The return to agricultural advice in Ethiopia: A rationale for a success story?
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No. 33/15

BATH ECONOMICS RESEARCH PAPERS

Department of Economics

ABSTRACT

The most recent data shows that cereal production in Ethiopia is increasing very rapidly. We examine the potential impact on this of the advice given by extension agents. Using survey data from 2014, we find a positive impact of several kinds of advice on both crop yields and income. However, not all advice is positive in its impact and there is evidence that advice on credit may actually have a negative impact, particularly on income, although this impact may be less for better educated farmers. This is particularly likely to be the case in areas affected by drought. In addition animal husbandry advice has most impact in drought affected areas and land management in non-drought areas. Marketing advice impacts positively in all areas.

Key words: Cereals; extension agents; credit
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Acknowledgements
We acknowledge funding from DFID

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Introduction

According to the latest figures from the World Bank's development Indicators, the value added of agriculture constitutes approximately 48.6% percent of GDP in 2012. Approximately eighty-three percent of the population of Ethiopia depends directly on agriculture for their livelihoods. Many others depend on agriculture-related industries such as textiles, leather, and food oil processing. There is ample land and in much of the country water resources are plentiful. Despite this, the 91.7 million population, in 2012, represents a large demand for agricultural products and some regions do suffer from water shortages. Unlike many other governments in the region, Ethiopia recognises the importance of agriculture and in 2008 16% of the government's budget was committed to the agricultural sector and has actively been attempting to promote its efficiency.

A core part of the government's investment in agriculture is the public agricultural extension system (Davis et al, 2010). Davis *et al.* note that the professional capacity of the extension program has been helped with the graduation of over 60,000 development agents (DAs) from the Agricultural Technical and Vocational Education and Training (ATVET) colleges in the previous six years with three-year diplomas. This is a big increase in both quality and quantity on what went before. Dercon *et al.* (2009) showed that a minimum of one visit from a DA raised production growth by 7 percent and reduced poverty by 10 percent. However Davis *et al*. also note that agricultural productivity remains low, inputs are scarce and expensive, and market and credit access are extremely limited. Little attention is supposedly paid to gender or age (EEA/EEPRI 2006) and according to Buchy and Basaznew (2005) women-focused extension is limited. In part this may be because of cultural perceptions that 'women do not farm' (Cohen and Lemma, 2011) despite the fact that women are closely involved in all aspects of agricultural production and marketing. About 77 percent of Ethiopians follow culturally conservative versions of Orthodox Christianity and Sunni Islam that may help reinforce the traditional perspective of women's role in society. However, national policies do pursue gender equality.

The Government of Ethiopia has recently established farmer training centres in every local administrative area (there are 18,000 nationwide) and three extension agents at every training

centre. Between 2000 and 2008, the number of extension agents increased from 15,000 to 45,000, with the aim of reaching about 66,000. Reaching that goal would probably give Ethiopia the world's highest ratio of extension agents to farmers[1]. This effort is reflected in the proportion of fields that use extension services rising from just over 5% in 2008 to 12% in 2011 (Khan et al., 2014). The posting of agricultural extension agents in local communities has improved their attentiveness to farmers' needs and constraints, and enhanced the working relationship between them (Cohen and Lemma, 2011).

Despite this focus, as we have already seen Ethiopia has not tended to be viewed favourably in terms of agricultural productivity (Dercon and Christansen, 2011; Spielman et al, 2010). For example, Dercon and Christansen commented that cereal yields in Ethiopia were currently only about 1250 kg/ha, compared with 2500 and 4500 kg/ha in South and East Asia respectively. Moreover they observe recent trends had shown only marginal improvement, at least until 2003. However, as Figure 1 shows in recent years there has been what might be described as a dramatic change in the picture with respect to cereal yields. The beginning of this upturn might be dated at 2003, but it really becomes very clear from 2008 onwards. There has been some improvement in Sub Saharan Africa as a whole, but at nothing like the rate we observe in Ethiopia and although still behind South Asia, this gap is closing[2]. What is more this has been accompanied by an expansion in land under cereal production from 8,486,199 hectares in 2003 to 9,547,242 in 2012, hence it is not the case that more marginal land has disappeared from the picture, raising the average productivity of what is left. Indeed the reverse is the case, with the improvement in productivity being achieved along with what is probably more marginal land being cultivated. Together these trends imply a substantial increase in production to 18,809,959 metric tons in 2012, up from 9,532,780 metric tons in 2003, i.e. an increase of 97.3%. This compares to an increase of 18.8% in South Asia over the same time period. Clearly Ethiopia is no longer performing as badly as in the past and on this measure at least may actually be counted as something of a success story.

Insert Figure 1 about here.

[1] http://www.farmingfirst.org/wordpress/wp-content/uploads/2012/06/Global-Forum-for-Rural-Advisory-Services_Fact-Sheet-on-Extension-Services.pdf

[2] It is of course not entirely valid to compare yields in different parts of the world with different climates and geographical characteristics.

In this paper we will be focusing on the potential impact of the extension system in explaining this recent success. Specifically, we will be examining the impact of extension agents based in *kebeles*. These typically consist of four to seven villages. The *kebele* is the lowest administrative tier in Ethiopia's federal structure, the other being: federal, regional, zonal and district. At the *kebele* level citizens elect councils that formally appoint executive and judicial bodies. An even smaller unit than the *kebele* is the *lemati budin*, which are collections of approximately 30 households. Extension agents often work closely with *lemati budin* (Cohen and Lemma, 2011), which may help explain why in some cases some people in the *kebele* are unaware of the existence of an extension agent, which others are aware of. This focus on *kebeles* may help in the development of strategies in tune with specific local conditions and reinforce the communities' ability to plan and manage development activities for themselves (Cohen, Rocchigiani, and Garrett 2008).

A full impact evaluation study is not possible given the data we have and hence we rely on the perceptions of the difference that the advice made to the recipients of that advice. We will be analysing several different types of advice including (i) agricultural practices, (ii) land management, (iii) fertilizers, (iv) marketing, (v) access to credit facilities and (vi) animal husbandry practices. In addition, we will be seeking to analyse the impact of the different types of advice on both crop yields and income. The paper proceeds as follows. In the next section we discuss the relevant literature. We then discuss from a theoretical perspective how advice might impact on farmers and other methodological issues, and we also present the data. The penultimate section presents the results and finally we conclude the paper.

Background

The literature on the extension program has been somewhat ambivalent. Deployment of extension teams to *kebeles* can facilitate communities' ability to plan and manage development activities for themselves on a sustainable basis (Cohen, Rocchigiani, and Garrett 2008). Extension services generally have positive impacts on nutrition and poverty reduction (Dercon *et al.* 2009). However, their success has said to be constrained by weaknesses elsewhere in the system. Hence EEA/EEPRI (2006) argue that distribution channels and institutions are flawed, the formal seed system has weaknesses, and there is a lack of markets, both for inputs and outputs. Extension agents have worked under targets for enrolling farmers. The process mainly works by the agents transferring knowledge to the farmers, with relatively little knowledge flow in the reverse direction (Buchy and Basaznew, 2005).

One of the reasons Dercon and Christansen (2011) gave for this poor performance was lack of fertiliser use. This they put down mainly to cost, but also to limited availability and non-suitability of the agro-climatic conditions. Lack of knowledge and skills in adopting modern

inputs was only a very minor factor. Nor was lack of credit deemed a major factor, although they note the very high interest rates. Fertilized plots were characterised by greater yields than non-fertilised plots, although not in periods of extreme droughts and floods, with extreme being denoted by below the 20th and above the 80th percentile. Thus they argued that fertilizer use is a high return, but high risk technology. The high interest rates on credit are perhaps a little surprising in view of public sector involvement in the provision of credit. The regional governments initiated a 100% credit guarantee scheme beginning in 1994. Credit is extended to farmers by the Commercial Bank of Ethiopia (a state-owned bank), through cooperatives, local government offices, and more recently, microfinance institutions (Spielman et al, 2010).

The extension system has focused on the distribution of standard packages to farmers. These include seeds and commercial fertiliser, credit needed to buy inputs, soil and water conservation, livestock and training. Efforts to promote other sustainable land management have concentrated on soil erosion without consideration of the underlying socioeconomic reasons for low soil productivity (Kassie, *et al.*, 2010). As a consequence, advice has been given which has been unprofitable, risky or irrelevant given the farmers' resource constraints (Amsalu, 2006; Pender *et al.*, 2006). The extension system has also been criticised for placing an emphasis on targets for physical input use, rather than concepts such as efficiency and input profitability. It has also been claimed that most extension agents see their role as to primarily distribute fertilizer and credit (EEA/EEPRI, 2006), rather than to give technical advice, and of course it is the latter which increases knowledge. Hence both Bonger *et al.* (2004) and EEA/EEPRI (2006) observe that many farmers who initially adopt the packages promoted by the extension system, subsequently stop doing so. However, Spielman *et al*., (2010) also note that a series of reforms have been made to redress these weaknesses. Firstly there has been an attempt to look beyond cereals to other crops and livestock. There has also been a focus on improved post-harvest technology adoption, and encouraging natural resource management. Nonetheless, they still argue the need for deep reforms to the extension system.

Other evidence is a little more positive, although still emphasising that practices could be better. Elias *et al*. (2013) argue that extension can increase productivity by increasing the speed of technology transfer, increasing farmers' knowledge and helping them with land management practices. Their study is based on three *kebeles* in Goazamin *woreda*, which has a population of approximately 134,00 in an area of 1218 $km^{2.}$ In all there are 25 *kebeles* in this *woreda*. They regress the log of output on individual characteristics, plot characteristics and a dummy variable indicating whether the farmer had participated in an extension program. Variables relating to participation include education, age and whether involved with the administration of the *kebele*. They found that participation in the extension program

increased productivity by about 20%. Other factors which influenced productivity included age, male head of household and plot characteristics. As age increased, plot productivity declined. Similarly higher education also reduced productivity, which was a slightly unexpected result. Despite this crop yields were below the targets set by the extension programme. Several reasons are discussed including the supply push focus of the program rather than demand pull, low technology adoption rate and shortage of basic training for extension staff. The nature of the loan system was also criticised.

Kassie, *et al.* (2010) find evidence of a strong impact of land management practices on agricultural productivity in the low agricultural potential areas. In the high agricultural potential region, however, fertilisers have a very significant and positive impact on crop productivity, whereas land management practices have no significant impact. The productivity advantages of minimum tillage in the low-potential areas may come from its ability to conserve soil moisture in dry environments. Fertilisers may be less profitable in such areas due to a lack of soil moisture. Furthermore they argue that investing in fertilisers in these environments is a financial risk to the farmers. Hence, their analysis raises the important point that the impact of advice and increasing knowledge may not be the same in all areas, but vary according to local conditions. Finally the most recent study is much more positive. Khan et al., (2014) conclude that the effect of woreda-level spending on agricultural extension workers is associated with higher yields for major crops. These include cereals, coffee, vegetables, enset and fruit. In addition such spending increases the probability that farmers will improve their farming techniques and that this will happen regardless of plot size.

Methods

We assume output to be a function of resources which are in turn a function of knowledge:

$$Y_{it} = A(\Gamma)S_{it}(\Gamma)^{\alpha S}L_{it}(\Gamma)^{\alpha L}K_{it}(\Gamma)^{\alpha K}F_{it}(\Gamma)^{\alpha F} \quad (1)$$

That is we adopt a Cobb-Douglas production function. Γ represents knowledge. i denotes the i'th farmer and t the time period. We are not at this stage differentiating between different types of knowledge, e.g. knowledge about fertilisers or animal husbandry. A denotes overall efficiency with which the different factors of production are used, i.e. it is total factor productivity (TFP). α_S represents the impact of a change in soil quality on productivity. Soil quality itself is a function of knowledge. A similar rational applies to the other factor of production. Thus L is labour input, not simply hours worked, but also the quality of that labour input. K is capital and again it reflects not just the amount of capital, but also the

effectiveness with which it is used[3] and finally F is fertiliser input. Abstracting from the subscripts, the impact on output of an increase in knowledge ($\Delta\Gamma$) is then given by:

$$\partial Y_{it}/\partial\Gamma\Delta\Gamma = \{(\partial A/\partial\Gamma)\Delta\Gamma/A + \alpha_S(\partial S/\partial\Gamma)\Delta\Gamma/S + \alpha_L(\partial S/\partial\Gamma)\Delta\Gamma/L + \alpha_K(\partial K/\partial\Gamma)\Delta\Gamma/K + \alpha_F(\partial F/\partial\Gamma)\Delta\Gamma/F\} A S_{it}^{\alpha S} L_{it}^{\alpha L} K_{it}^{\alpha K} F_{it}^{\alpha F} \quad (2)$$

Hence the impact of extra knowledge on output via soil quality depends upon the marginal product of soil quality (α_S), the responsiveness of increased soil quality to knowledge and the extent to which knowledge increases ($\Delta\Gamma$). But it also depends upon basic conditions, including initial soil quality via the final term multiplying the term in {.}. Focusing on soil quality, a low level means the gains from the advice can be small, because output is in any case small. Moreover if soil quality varies according to the climate, then in a bad year it can fall substantially meaning that despite the advice given and the resulting improvements in practice, output falls from the previous year. If the advice has resulted in increased expenditure then financially the farmer can be worse off because of that advice. If in addition, the farmer has borrowed money which has to be repaid, the results can be very serious. Note, the problems are caused by adverse weather, but if the farmer had not been given the advice they would not be faced with these problems. This can also affect output as well as income, if these financial problems force the farmer to cut back on some factors of production.

The impact is of two kinds. Firstly that which can directly increase crop yields and secondly that which can increase their income, given a specific crop yield. Of course if a farmer increases their yield they are likely to increase their income provided price stays unchanged. In addition, if an individual can get more income per unit of output, then this can be a spur to increasing output. Marketing advice is typically aimed at increasing income per unit of output. Other types of advice may increase output or may reduce unit costs of production by facilitating the more efficient use of inputs. There may also be spillover effects on neighbouring farmers as they gain directly, for example, by better land management which means animals do not roam as much on to other farms, or indirectly as they increase their own knowledge by observing what their neighbours are doing. Hence we assume that output gains are a function of

$$\partial Y_{it}/\partial\Gamma_{it}\Delta\Gamma_{it} = f(\mathbf{X}_{it}, \mathbf{P}_{it}, \mathbf{\Gamma}^*_{it}) + \varepsilon_{it} \quad (3)$$

[3] Alternatively we could suppose that the α coefficients are a function of knowledge. Our approach is a little simpler.

where **X** represents the individual farmer's characteristics which impact both on overall output and the ability to learn from advice. $\mathbf{P}_{it}$, is a vector of plot characteristics, such as soil moisture and $\mathbf{\Gamma}^*_{it}$ is a vector of the different type of advice given to the individual farmer. ε_{it} is a normally distributed error term.

We do not have data on output per se, rather on perceptions of the impact of the advice on both crop yields and also on income. This has the advantage of focusing attention on the impact of the advice, whereas production can vary for a number of reasons and to analyse it fully it is desirable to have a combination of cross section and time series data. It has the disadvantage of being an ordinal measure of improvement. Our dependent variable is coded 1 if the advice made no difference, 2 if it made some difference and 3 if it made a lot of difference. The response belongs to the j^{th} category if:

$$\alpha_{j-1} < (\partial Y / \partial \Gamma)\Delta\Gamma \ < \alpha_j \qquad j = 1,2,...,m \tag{4}$$

Where m=3. Note that $\alpha_0=-\infty$ and $\alpha_m=+\infty$. Define $Z_{i,j}=1$ if $\partial Y_{it}/\partial\Gamma\Delta\Gamma$ is in j^{th} category, and $Z_{i,j}=0$ otherwise, for the i'th individual. Then the probability of $Z_{i,j}=1$, i.e. the probability the i-th individual has the j-th response, is:

$$\Pr\left(Z_{i,j}=1\right)=\Phi\left(\alpha_j - f(X_i,P_i,\Gamma_i^*)\right)-\Phi\left(\alpha_{j-1} - f(X_i,P_i,\Gamma_i^*)\right) \tag{5}$$

where Φ is the cumulative standard normal distribution for ε_i. Linearising f(.) we can estimate both the coefficients and the dividing points (α_j) between the different categories by ordered probit.

Insert Table 1

Data

The data was obtained from the Woreda and City Benchmarking Survey (WCBS) collected in 2014 using a multi-stage stratified sampling approach based on the remoteness and food security levels of households (World Bank, 2012[4]). Within each region the sub-sample size was determined by population (based on census data). Data was collected on 326 *kebele* in 48

[4] http://web.worldbank.org/WBSITE/EXTERNAL/EXTMODELSITE/EXTCOUNTRYMODEL/0,,contentMDK:22838982~menuPK:3968189~pagePK:64027988~piPK:64027986~theSitePK:223224,00.html

woreda covering the whole of the country. In total 7429 individuals were interviewed. This survey is focused on rural areas. A wide variety of questions were asked in addition o the ones included in this study, relating, e.g. to issues of governance, service provision and taxes. A companion survey focuses on urban areas. The variables we use are defined in Table 1. All the variables relating to farming and farming practice are used in this study. Apart from the two variables on the impact of the advice and the variables on whether different types of advice were given, we also have information on individual age, gender, level of education and the number in the family. Information on the characteristics of the plot relate to whether the individual grew crops and had animals, these not being mutually exclusive events. Thus most people sampled, 60.8%, raised both animals and grew crops, a substantial proportion just grew crops (31.3%) and an even smaller proportion just had animals (7.9%). Less than 1% of those in the sample neither had animals nor grew crops. But they must have had some link with agriculture as they still received extension service advice, e.g. 12.5% of this 1% received advice on animal husbandry and the mean response on impact was still positive. In addition we used information on drought conditions to proxy soil moisture, for reasons we expand upon later.

Insert Figure 2 about here.

Figure 2 shows the proportion in a *kebele* who were aware of an extension agent in the *kebele*. Ideally we would just see observations around the zero and one proportions. The left hand side of the diagram shows that there were only a few occasions when some people reported an extension agent, but most did not. This is certainly the case up to a proportion of 0.4 and we can conclude that in such *kebeles* there was no extension agent. This related to some 254 individuals out of a total of 7,420. Once we move to a proportion in excess of 0.5 the observations become much more common. 2,045 respondents lived in a *kebele* where between 50% and 80% of those interviewed reported an extension agent. Finally 5,019 lived in *kebeles* were the proportion reporting an extension agent was in excess of 80%. Thus we can conclude from this, that most *kebeles* in our sample had an extension agent, but knowledge of this was far from perfect. Hence in *kebeles* where 70% or more reported an extension agent some 7.7% of the respondents did not know about it. This is perhaps a matter of concern.

Insert Figure 3 about here.

Figure 3 shows the number of pieces of advice obtained. The majority obtained at least one piece of advice, i.e. it was very much the norm. Table 2 shows the linkages from receiving one type of advice to another. It shows, e.g., that for those who received advice on credit, 76% also received advice on marketing. The mirror image of this is that of those who received advice on marketing, 65% also received advice on credit. The two do appear closely linked, and, e.g., no other type of advice is accompanied with a similar response in marketing advice. Thus the next highest linkage is from those who receive advice on animal husbandry, where 44% received also received advice on marketing. The proportion receiving advice on agricultural practices having also received advice on credit is very high at 93%, although the former tends to be a common form of advice. Nonetheless, there is evidence that credit advice, and to a lesser extent marketing advice, tends to be given jointly with other advice. Data on all types of advice are reported for all farmers. But of course there is a preponderance of advice given on animal husbandry to those who rear animals, where 81% received advice. However 21% of those who did not rear animas also received such advice. Why should this be the case? One possibility is that they were exploring the possibility of rearing animals, another is that they have ceased to do so, possibly as a consequence of the advice. A third possibility is that they are in an industry linked to agriculture.

Insert Table 2 about here.

Table 3 shows the summary data as it varies across individual characteristics. The first column relates to whether the individual knew of an extension agent in their *kebele*. The majority of people responded yes, although the most highly educated were slightly less aware of this than others[5]. The next column represents the proportion who had received advice on animal husbandry. Again a majority of respondents had, and once more the lowest incidence of people answering yes were amongst the most highly educated. The next two columns related to advice on credit and marketing. They follow a similar pattern and in general a much smaller proportion of those questioned had received such advice. Once more the highly educated are an outlier, although this time being more likely to have received such advice than others. The next two columns relate to information on fertilisers and land management. Once more a majority of respondents had received information on these. The most noticeable difference this time, is the greater incidence of young people receiving such advice, particular in comparison to older people. This, apart from animal husbandry advice, would appear to be

[5] This does suggest, as also indicated by the literature, that perhaps higher educated people have activities other than farming.

a general trend. This makes sense as the young will have learnt less 'by doing'. The final column of this kind relates to agricultural practices and as such covers a very wide area. A large majority of people have received such advice and again the highly educated are slightly more likely than others to have done so. The final two columns relate to the impact this advice, in general, has had on crop yields and the individual's income[6]. The responses ranged from 1 (none) to 3 (a lot). Thus we assume that output and income cannot fall as a result of the advice received. The responses to both questions were fairly enthusiastic, although very slightly more so for crop yields than income. The biggest gainers in both respects tend to be the better educated.

Insert Table 3 about here.

Table 4 summarises the data across the different regions. The first column shows that the bulk of the survey respondents were in Oromiya, with only a very small proportion residing in Gambela. Those in Oromiya were the most likely to know of an extension agent in the *kebele* and those in Gambela least likely, although the sample size for the latter is so small that too much should not be made of it. Apart from differences in coverage of extension agents across the country, there are substantial differences in the remaining columns. For example, those in Tigray received relatively little advice on animal husbandry. In part some of these differences reflect differences in agricultural patterns. But we also note that those in Oromiya received most of the information on credit and marketing, with Amhara and SNNP also figuring prominently in both respects. There are also substantial differences in the impact this advice has had, as indicated in the final two columns. Focusing on crop yields, Binshangul Gumuz has fared the best followed by SNNP and Oromiya. The poorest return on the advice has been in Afar. Of course some of these regional differences may be due to the different characteristics of the regions. In order to consider this more we now turn to the regression analysis. This will also help us determine which of the variations across the socio-economic characteristics shown in Table 3 actually reflect causal impacts

Insert Table 4 about here.

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[6] If the question had been on what had happened to yields and income then just focusing on those who received advice would be problematic. But we cannot ask a similar question of those who did not receive advice as the question we are analysing pertains to the impact *the advice* had on yields and income. Obviously this question cannot be asked of those who did not receive advice.

Regression Results

In Table 5 we present the results relating to the impact on yields. They are based solely on those who had received some advice[7]. Column 1 shows that advice received on animal husbandry, marketing, land management and fertilisers were all significant at the 1% level of significance. Advice on agricultural practices was not significant. However being in receipt of advice on credit was significantly negative. This is not impossible. Credit has to be repaid and eventually this can cost the farmer more than they gain, even in terms of crop yields, as the literature has emphasised. However this does alert us to a potential problem of endogeneity. To the extent that the farmer is the one seeking this advice, rather than being proffered it by the extension agent or some other person, then it could signal that the individual is in financial problems. At the very least it reflects an interest by the farmer in gaining access to credit. The negative sign in the regression may be picking this up. With respect to the other variables this endogeneity problem is probably more limited as extension agents are incentivised to contact individuals. We return to this issue later.

Insert Table 5 about here.

However, partly because of this possibility, in the second regression we replace these individual responses by the collective responses of others in the *kebele*. The results are now somewhat different. Advice on animal husbandry, land management and fertilisers remains positively significant at the 1% level of significance, but this is not the case for marketing. Credit is now significantly positive. In the cases were advice on credit leads to an individual receiving credit, the impact may be twofold, firstly on the individual who receives the credit and secondly on others in the *kebele* who may now be more likely to be paid any money they are owed, which they can invest in their own production. This twofold impact potentially exists, albeit for differing reasons, for the other variables too. The third column attempts to capture this twofold effect by including both individual based and *kebele* based variables and with credit there is indeed evidence of these different effects. In column 5.4, we added an interactive variable equal to education multiplied by the variable reflecting having received advice on credit. This is significantly positive, which indicates that the damage receiving credit does to crop yields declines with the individual's level of education. Only significant

[7] This suggests that potentially sample selection bias could be a problem. But applying Heckman's methodology to the equations, there was no significant correlation between the error terms in the sample selection equation and the equations we are estimating.

variables are retained in this specification. The nature of the individual based variables is as before, but for the *kebele* based variables, only land management remains significant. Thus despite potential problems of endogeneity with the individual variables, these results suggest that providing information on land management has a potential dual effect. Firstly on the individual receiving the advice and secondly on the other individuals in the *kebele*. What we do not know is this is because they learn by observation, which with land management may be particularly likely, or whether better land management for A has direct positive implications for A's neighbours. The other variables in these equations are of interest. Taking the equations as a whole, family size is never significant, nor gender. However, more educated people and older people tend to have benefited more from the advice than others, although the impact of the former declines once we introduce the interactive term between education and the receipt of credit advice. This suggests that much of the impact of increased education is by increasing the ability of those who use credit to use it to their advantage. Both those who grow crops and those who rear animals tended to benefit from such advice, although the former much more than the latter.

The literature has suggested that the impact of advice may vary according to the conditions facing the individual. A critical factor is soil moisture, which is impacted on by water availability. We do not have in the data base a measure of rainfall in the *kebele*, but we do have a variable which asked the individual whether they were usually subject to water shortages for drinking at some time in the year. Slightly over 51% responded that they were subject to such shortages. We now split the sample into those who were subject and not subject to water shortages. Column 5.5 relates to those who were not subject to water shortages and 5.6 to those who were subject to such shortages. The positive impact of animal husbandry advice is limited to the latter, and land management to the former. Marketing advice continues to impact on both. But the negative impact of credit advice is restricted to those subject to water shortages, which is again consistent with the literature.

Finally we return to the endogeneity issue. The results based on individual responses potentially reflect the joint impact of both an interest in the subject area of the advice and the advice itself. Hence we can conclude from these results that the joint impact of an interest in land management, together with receiving advice on this from the extension agent is to increase yields. We cannot conclude that this is due solely to the receipt of advice. Hence we now model such advice separately and include the predicted probabilities in the regressions in place of the individual responses. These predicted values are based on regressions which include the proportion in the *kebele*, other than the individual in receipt of advice, on each different area together with the drought variable. The results are shown in the final column of the table. Advice on animal husbandry and fertilisers remain positively significant. The most

important change is with respect to credit advice which is no longer significant. This suggests that people who are given such advice are likely to fair badly in the future in terms of crop yields, but that is not because of the advice per se.

In Table 6 we look at the results pertaining to improvements in income dependent upon the advice given. If we focus on the differences to Table 5, we can see that advice on fertilisers is now significantly positive, but only in the non-drought areas. The area of specialisation is no longer positively significant, although rearing animals has led to reduced financial returns[8]. Focusing now on the final column, we can see that advice on animal husbandry and fertilisers remain significant. Advice on credit is now weakly significantly negative at the 10% level, an effect again mitigated by an individual's level of education. But in addition, advice on marketing is now significant at the 10% level, and land management at the 5% level of significance.

Insert Table 6 about here.

Conclusions and Policy Implications

Our analysis has shown that the advice given by extension agents is having a positive impact in increasing both yields and incomes. On a less positive note, we note that there are a substantial number who are unaware of extension agents in a *kebele*, when most others are aware of them. Being as a *kebele* tends to consist of several villages, this may be a geographical problem, rather than a socio economic one. The results in the initial regressions are questionable in terms of showing the impact of advice, as they may also reflect the individual's interest in the area, if the individual plays a part in determining the type of advice given. But with the potential exception of advice on credit, which may also reflect the individual's financial position, they do show the combined impact of the person being interested in the area and receiving advice on it. Viewed in this light these combined interest variables do suggest that an interest in and advice on animal husbandry, land management and marketing all increase both crop yields and income, whilst in the initial regressions advice on fertilisers impact most clearly on income. The impact of marketing is particularly substantial, but it fails to show up in the regressions based solely on the *kebele* average responses. Whereas animal husbandry, land management and fertilisers all show up in these regressions. Land management advice is particularly strong in impacting on both crop yield

[8] This may be a short term effect, relating to conditions at the time of the survey.

and income and there is some suggestion that both the individual in receipt of the advice and their neighbours benefit from this focus of attention. The lack of significance of advice on agricultural practice may simply be that this is simply too broad a concept and needs to be further broken down. The pattern of significance of the other variables suggest that agricultural support yields its best results when targeted at those with the ability to use it, i.e. the better educated and older people who will have learned from experience. The former emphasises once again the value of education per se in promoting growth, innovation and development.

There are also significant differences between the type of area. In areas which are not prone to drought, a focus on land management and fertilisers has a positive impact, but not in areas which are prone to drought. In these areas it is a focus on animal husbandry which pays dividends. A focus on marketing yields positive rewards in all areas and this is true for both crop yields and financial rewards. The impact on crop yields is plausibly an indirect one whereby farmers respond to increased prices and a greater ability to sell output by increased effort. Finally the negative impact of a focus on credit is restricted to drought prone areas. If we focus just on the impact of advice as reflected in the final columns of each table, we note first of all that the negative impact of credit disappears for crop yields, but not for financial rewards. However, this negative impact is moderated by levels of education. This suggests that care needs to be taken when giving advice on access to credit and perhaps more emphasis on the dangers associated with this, particularly in drought prone areas which may be particularly subject to weather shocks, and particularly for poorly educated people. More generally advice on animal husbandry and fertilisers has a positive impact on both crop yields and income, whilst advice on land management and marketing also impacts positively on financial rewards. We did not have enough data to investigate whether different types of advice work better in tandem. But a variable equal to the number of types of advice given, although negative, gave only weak evidence for declining returns with respect to the amount of advice given

As we began the paper we thought that this would be a story about the impact of extension agents. And to a large extent it is, the information in our sample is being provided by extension agents and the advice they have given has had a positive impact on farmer's crop yields and income. Thus it can be seen as a factor behind the remarkable success story of Ethiopian agriculture in recent years. But our analysis has also showed that more information can improve the efficiency of farmers and also their income, although not all types of information has an equal impact. Hence just as much as a story about extension agents, it is a story about the importance of knowledge. Nor were there any substantial differences in any of

our equations or basic statistics between men and women. This seems to be knowledge distributed to all, benefitting all.

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Table 1: Data definitions

Socio-economic, demographic variables	
Age	Age in years
Education	Coded from 1 (no schooling) to 24 (degree) and 25 above degree, as an increasing measure of education.
Male	Coded 1 if the individual was a male
Family size	Number of people currently living in the individual's household.
Plot Characteristics	
Grows crops	Coded 1 if the individual grows crops, otherwise 0
Rears animals	Coded 1 if the individual rears animals, otherwise 0
Drought	Coded 1 if the individual suffers from regular periods of drought in the sense of a shortage of drinking water, otherwise 0
Received information on (coded 1 for yes and 0 no):	
Agricultural practices; Land management; Fertilizer; Marketing; Credit facilities; Animal husbandry	
Impact	
Crops improve	The difference the above advice has made to the crop yield ranging from 1 (none) to 3 (a lot)
Income improves	The difference the above advice has made to income ranging from 1 (none) to 3 (a lot)
kebele based variables (*average of responses of others in the individual's locality)*	

Table 2: The Inter-linkages between the different forms of advice.

	Credit	Market-Ing	Animal husbandry	Fertilisers	Land management	Agricultural practices
Credit		0.76	0.84	0.89	0.86	0.93
Marketing	0.65		0.81	0.8	0.87	0.62
An. Husband.	0.39	0.44		0.72	0.74	0.86
Fertilisers	0.39	0.4	0.66		0.8	0.93
Land man	0.38	0.43	0.68	0.81		0.9
Ag Practices	0.33	0.35	0.66	0.77	0.75	

Notes: Shows the proportion getting advice in the column variable when they receive advice in the row variable. For example, of those who receive credit advice, 76% receive advice on marketing.

Table 3: Summary Data Relating to Individual Characteristics.

	Extension agent	Animal Husbandry	Credit	Marketing	Fertiliser	Land Man-agement	Agricultur-al Practices	Crops improve	Income Improves
All	0.779	0.62	0.291	0.329	0.679	0.524	0.817	2.36	2.3
Young<30	0.797	0.631	0.321	0.329	0.731	0.561	0.847	2.37	2.29
Older>=30	0.76	0.612	0.264	0.326	0.634	0.488	0.787	2.35	2.29
Male	0.793	0.621	0.278	0.317	0.665	0.525	0.815	2.36	2.3
High educated	0.724	0.585	0.342	0.447	0.707	0.523	0.845	2.51	2.41
No education	0.77	0.622	0.292	0.313	0.678	0.501	0.804	2.32	2.28

Notes: The final two columns relate to the average response which varied from 1 (none) to 3 (a lot) to the difference the support has made. All other columns relate to the proportion receiving advice in the different headings.

Table 4: Summary Data relating to Regions

Region	Sample	Extension agent	Animal Husbandry	Credit	Marketing	Fertiliser	Land Man-agement	Agricultural Practices	Crops improve	Income Improves
Tigray	8.3%	0.719	0.321	0.04	0.043	0.785	0.719	0.787	2.222	2.176
Amhara	16.2%	0.855	0.431	0.292	0.236	0.742	0.565	0.796	2.203	2.138
Oromiya	41.5%	0.932	0.748	0.408	0.511	0.754	0.778	0.894	2.449	2.343
SNNP	16.5%	0.857	0.488	0.294	0.309	0.69	0.769	0.827	2.529	2.454
Binshangul Gumuz	4.8%	0.938	0.752	0.109	0.142	0.634	0.864	0.981	2.741	2.563
Afar	4.6%	0.718	0.943	0	0	0.052	0.1	0.14	1.23	1.719
Somali	5.4%	0.668	0.521	0.009	0	0	0.019	0.46	2.204	2.135
Gambela	2.6%	0.074	0.8	0	0.2	0.5	0.4	0.6	3	2.9

Notes: The sample proportions show the proportion of the survey in that state, it does not sum to 100 due to other states where these questions were not asked. For other definitions of other columns see Table 2.

Table 5: Regression Results: Impact on Crop Yields

	5.1	5.2	5.3	5.4	5.5	5.6	5.7
Extension Agent Advice							
Animal husbandry	0.2934***		0.2723***	0.2822***	0.143*	0.3083***	0.8224***
	(6.10)		(5.34)	(5.90)	(1.81)	(4.98)	(4.79)
Credit	-0.2129***		-0.2242***	-0.3372***	-0.0944	-0.3173***	0.0085
	(4.36)		(4.34)	(5.79)	(0.93)	(4.07)	(0.04)
Marketing	0.3897***		0.4274***	0.3797***	0.5656***	0.3555***	0.1555
	(8.17)		(8.11)	(8.10)	(6.79)	(5.88)	(0.95)
Fertilizers	0.0102		-0.0149				0.9373***
	(0.22)		(0.31)				(3.47)
Land management	0.2341***		0.1838***	0.1949***	0.2567***	0.0887	0.3482
	(5.17)		(3.98)	(4.33)	(3.55)	(1.46)	(1.22)
Agricultural practices	0.0474		0.005				0.068
	(0.80)		(0.08)				(0.32)
Credit x education				0.0383***	0.0608***	0.0075	0.0403***
				(4.07)	(3.69)	(0.59)	(4.69)
Individual Based variables							
Log age	0.1759***	0.1528**	0.1402**	0.1263**	0.271***	0.0122	0.0726
	(2.70)	(2.33)	(2.13)	(1.98)	(2.77)	(0.14)	(1.07)
Education	0.0245***	0.025***	0.0235***	0.0089	0.0057	0.0146	0.0152*
	(4.82)	(4.89)	(4.60)	(1.43)	(0.67)	(1.60)	(1.80)
Male	-0.0282	-0.0271	-0.0221				
	(0.79)	(0.76)	(0.61)				
Log family size	-0.00057	0.0091	-0.0036				
	(0.01)	(0.20)	(0.08)				
Plot Based Variables							
Crops	1.054***	1.022***	1.000***	1.021***	1.347***	0.6208***	0.113
	(9.65)	(10.35)	(9.04)	(10.22)	(8.31)	(4.99)	(0.59)
Animals	0.1041**	0.291***	0.0996**	0.0926*	0.204**	0.0312	-0.413***
	(2.08)	(6.92)	(1.97)	(1.86)	(2.46)	(0.48)	(3.58)
Kebele Based variables (Advice)							
Animal husbandry		0.1323	0.0285				
		(1.47)	(0.30)				
Credit		0.3213**	0.390***				
		(2.43)	(2.78)				
Marketing		-0.0687	-0.3458***				
		(0.63)	(2.98)				
Fertilizers		0.095	0.1384				
		(0.75)	(1.05)				
Land management		0.4956***	0.4065***	0.453***	0.5785***	0.4999***	
		(3.95)	(3.20)	(5.07)	(4.34)	(4.04)	
Agricultural practices		-0.0818	-0.055				
		(0.76)	(0.48)				
Observations	5192	5185	5185	5190	2259	2931	4789
Log Likelihood	-3636	-3682	-3612	-3612	-1508	-1976	-3417
X^2	3641	4326	3856	1900	1659	2407	582.7

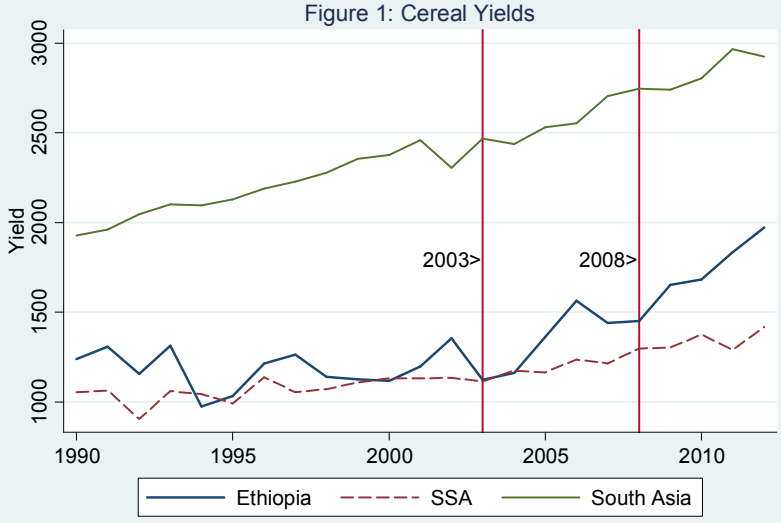
Notes: Regressions estimated by ordered probit; t statistics in italics. ***/**/* denotes significance at the 1%/5%/10% levels of significance. Standard errors have been corrected for heteroscedasticty. Variables defined in Table 1, X^2 represents the likelihood ratio test statistic. Regional variables included in all regressions. The advice variables in 5.7 have been instrumented. 5.5 is based on individuals not suffering from drought and 5.6 is based on individuals suffering from drought.

Table 6: Regression Results: Impact on Income

	6.1	6.2	6.3	6.4	6.5	6.6	6.7
Extension Agent Advice							
Animal husbandry	0.326*** (7.20)		0.2962*** (6.17)	0.3075*** (6.79)	0.0725 (0.98)	0.4427*** (7.21)	0.9559*** (5.73)
Credit	-0.2863*** (6.27)		-0.3031*** (6.35)	-0.4457*** (8.13)	-0.1494 (1.60)	-0.5104*** (6.62)	-0.332* (1.75)
Marketing	0.4026*** (8.83)		0.3942*** (7.94)	0.4012*** (8.80)	0.6761*** (8.58)	0.3134*** (5.15)	0.3043* (1.94)
Fertilizers	0.1489*** (3.30)		0.1264*** (2.71)	0.1161*** (2.62)	0.1582** (2.12)	0.0903 (1.54)	0.7574*** (2.90)
Land management	0.2292*** (5.12)		0.1877*** (4.10)	0.1966*** (4.33)	0.3015*** (4.01)	-0.0138 (0.22)	0.586** (2.06)
Agricultural practices	-0.0486 (0.85)		-0.0682 (1.14)				-0.0177 (0.08)
Credit x education				0.0455*** (5.19)	0.0389*** (2.75)	0.0306** (2.54)	0.0871*** (4.69)
Individual Based variables							
Log age	0.1423** (2.24)	0.1219* (1.92)	0.1066* (1.67)	0.0936 (1.51)	0.203** (2.18)	-0.0857 (0.98)	0.0769 (1.17)
Education	0.0177*** (3.78)	0.0184*** (3.86)	0.0168*** (3.54)	-0.00066 (0.12)	-0.0042 (0.55)	0.0018 (0.21)	-0.009 (1.15)
Male	-0.0065 (0.19)	-0.0046 (0.13)	0.00052 (0.02)				
Log family size	0.0081 (0.19)	0.029 (0.68)	0.0137 (0.32)				
Plot Based Variables							
Crops	0.2137** (2.22)	0.1991** (2.36)	0.167* (1.73)	0.1243 (1.42)	0.0404 (0.30)	0.1731 (1.38)	-0.4713*** (2.64)
Animals	-0.1338*** (2.81)	0.0499 (1.24)	-0.1561*** (3.24)	-0.1405*** (2.96)	-0.2761*** (3.32)	-0.0017 (0.03)	-0.7248*** (6.46)
Kebele Based variables(Advice)							
Animal husbandry		0.2799*** (3.19)	0.1653* (1.79)				
Credit		0.1692 (1.35)	0.2959** (2.23)				
Marketing		0.1165 (1.12)	-0.1166 (1.05)				
Fertilizers		0.3244*** (2.68)	0.2885** (2.29)				
Land management		0.3676*** (2.94)	0.2641** (2.07)	0.4276*** (4.86)	0.7327*** (5.65)	0.3126** (2.46)	
Agricultural practices		-0.2019* (1.89)	-0.135 (1.21)				
Observations	5195	5188	5188	5193	2262	2931	4790
Log Likelihood	-4096	-4148	-4069	-4068	-1808	-2054	-3779
X^2	697.6	608.8	743.7	726.5	1448	372.8	431.1

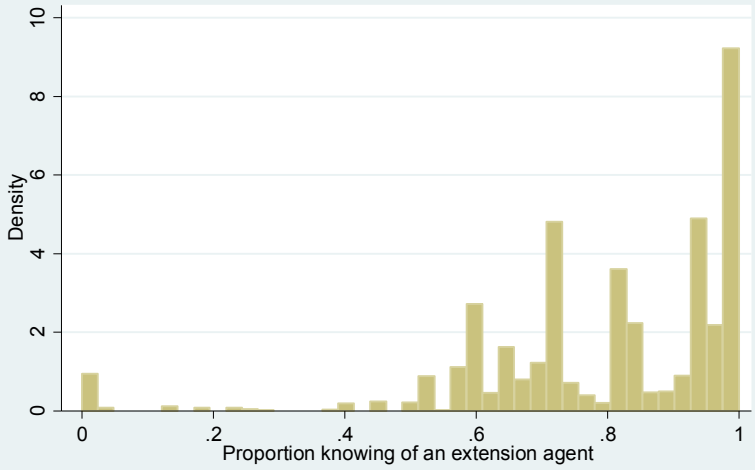
Notes: See Table 5.

Figure 1: Cereal Yields



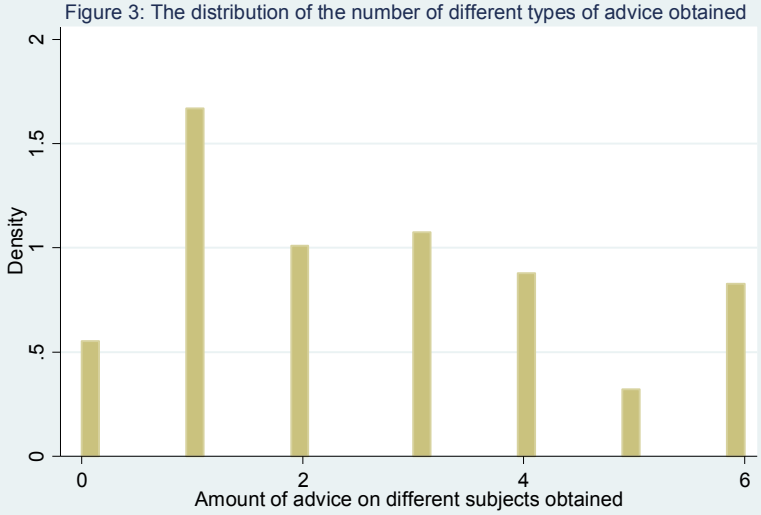
kg per hectares. Source: World Bank Development Indicators

Figure 2: The proportion in a kebele being aware of an extension agent in the kebele



Source: Dervived from DfID survey

Figure 3: The distribution of the number of different types of advice obtained



Source: Dervived from DfID survey