Targeting by efficiency				
High marginal prod. seeds [(2)]	0.051	0.051	-0.001	0.062
				(0.198)
High marginal prod. fertilizer[(3)]	0.024	0.025	-0.002	0.024
				(0.246)
Past non users of improved seed	-0.096	-0.055	-0.041	-0.060
				(0.202)
Past non-users of fertilizer	-0.191	-0.057	-0.134	-0.055
				(0.237)

Note: Means of the variables per village are reported. Standard deviations are reported in the brackets. (1) The poverty line is the Food-Energy-Intake poverty line taken from Christiaensen and Pan (2010). (2) Households with marginal productivity of improved seeds bigger than the village median are defined as productive in using improved seeds. (3) Households with marginal productivity of inorganic fertilizer bigger than the village median are defined as productive in using inorganic fertilizer.

Table 4: Correlates of decentralized targeting performance

	min	p10	p25	p50	p75	p90	max
Political factors							
# vouchers per village received by sample households with elected positions and VVC members [(1)]	0.00	1.06	1.22	2.42	4.34	5.91	9.59
share of vouchers received by households with elected positions and VVC members	0.00	0.16	0.40	0.60	1.00	1.00	1.00
Land inequality (Gini index)	0.24	0.32	0.37	0.42	0.49	0.53	0.99
%Listen to/read/watch radio, TV, newspaper, internet[(2)]	0.57	0.71	0.79	0.87	0.92	0.94	1.00
Social factors							
%with illiterate household head	0.00	0.00	0.00	0.07	0.15	0.25	0.42
%Trust[(3)]	0.00	0.06	0.11	0.17	0.21	0.27	0.33
Program design factors							
# vouchers per village received by sample households per village[(1)]	1.02	1.44	2.42	4.68	7.41	9.80	14.9
Socio-Economic environment							
Agricultural extension agent	0.00	0.00	1.00	1.00	1.00	1.00	1.00

Note:
(1) corrected for attrition using attrition weights from appendix A1
(2) Dummy variable, 1= Listen to/read/watch radio, TV, newspaper, internet at least once a month.
(3) Dummy variable, 1=Strongly or somewhat agree that most people can be trusted.

Table 5: Elite capture deteriorates targeting; the poor are better targeted in better covered and more trustworthy settings; extension agents favor existing users with lower marginal productivity.

Targeting differential T_v based on following targeting criteria using Tobit estimator	Poverty[(1)] (PL=FEI)		Poverty [(2)] (PL=regional median cons/ae)		Marginal productivity of seeds		Marginal productivity of fertilizer		New-seed user		New inorganic fertilizer user	
Political factors												
# vouchers captured by households with elected positions and VVC members	-0.068	***	-0.078	***	-0.044	**	0.036		-0.005		-0.063	*
	(0.020)		(0.022)		(0.019)		(0.043)		(0.030)		(0.035)	
Land inequality (Gini index)	0.226		0.045		0.290	*	-0.370		0.103		0.358	
	(0.327)		(0.407)		(0.166)		(0.232)		(0.272)		(0.300)	
% villagers listening to the radio/watching TV/ reading the newspaper/ using the internet at least once a month	0.079		0.326		0.631	**	0.631	*	-0.733	*	-0.780	***
	(0.236)		(0.268)		(0.306)		(0.379)		(0.421)		(0.282)	
Social factors												
% villagers with illiterate household head	0.209		0.377		1.017	***	0.351		-0.276		-0.191	
	(0.371)		(0.295)		(0.211)		(0.414)		(0.410)		(0.487)	
% villagers having high level of trust in others	1.030	**	0.855	**								
	(0.449)		0.421									
Program design factors												
# vouchers received per village	0.053	***	0.048	***	0.024	**	-0.013		0.009		0.029	
	(0.013)		(0.013)		(0.012)		(0.022)		(0.017)		(0.023)	
Socio-economic environment												
Agricultural extension agent present in village	-0.119		-0.175		0.011		-0.203	***	-0.203	***	-0.102	*
	(0.241)		(0.219)		(0.099)		(0.066)		(0.059)		(0.061)	
_cons	-0.397		-0.403		-0.744	***	-0.210		0.715	**	0.589	**
	(0.375)		(0.372)		(0.262)		(0.300)		(0.339)		(0.260)	
N	37		37		37		37		36[(3)]		32[(3)]	
F	4.069		4.909		8.968		2.388		8.254		5.339	

Note: Standard deviations are reported in the brackets.*Denotes significance at 10% level; ** at 5% level, *** at 1% level. Weights calculated in Appendix A1 are aggregated at the village level and used in all regressions. (1) Poverty line taken from Christiaensen and Pan (2010); (2) poverty line = regional median consumption per adult equivalent. (3) The sample size is smaller because some villages had no users of improved seeds and inorganic fertilizer in 2004 and the targeting differentials are not defined for these villages.

Table 6: The more unequal land is distributed and the further away from a town the village is, the larger is the elite capture of the vouchers.

Tobit estimates	# vouchers per village captured by elected officials or VVC members	
Political factors		
Land inequality (Gini index)	2.409	**
	(1.024)	
% villagers listening to the radio/watching TV/ reading the newspaper/ using the internet at least once a month	1.145	
	(2.399)	
Social factors		
% villagers with illiterate household head	-0.229	
	(1.618)	
% villagers having high level of trust in others	-3.189	
	(2.728)	
Program design factors		
# vouchers received per village	0.405	***
	(0.080)	
Socio-economic environment		
Agricultural extension agent present in village	-0.073	
	(0.493)	
Distance to nearest town (km)	0.050	***
	(0.018)	
Constant	-1.523	
	(2.085)	
N	37	
F	13.84	

Note: Tobit estimates. Standard deviations are reported in the brackets.*Denotes significance at 10% level; ** at 5% level, *** at 1% level.