The Effect of Aspirations on Agricultural Innovations in Rural Ethiopia

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Abstract

Previous studies on innovation in agriculture focus mainly on identifying observable and resource related deprivation or 'external' constraints. Yet, related literature suggests that 'internal' constraints, such as lack of aspirations, could reinforce external constraints and this may lead to a self-sustaining trap of poverty and lack of proactive behavior. Since both aspirations and innovations are future oriented they are likely to be intimately linked. Aspirations are motivators which can enhance innovations. On the other hand, aspirations are also affected by one's level of achievement implying that aspirations and innovations are simultaneously determined. To identify the effect of aspirations on adoption of agricultural innovations, we conduct both plot level and household level analysis using a purposely collected data from sample households in rural Ethiopia. Using econometric strategies that account for the endogenous nature of the variable of interest, we find that low aspirations (and having very-narrow/wide aspirations gap) are strongly associated with low innovativeness of farm households and low adoption of innovation products such as improved seed, and low involvement in row-planting and sustainable natural resource management practices. Results suggest that the effect of aspirations is stronger on the intensity of use of innovations (e.g. fertilizer use per hectare of land) than its effect on access to or use of individual innovations if those innovations are widely adopted in the study areas. We also find other internal factors such as self-esteem, internal locus of control, trust in others, subjective wellbeing, and perception on causes of poverty to be strongly correlated with aspirations and expectations.

Key words: Aspirations, innovations, agriculture, Ethiopia

1. Introduction

This paper studies the relationship between aspirations and innovation behavior of farmers in rural Ethiopia. Previous studies on innovation mainly focus on adoption patterns of technologies and while incomplete they have increased our understanding of why some technologies diffuse faster than others. Technology attributes and farmers' perception about them (Adesina and Zinnah, 1993; Negatu and Parikh, 1999), land size, risk preferences, education, access to credit and extension services, wealth and labor endowment, roads, markets, tenure arrangement, and availability of complementary inputs, networks, etc are the main determinants identified in the innovation literature (for extensive reviews see (Rogers, 1983, Feder et al, 1985, Feder and Umali, 1993; Foster and Rosenzweig, 2010).

These widely studied determinants of innovation, however, are mainly observable and resource related, or they are 'external' constraints. Any policy targeted purely at addressing them may not necessarily bring about the desired change. This is because external constraints could be reinforced with 'internal' constraints, such as self-efficacy and other psychological factors, which may lead to a self-sustaining trap of poverty and lack of proactive behavior (Appadurai, 2004, Ray, 2006; Dalton et al., 2014). In line with Bandura's (Bandura, 1977) theoretical exposition of how perceived self-efficacy and behavioral changes might be related, (Bandura et al., 1977) empirically test and find that changes in behavior can be altered by altering the level and strength of self-efficacy.

In addition, notwithstanding the importance of policy interventions that relax external constraints, for example provision of credit and extension services, (Bertrand et al., 2004) argue that highly consequential behaviors are often triggered by situational or "channel factors", which may include psychological factors as addressed in the context of this paper. Thus, it is essential that internal constraints are considered and factored in social policy initiatives (The Psychologist, 2009) for at the very minimum they can enhance the effectiveness of policies that address material deprivation (Dalton et al., 2014). In fact, the recent World Development Report (World Bank, 2015) reflects the growing emphasis being given regarding the importance of understanding the psychological and social underpinnings of behavior in development research and policy.

The main objective of this paper is to investigate whether low aspirations lead to low innovations. Aspirations are future oriented and they entail effort on condition that one believes in own ability to change outcomes also known as having self-efficacy which in turn

imply having internal locus of control – a belief that life outcomes are controlled by oneself (Bernard et al., 2011). Yet, (Genicot and Ray, 2014) argue that aspirations encourage investment to an extent that they are moderately above an individual's standard of living. Ray elaborates that it is the aspirations gap – the difference between aspired and achieved outcomes – that affects future oriented behavior. So, according to Ray, when this gap is either too low or too large leads to aspirations failure or exit (i.e. lack of investment efforts to narrow the gap and raise future standards of living). The reason is because for the former the reward is too small to be worth the effort; and for the latter the relative gap will remain very large regardless of investment effort.

It is a widely recognized fact that the existence of various reference groups along with availability of information and economic opportunities make it imperative for observations and learning to occur through social interactions. According to (Appadurai, 2004), aspirations are socially determined and the poor may lack the resources (or the "capacity") to aspire, but mobilization by social movements can expand the capacity to aspire, in part through regular social gatherings and sharing ideas and experiences about future-oriented activities among the poor. This is because as much as it is drawn from own past experience, aspirations are formed from experience and average outcomes of relevant others or the aspirations window (Ray, 2006) and also going distribution of income (Genicot and Ray, 2014; Stark, 2006). Relatedly, Akerlof's discussion of social distance and interactions (Akerlof, 1997) notes the importance of one's initial condition for social decisions that affect one's behavior such as aspirations and eventually economic decisions.

Innovation on the other hand is also an effort to bring about change and hence it could also be understood as future oriented. Thus, we hypothesize that innovation is intimately linked to aspirations and that low aspirations or very- narrow/wide aspirations gap would lead to low innovations or low adoption of innovation products. The remainder of this paper is organized as follows. The next section presents the background and review of related literature followed by section 3 which presents the theoretical model. Section 4 presents data and the empirical strategy. Results are discussed in section 5, and section 6 concludes.

2. Background and literature review

Existing literature provides different theories and analytical tools that facilitate a better understanding of the circumstances of the poor and finding possible pathways out of the

situations they are in[1]. One of the recent additions in the economics sciences literature includes the study of individual behavior using aspirations-based approach (See Bernard et al., 2011 for an extensive review and particularly with the Ethiopian context, the focus of this paper). On the other hand, innovation is regarded as one important avenue to bring about change and sustain development. In fact, the concept of innovation in the context of agricultural development has been increasingly gaining prominence in policy dialogues[2]. In the systems approach, innovation is broadly defined as "the process by which individuals or organizations master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country, or the world" (Ernst et al, 1998). Innovation in agriculture may involve use of agricultural technologies, improved practices, and institutional innovations and opportunities that can help facilitate interactions among different actors and help improve efficiency and growth in the sector.

Conceptually, the innovation systems concept (ISC) is particularly attractive for it gives attention to tacit knowledge which is widely the case in developing countries as opposed to codified knowledge and yet "difficult to articulate or write down" and "often embedded in skills, beliefs, or ways of doing things" (Mytelka, 1987 cited in World Bank, 2007). Closely related but highly relevant to this study is the attention ISC gives to attitudes and practices which are important to innovation processes. According to (Hall et al., 2006), some attitudes and practices such as mistrust, being closed to others' ideas, secretiveness, lack of confidence, limited scope and intensity of interaction, etc are restrictive while others such as trust, openness, transparency, confidence and proactive networking, etc actually support innovation processes. The typology of attitudes and practices that (Hall et al., 2006) offer is within the context of organizations but it can easily be adapted to understand innovations at household or individual level and in fact it could also help offer partial explanations to some "non-fully rational" behaviors such as the ones described next.

(Duflo et al., 2011, 2008) find evidence of non-fully rational [in economic terms] behavior of farmers in explaining their production decisions. Unlike the wide belief that low adoption of fertilizer is due to low returns or credit constraints, their experimental evidence from Kenya suggests that simple interventions (such as free delivery of fertilizer but at full market price)

[1] For example, Amartya Sen's (1981) essay on entitlements and deprivation is referred to as the breakthrough in the analysis of poverty and famines, and which have led to the development of related concepts including the Human Development Index and many other multidimensional poverty measures, among others.
[2] e.g. see G20 2011 communiqué of Ministerial Meeting on Development

just after harvest substantially increases adoption (an effect which the researchers find comparable to that of a 50 percent reduction in the price of fertilizer later in the season). Surprisingly, they did not find impact on fertilizer adoption of offering free delivery at the time when fertilizer is actually needed (Duflo et al., 2011, 2008). Findings like these motivate economists to explore alternative explanations from other disciplines, substantiating the perspective that beliefs and/or internal factors help understanding individuals' decision making.

Hence, in line with the ISC concept on determinants of innovation processes, there is a growing literature in economic sciences that tries to understand the role of attitudes and behaviors on economic outcomes. Some recent studies including (Beaman et al., 2012; Bernard et al., 2011; Bernard et al., 2014a; Knight and Gunatilaka, 2012; Stutzer, 2004; Macours and Vakis, 2009; Maertens, 2013) etc examine the links between aspirations and various economic outcomes.

(Knight and Gunatilaka, 2012) and Stutzer (2004) analyse the determinants of aspirations for income and the determinants of subjective wellbeing (in particular the influence of aspirations for income on subjective wellbeing) in rural China and Switzerland, respectively. They use income reported as either 'sufficient' or as the 'minimum required' to proxy for aspirations for income; and two variables - satisfaction with income measured as per-capita household income, and satisfaction with life predicted from different indicators– as proxy for subjective wellbeing. They also define reference income as own income, own income relative to that of relevant others, and own income in the past. (Knight and Gunatilaka, 2012) find that aspiration income is a positive function of actual income and reference income, and that subjective well-being is raised by actual income but lowered by aspiration income. They referred to the later as the 'hedonic treadmill'. In other words, people frame their aspirations based on their relative deprivation in income which in turn influences their subjective wellbeing. The authors argue that this may explain why subjective well-being in China appears not to have risen despite rapid economic growth. Stutzer (2004) also finds that aspiration income reduces subjective well-being and that aspiration income is a positive function of current income, lagged income, and community income.

Studying within the framework of the aspirations failure theory, Bernard et al (2014a) conduct a video-based experiment that features success stories to test whether aspirations and future-oriented behavior can be altered. Using data collected six months after the video

screening the authors identify multiple treatment effects including significant improvements in: aspirations, use of financial tools related to both savings and credit, number of children enrolled in school and total spending on children's education. They also find a positive treatment effect on a hypothetical demand for loan - a result consistent with previous studies by (Bernard et al., 2011; Bernard and Taffesse, 2012) which find evidence of low aspirations correlated with lower demand for long-term loans and the use of these loans for long term investments.

Similarly, based on a psychological training of sex workers in Kolkata, India in a randomized control trial setting, Ghosal et al (2013) report finding a positive and significant treatment effect on self-reported measures of agency, happiness and self-esteem, as well as evidence of higher effort towards improving future outcomes as measured by savings choices and health-seeking behavior. Also in India (Beaman et al., 2012) conduct a randomized natural experiment to examine the influence of female leadership (those positions by law reserved for women in village councils) on career aspirations and educational attainment of adolescent girls. They find that, even in the absence of change in labor market opportunities, exposure to female leaders in local government raises both the aspirations and educational attainment of girls.

(Kosec et al., 2012) exploit Pakistan's 2010 floods as a natural experiment to study the effect of weather shocks on aspirations level one and a half years later. They find significant negative impact of the floods on aspirations of people particularly those: in the bottom three quintiles of per capita expenditures, in land cultivating households, and those reliant on agricultural wage, and those engaged in rainfed agriculture. In addition, (Kosec et al., 2012) study the correlation of aspirations and individuals' economic decisions and outcomes in rural Pakistan. They report that people with high aspirations had- higher household expenditures on agricultural inputs, higher yields, and higher savings. They also find higher aspirations correlated with higher internal locus of control, higher self-esteem, higher religiosity, higher trust in others, higher trust in justice; and, negatively correlated with other indicators such as rivalry, perception of poverty being caused by external factors and remoteness.

The literature on aspirations is relatively wide in the context of studying school participation decisions and outcomes. Among recent studies, for example, Maertens (2013) examines the effect of perceptions of the ideal age of marriage on the educational aspirations parents have

for their children. Using child level data collected from three villages in India, Maertens finds that educational aspirations are lower for girls compared to boys. (Dercon and Singh, 2013) also report finding a pro-boy bias in terms of parental aspirations for children's education in India, Ethiopia and rural Peru while their findings in contrast show pro-girls bias in Vietnam.

In an effort to understand the aspiration-poverty trap, Guyon and Huillery (2014) study reasons why students from low social background - such as having parents with low education and living in disadvantaged neighbourhood - in France exhibit low aspirations to education despite having same academic abilities as students from high social background. Guyon and Huillery report that the main reasons are: having a limited option set in mind, fear of peer sanction, and underestimation of own academic proficiency.

The importance of aspirations on education is also identified by other studies including (Galab, 2013) on private school enrolment, Serneels and Dercon (2013) on educational outcomes, and (Goux et al., 2014) on dropout behavior, to mention just a few. In addition, (Gorard et al., 2012) document various findings based on a review of studies from education, psychology and related social sciences literature that examine the importance of attitudes and aspirations of young people and their parents on educational attainment and participation.

While existing studies on aspirations examine its formation and the role of aspirations on various outcomes, effects of aspirations on agricultural innovations remain largely understudied. If any, related behavioral studies such as (Kebede and Zizzo, 2015) show the negative impact of social preferences such as envy (measured using experiment on money burning) on agricultural innovations. Other studies on innovation focus on patterns of adoption based on mainly observable socio-economic characteristics (as described in the introduction of this paper). This study contributes to the literature by examining internal constraints such as aspirations as determinants of agricultural innovations.

3. Theoretical model

To understand the link between aspirations and adoption of agricultural innovations, this paper adopts a simple theoretical model developed by (Dalton et al., 2014)[3]. The two key premises of the model are:

[3]Detailed presentation and corresponding proofs can be referred there.

i. aspirations are reference points that affect utility from achieving a particular status, but -
ii. aspirations are endogenous reference points in that they are affected by effort choices.

In this framework, an individual is assumed to have aspirations level (A) about his[4] final wealth status (w_f) which is determined by his initial wealth (w_0) and the level of effort (e) that he puts in. This implies for the given initial status w_0, the individual's utility derived from achieving a particular status w_f by choosing effort level e also depends on his aspirations level (A). The individual's utility function can be described as:

$$u(e, A, w_f) = b(w_f) + v\left(\frac{w_f - A}{w_f}\right) - c(e) \quad (1)$$

Where:

- $w_f = f(e, w_0)$ is assumed to be an increasing function of effort e, $\{e \, \epsilon [0, 1]\}$, which comes with some cost $c(e)$ where the cost function is assumed to be smooth, increasing and convex with $c(0) = 0$;
- $b(w_f)$ is assumed to be a smooth, increasing, concave function over final status with $b(0) = 0$;
- $v(.)$ is a continuously differentiable reference-dependent value function that captures the premise that individual aspirations level A is a reference point that affects the satisfaction experienced from achieving a final outcome w_f.

According to (Dalton et al., 2014), poverty imposes external constraints (e.g. lack of access to information or credit to acquire skills, etc) which in effect reduces the productivity of the poor. Consequently, for a given effort level, final wealth is proportional to initial wealth $\{w_f = f(e, w_0)\}$ which clearly puts the poor at a disadvantage since the marginal product of effort is increasing in initial wealth. This again would lead the poor to limit their effort choice and thereby their aspirations level since agents would aspire only to an outcome that is perceived as attainable. This delivers the second premise of the model that aspirations are

[4] We use male pronouns throughout for ease of composition as male headed households constitute about 90% of the sample.

endogenous to effort choice. In this context, therefore, given individual effort aspirations level A can be defined as the final outcome attained[5]:

$$A = f(e, w_0) \tag{2}$$

Now, bringing the two premises of the model imply two-way feedback effect between aspirations to effort. Thus, to find an optimal level of status and utility, the rational solution would be to jointly choose $(\hat{e}, \hat{A})$, an effort level and aspirations level as:

$$\hat{e} \,\epsilon\, \arg max\ s(e, w_0) = u\big(e, f(e, w_0), f(e, w_0)\big) \tag{3}$$

where $e \,\epsilon\, [0, 1]$ and,

$$\hat{A} = f(\hat{e}, w_0) \tag{4}$$

However, as the evidences also presented in the literature review suggest most individuals may not be far-sighted to recognize the feedback effect and make decisions in this manner. Such decision makers are referred to as behavioral decision-makers. Hence, according to (Dalton et al., 2014), a behavioral decision-maker takes his aspired status A as fixed (instead of endogenously evolving with effort and achieved status), thus imposing an externality on himself that isn't fully internalized. Hence, for a fixed level of initial wealth, a behavioral solution is $(\ddot{e}, \ddot{A})$ which is different (or less than) from the rational solution $(\hat{e}, \hat{A})$, and the decision-maker is internally constrained. This implies poverty and initial disadvantage interact to generate a behavioral poverty trap characterized by minimal effort-aspirations pair.

The implication from the theoretical framework is that interventions could be used to break behavioral poverty traps simply by raising aspirations of the poor or jointly with a mechanism that raise wealth of individuals and/or by reducing the cost of effort (e.g. cost of innovations) the poor face. Hence, using agricultural innovations as proxy to effort and as avenue to improved rural livelihoods, this paper tests whether aspirations actually determine agricultural innovations.

[5] the basic assumption is that everyone can reach their aspirations, and also by noting that reaching aspirations does not necessarily imply aspiring optimally (Dalton et al., 2014)

4. Data and empirical strategy

Empirical model

Following the reviewed literature and theoretical framework outlined in the previous sections, this part presents the estimation strategy of the paper. We begin by noting that innovations are efforts to achieve a certain outcome, and innovations may require patience and risk taking which are central in the decision process. Aspirations, on the other hand, are motivators which can enhance such behavior not only in their own right but also through their determinants including other internal traits (such as self-efficacy, locus of control, etc) which may be unobserved. This again implies that aspirations may affect innovations through multiple channels and hence it may be endogenous and/or simultaneously determined.

On the other hand, since data generating processes for individuals with different level of aspirations (i.e. those with lower aspirations and those with higher aspirations) may be different, a simple regression model may not capture both variations within and between groups of individuals. One alternative approach would be to sort individuals into two groups or 'positions' based on their aspirations status. However, as noted above, outcomes (or innovations) and the status of aspirations are simultaneously related leading to a selection bias as the assignment of persons to the two positions is not random. Hence, among the class of estimating strategies that may allow joint determination of endogenous discrete variables and the outcomes that they affect, endogenous switching models are preferred (Mare and Winship, 1987; Adamchik and Bedi, 2000; Di Falco et al., 2011). According to Mare and Winship (1987), the main advantages of these models are that they enable one to: model both allocation of persons to various 'treatments' and the effects of treatment on other outcomes; estimate the degree to which common, unmeasured variables affect both the outcome and explanatory variables; take account of potential selection bias; and, estimate the impact of the classification regime by simulating how individuals would fare had they entered different 'treatment' groups.

Formally, the determination of household innovations can be expressed in the following function:

$$y_j = f(A, IN, HH, C, V) \quad (5)$$

Where y_j represents innovations implemented by the household, A represents aspirations status, IN denotes other individual characteristics, HH and C respectively denote household

and community level characteristics that may influence innovations, and V represent location or village fixed effects. But for ease of presentation, let t_j denotes the 'treatment' variable A, and X_j denotes IN, HH, C and V. For implementation, we follow Wooldridge (2010) and the above function can be expressed as an endogenous treatment-effects model with the regression form:

$$y_j = X_j\beta + \delta t_j + \varepsilon_j \tag{6}$$

where t_j is a binary-treatment variable that is assumed to stem from an unobservable latent variable:

$$t_j^* = w_j\gamma + \upsilon_j \text{ with } t_j = \begin{cases} 1, if\ t_j^* > 0 \\ 0, otherwise \end{cases} \tag{7}$$

Where w_j are the covariates used to model aspirations status (or treatment), and the error terms ε_j and υ_j are bivariate normal with mean zero and covariance matrix $\begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix}$. The covariates X_j and w_j are unrelated to the error terms, or they are exogenous.

The log likelihood for observation j is given by:

$$lnL_j = \begin{cases} ln\Phi\left\{\frac{w_j\gamma + \frac{(y_j - X_j\beta - \delta)\rho}{\sigma}}{\sqrt{1-\rho^2}}\right\} - \frac{1}{2}\left(\frac{(y_j - X_j\beta - \delta)}{\sigma}\right)^2 - ln\sqrt{2\pi\sigma}\ ,\ t_j = 1 \\ ln\Phi\left\{\frac{-w_j\gamma - (y_j - X_j\beta)\rho/\sigma}{\sqrt{1-\rho^2}}\right\} - \frac{1}{2}\left(\frac{(y_j - X_j\beta)}{\sigma}\right)^2 - ln\sqrt{2\pi\sigma},\ t_j = 0 \end{cases} \tag{8}$$

Where $\Phi(.)$ is the cumulative distribution function of the standard normal distribution.

The Stata program etregress (StataCorp, 2013) will be used for the estimation of the endogenous treatment-effects model with maximum likelihood when the dependent variable is continuous. For binary dependent variables, estimation will be conducted using the endogenous switching model with full information maximum likelihood. To fit the model, a "wrapper" program, ssm, that calls for the gllamm Stata program (Miranda and Rabe-Hesketh, 2006) will be used. Description of the model can be referred to Miranda and Rabe-Hesketh (2006) and will not be presented here for it is close to the treatment effects model already presented.

When the dependent variable is count, we follow Cameron and Trivedi (2010) and use a structural model approach. Similar to the switching model, this approach also defines explicit models for both the dependent variable (y_j) and the endogenous regressor (t_j). The basic assumption is that the structural equation for the count variable y_j is a Poisson model with a mean that depends on an endogenous regressor:

$$y_j \sim \text{Poisson}\,(\mu_j) \text{ and}$$

$$\mu_j = \mathrm{E}(y_j|t_j, X_j, \upsilon_j) = exp(\beta_1 t_j + X_j'\beta_2 + \upsilon_j) \quad (9)$$

Where the error term υ_j can be interpreted as unobserved heterogeneity and it is assumed to be uncorrelated to X_j but correlated with t_j allowing for endogeneity. The addition of υ_j also controls for over dispersion in the Poisson model. The interdependence between $t_j$and υ_j is specified as:

$$t_j = X_j'\gamma_1 + w_j'\gamma_2 + \varepsilon_j \quad (10)$$

Where w_j is a vector of exogenous variables that affects t_j nontrivially but does not directly affect y_j, which is commonly known as an instrument or an exclusion restriction. Further, the errors υ_j and ε_j are assumed to be related via:

$$\upsilon_j = \rho\varepsilon_j + \eta_j \quad (11)$$

Where $\eta_j \sim [0, \sigma_\eta^2]$ is independent of $\varepsilon_j \sim [0, \sigma_\varepsilon^2]$. Consequently, this means that ε is a common latent factor that affects both y_j and t_j and is the only source of dependence between them after controlling for the influence of the observable variables X_j and w_j. If $\rho = 0$, then t_j can be treated as exogenous. Otherwise, t_j is endogenous since it is correlated with υ_j in (10) for both t_j and υ_j depend on ε.

Now, substituting (11) for υ_j in (9) yields $\mu_j = exp(\beta_1 t_j + X_j'\beta_2 + \rho\varepsilon_j)e^{\eta}$. Then, taking the expectation of μ_j with respect to η yields:

$$\mathrm{E}_\eta(\mu) = exp(\beta_1 t_j + X_j'\beta_2 + \rho\varepsilon)\ \text{x}\ \mathrm{E}(e^{\eta}) = exp(\beta_1 t_j + ln\mathrm{E}(e^{\eta}) + X_j'\beta_2 + \rho\varepsilon) \quad (12)$$

The constant term $ln\mathrm{E}(e^{\eta})$ can be absorbed in the coefficient of the intercept, a component of X_j. It follows that:

$$\mu_j|X_j, t_j, \varepsilon_j = exp(\beta_1 t_j + X_j'\beta_2 + \rho\varepsilon_j) \quad (13)$$

Where ε_j is a new additional variable, and the intercept has absorbed $E(e^{\eta})$. If ε were observable, including it as a regressor would control for the endogeneity of t_j. Given that it is unobservable, the estimation strategy is to replace it by a consistent estimate from a two-step estimation procedure as follows. First estimate (10) by OLS and generate the residuals $\acute{\varepsilon}_j$. Second, estimate parameters of the Poisson model given in (13) after replacing ε_j by $\acute{\varepsilon}_j$. Finally, if $\rho = 0$, then we can add the command vce(robust) option, but if $\rho \neq 0$, then the VCE needs to be estimated with the bootstrap method that controls for the estimation of ε_j by $\acute{\varepsilon}_j$ (Cameroon and Trivedi, 2010).

Sampling, data and measurement issues

The data comes from a household survey carried out between January and March 2014 in Ethiopia. The survey revisited an existing sample of agricultural households surveyed between 2006 and 2009 in Oromia region under an NGO project that promoted agricultural innovations and ended in 2009. The original survey used purposive and random sampling procedure to select 390 households from three study sites (Aredo, et al. 2008). The primary sampling unit consisted of a pair of neighbouring districts or woredas which had been chosen based on the density of cultivation of the major crop and presence of active farmers' cooperatives. At the second stage, kebeles (sub-districts) which had active farmers' cooperatives were selected. Using the number of participating households within a cooperative as sampling frame, households were randomly selected. The major crop and total sample size at each research site are summarized in Table 1.

<<Table 1. Total sample size>>

Psycho-social indicators

The new survey instrument added to the existing instrument a module that asks about aspirations and other internal features. The new module was the same one used by (Bernard and Seyoum Taffesse, 2014) and the instrument passed their test for validity and reliability based on a test–retest approach (for details, see Bernard and Seyoum Taffesse, 2014).

To capture aspirations and expectations, the instrument asks individuals about:

1st, their current level, aspired level, and expected level on each of the four dimensions (income, wealth, social status, and children's education). Wealth (or current value of assets)

and income (annual income from agriculture and non-agricultural activities) were asked in terms of Ethiopian Birr; Children's education in terms of levels/grades of education; and, social status in terms of percentage of people in that village that ask for the individual's advice on some important decisions.

2nd, the weight or relative importance the individual places on each of these dimensions.

Following (Beaman et al., 2012; Bernard and Taffesse, 2012; Kosec et al., 2012), the aspirations level is calculated using an aggregate index based on respondents' answers to questions about their aspirations in the four dimensions[6]. Accordingly, the index is constructed by first normalising each dimension (i.e. by removing the average level for individuals in the same district, and then dividing this difference by the standard deviation for individuals in the same district), and multiplying the result by the weight each individual gives to each of the four indicators. Summing across the weighted average of the four normalized outcomes provides the aspirations index.[7]

Mathematically, the aspirations index (A_i) can be represented as:

$$A_i = \sum_{n=1}^{4} \left(\frac{a_n^i - \mu_n^d}{\sigma_n^d}\right) x\ w_n^i \qquad (14)$$

Where:

a_n^i is the aspired outcome of individual i on dimension n (income, assets, education, or social status).

μ_n^d is the average aspired outcome in district d for outcome n.

σ_n^d is the standard deviation of aspired outcomes in district d for outcome n.

w_n^i is the weight individual i places on dimension n.

In addition, the survey instrument also asks several questions aimed at capturing factors that help shape aspirations. These include factors associated with cognitive processes such as locus of control, perceptions of causes of poverty, attitudes to change, self-esteem, envy, and trust. The psychosocial indicators are measured using Likert-type scales (see Table 6).

[6] Since individuals aspire to achieve different things depending on their experiences and information set that they have, relying on any single indicator may not suffice to measure aspirations. Yet, these four indicators are believed to be strongly correlated to many dimensions a person might want to achieve in his/her life. Hence, the aggregate index is believed to capture broader aspects and to serve as a strong proxy.

[7] Constructing the expectations index follows the same method.

Innovation and adoption indicators

Innovation and adoption behavior of farmers are measured using different indicators. First, to elicit innovativeness, farmers were asked about 12 value chain innovations in the following manner:

Question: In the past 5 years, have you changed the way, or do you have a new or better way of [….][8]?

Using individual responses (1 yes, 0 otherwise), innovation index (Y_j) can be calculated as:

$$Y_j = \sum_{n=1}^{12} I_{ij} \qquad (15)$$

where I_{ij} refers to the type of innovation i individual j implemented, and $Y_j = [0, 12]$.

On the other hand, innovation adoption is measured through access to or use of (i.e. what innovation?) and intensity of use (unit/ha) (i.e. how much?) of- specific agricultural technologies such as fertilizer, improved seed, herbicides and pesticides, and other agronomic practices such as improved method of planting and use of sustainable natural resources management practices (see Table 6).

5. Results and discussion

Descriptive statistics

We begin by presenting a general overview of sample households by study sites on their demographics, resources, membership in groups, and other factors. Table 2 indicates that, on average, sample households in the three sites have similar characteristics with only a few exceptions of the Bako-Sire site which shows a slight difference on some indicators. According to these results, the Bako-Sire site have on average, household heads that are slightly- younger, and more educated, as well as slightly larger households and a slightly smaller share of female headed households.[9]

<<Table 2. Descriptive statistics on demographics, endowment, membership in groups, and other factors>>

[8] This question was asked about **changes** in the context of, for example, What to grow in each season; what kind of seeds are used and where to buy them; what and how much to apply of other inputs such as fertilizer and chemicals; use better agronomic practices (e.g. planting techniques, land preparation,…), adoption of soil and water conservation (e.g. mulching, zero (reduced) tillage, use of crop residue, water harvesting, drip irrigation...); about marketing information ; about credit and loans?

[9] These slight differences however came about for some households who did not cultivate any of the three main crops and were left out of the analysis since the focus of this study is limited to the three main crops.

Employing the formula described in equation (14) on the computation of aggregate indices results in only a marginally skewed (to the right) distribution of the aspirations and expectations scores (Fig. 1a and 1b) which may be reflecting a fair representation of population in the given sample. The aggregate indices were also used to classify individuals into low-aspirations/expectations and high- aspirations/expectations status categories by comparison to corresponding district average outcomes. Results in Table 3 indicate that about 33% of- and 41% of- household heads reveal low aspirations and low expectations, respectively. More female household heads show low status in both aspirations and expectations measures compared to male heads while the share of individuals with low aspirations and low expectations decreases with increase in level of education and wealth status. Surprisingly, more share of people in the relatively younger age group reveal low aspirations and low expectations.

<<Fig. 1. Distribution of aspirations and expectations indices>>

<<Table 3. Share of household heads with low aspirations and low expectations (%)>>

Since other cognitive processes might determine an individual's level of aspirations, see for example findings by (Mani et al., 2013) on the relations between poverty and cognitive function, Figure 2 presents the means of standardized outcomes of some cognitive indicators by status of aspirations. The results of mean comparison tests indicate that people with higher aspirations reveal more internal locus of control, higher self-esteem, more trust in others, higher subjective wellbeing, and show less risk aversion behavior. Further, results suggest that, on average, people with high aspirations perceive less on the causes of poverty to be external, and these results are all statistically significant (Fig. 2.b.) There was not much difference between the two aspirations status groups in other cognitive indicators such as openness to change, competitiveness/envy and in terms of time preferences or impatience.

<<Fig. 2. Descriptive statistics on cognitive indicators>>

Several innovation and adoption indicators are examined in this study, first, in terms of innovativeness or use of innovations and, second, at the intensity of use of innovations conditional on adoption. Results (Table 4) suggest that on average male headed households reveal higher innovativeness and adopt row-planting techniques more than female headed households do. They also display more intensity (kg/ha) in their use of fertilizers. Yet, there does not seem to be much difference across genders in terms of their access to fertilizer,

herbicides and pesticides, improved seed, in terms of adopting sustainable natural resource management practices (SNRMPs), and in terms of their intensity of use of herbicides and pesticides, improved seeds or in terms of their intensity of general innovativeness (innovativeness index).

<<Table 4. Comparison of innovation/adoption by sex of household head (M=329, F=34)>>

A comparison of innovations by aspirations and expectations status also reveals significant results. For example, innovativeness and adoption of innovation products including fertilizer and improved seed seem to be higher for individuals with higher aspirations than those with low aspirations and results were statistically significant (Table 5). Yet, people with higher expectations seem to perform better only with innovativeness index. Further, comparing only those households who had actually innovated or adopted any of the given technologies suggest that those with high aspirations used more fertilizer per hectare of land and had more share of land planted with improved seed. Similarly, people with high expectations seem to have innovated more, had more share of land planted with improved seed, and adopted more SNRMPs, on average.

<<Table 5. Comparison of innovation/adoption by aspirations and expectations status>>

Evidences from bivariate analysis presented in this section clearly imply that aspirations and expectations might be important determinants of agricultural innovations. Evidences also suggest that the gender of the household head could also matter for certain innovations. The next section employs econometric analysis and examines if findings in the present section would still hold after controlling for all other factors. The main variables used in the regressions are described in Table 6.

<<Table 6. Description of variables used in the regressions>>

Estimation results

We present regression results from various specifications which account for the endogenous nature of the main variable of interest (i.e. aspirations status). Estimation techniques such as endogenous treatment effects, simultaneous equation with endogenous switching, and structural equation approach are used. To improve identification, indicators for subjective wellbeing and trust are used as the main exclusion restrictions. These indicators represent individual's own beliefs and they are likely to affect innovations only through their effect on individual's preferences (i.e. aspirations). Due to a highly endogenous nature of aspirations, more instruments were hard to come by with the existing data. The two indicators passed

formal tests for weak instrument[10]. As a standard comparison, other estimation techniques such as negative binomial (when the dependent variable is count) and ordinary least squares (when the dependent variable is continuous) are used under the exogeneity assumption of the aspirations indicators. Various innovation indicators are considered for analysis and results are summarized below.

Result 1: Effect of low aspirations and very- wide/narrow aspirations- gap on innovativeness of farmers

<<Table 7. Determinants of farmer innovativeness>>

Table 7 presents regression results on the effect of low aspirations on innovativeness of farmers. Results suggest that, after controlling for other factors, aspirations are an important determinant of household innovativeness. For example, results from negative binomial (specification 1) suggest that there is no difference in innovation behavior between households with low aspirations and those with high aspirations. Yet, when the endogenous nature of the regressor (i.e. aspirations) is accounted for, results (specifications 2 & 3) provide strong evidence that suggest that households with low aspirations are less likely to innovate. This finding does not change when the standardized aspiration index (continuous variable where higher index means higher aspirations) is instead used (specifications 5 & 6). In addition, the finding seems to be robust for it is qualitatively the same and statistically significant in all four specifications which account for the endogenous nature of aspirations. Further, given the indicators used for the construction of innovation index, one may expect household size to have a positive effect on household innovativeness since such innovations might require more labor time. Yet, contrary to expectations results seem to suggest that household size has a negative effect on innovativeness and the reason is less clear. Other factors[11] such as average distance to office of farmer cooperatives and distance to local input dealer all seem to negatively affect farmer innovativeness. This might reflect the fact that the further one is away from a cooperative office or from a local input dealer the lesser chance one would have to access information and agricultural inputs.

[10] The Stock and Yogo (2005) test of weak instruments was used for various specifications. The null hypothesis of weak instrument was rejected using either a minimum value of 10 as a rule of thumb for *F* statistic, or the minimum eigenvalue statistic to tolerate distortion for a 5% Wald test based on the 2SLS and LIML estimators. Results are not reported here for they are too many but they are available upon request. Other cognitive indicators such as *self-esteem* and *locus of control* were also considered but did not pass tests of weak instrument.

[11] There is only one credit constrained household in the given sample. Hence, we do not control for credit access in the estimations.

Result 2: Effect of aspirations on access to or use of fertilizer, improved seed, and herbicides and pesticides and adoption of row-planting techniques

Table 8 and Table 9 present determinants of access to or use of different technologies at plot level. According to these results (Table 8), aspirations are significantly associated with use of improved seeds and adoption of row-planting techniques - a recent innovation in Ethiopian agriculture. This means that people with low aspirations are less likely to innovate, and the evidence is strong and robust for various specifications. In contrast, low aspirations do not seem to be important determinants of access to or use of herbicides and pesticides (Table 8) and chemical fertilizers (Table 9). Further, an attempt is made to see if aspirations-gap matters for access to or use of fertilizers. Again results (Table 9) suggest that aspirations-gap seems to be less important for fertilizer. Perhaps results on access to or use of fertilizer and herbicides/pesticides could be a reflection of little variation that exist in terms of access to or use of these innovations among households since results presented in Table 4 suggest that more than 90 percent of the households actually had access to or used these technologies. Hence, the effect of aspirations might be rather important for the intensity of use of these innovations which is investigated (only for fertilizer) in subsequent sections both at plot level, at household level and by crop type.

<<Table 8. Determinants of the use of improved seed, herbicides/pesticides and row-planting techniques>>

<<Table 9. Determinants of the use of fertilizer (plot level)>>

Plot size is positively and significantly associated with use of all technology indicators and under various specifications (Tables 8 and 9). This perhaps might be reflecting the fact that it is picking up a wealth effect (for wealth serves as a cushion against innovation risks) for other wealth indicators are not controlled due to endogeneity concerns. Other plot level characteristics such as perceived soil quality and distance from residence do not seem to be important determinants of whether to use chemical fertilizers, improved seed, or herbicides and pesticides. If any, those plots very close to residence, which are likely to be homesteads, are negatively associated with chemical fertilizer use. Perhaps, this is because farmers might opt to rather use inputs such as household refuse which are less costly to get but costly to transport to remotely located plots. Turning to other results, we find that female headed households and age of household head are respectively positively and negatively associated with use of improved seed. In addition, having been a participant in technology promoting

NGO intervention in the past seems to be important for adoption of all innovations (Table 8) except for use of fertilizers (Table 9).

Since the type of crop also determines use of inputs and improved practices, results suggest that both maize and wheat plots are positively associated with use of improved seed and row-planting techniques in comparison to teff plots (Tables 8). This may be because both wheat and maize crops in general give higher yields and also easier to manage than teff crop. However, maize plots are found to be negatively and strongly associated with use of fertilizer and herbicides/pesticides while wheat plots in contrast are found to be positively and significantly associated with use of fertilizer in contrast to teff plots (Table 9). In addition, indicators of distance (remoteness) of the location of: agricultural cooperative office, local input dealer, and FTC are all found to be negatively associated with use of improved seed and use of herbicides and pesticides, or adoption of row-planting techniques. This is in line with expectations as access to inputs, extension, and advisory services are likely to be limited when farmers are located farther away from service centers. Surprisingly, however, results also suggest that distance to market are positively associated with use adoption of row-planting techniques and use of herbicides and pesticides, a result which seems less intuitive.

From the switch parts (where dummy for low aspirations is a dependent variable) of the endogenous switching regression, results suggest that education level and age of household head, household size, size of plot, and subjective wellbeing are negatively associated with low aspirations while female headship, having been a beneficiary of past technology interventions, having experienced negative shock in the past, and average distance of residence to asphalt road are all positively and significantly associated with low aspirations (Tables 8). Except for the negative coefficient of the dummy that represent whether the household was a beneficiary in past project interventions, the remaining results are in line with theoretical predictions. This is because, in the words of Apadurai (2004), these are factors that may limit one's capacity to aspire.

Result 3: Effect of aspirations on the intensity of fertilizer use

Since innovation and technology adoption involve passing multistage decision (or "hurdle") by economic agents, given all other constraints, it is essential that we examine the effect of the variable of interest at each stage. In line with this, we have already seen results from the first stage analysis that there does not seem to be much evidence on the effect of low

aspirations on access to or use of fertilizer and herbicides and pesticides (Table 8 & Table 9). In this part we present estimation results rather on the effect of low aspirations on the intensity (kg/ha) of fertilizer use across different specifications including at plot level, by crop type and at household level.

<<Table 10. Determinants of intensity of use of fertilizer (kg/ha), at plot level>>

Result 3.1. Effect of aspirations on intensity of fertilizer use: at plot level

Unlike results of the previous section, we find that low aspirations and very-narrow/very-wide aspirations-gap are negatively and significantly associated with the intensity of fertilizer use at each plot (Table 10). Results are also robust across different specifications. For example, results suggest that households with low aspirations are associated with a lower use of fertilizer by a magnitude of 23 - 26 kg/ha (specification 1 & 2) compared to intensity of fertilizer use by average household with high aspirations (Table 10). Similarly, having a very-narrow or very-wide aspirations-gap is associated with a lower use of fertilizer by a magnitude of between 50 to 64 kg/ha (specifications 3 and 4) compared to those households with moderate aspirations-gap. These figures could also be interpreted as the estimated average treatment effect (ATE) of having low aspirations and having very-narrow/very-wide aspirations gap, respectively. In addition, since the treatment variables (i.e. low aspirations or very-narrow/very-wide aspirations gap) are not interacted with other regressors, the average treatment effect on the treated (ATET) is the same as the ATE (StataCorp, 2013).

With regard to other factors, results shown in Table 10 (in all specifications) suggest that having been exposed to some technology intervention in the past, and type of crop planted (in comparison to teff) such as maize and wheat are found to be positively and strongly associated with increased use of fertilizer. In contrast, female household heads and age of the household head are found to be negatively associated with intensity of fertilizer use but only in two out of four specifications. On the other hand, other plot level factors including perceived quality of soil (dummy for medium quality) and closeness of plot to residence were associated with less use of fertilizer per hectare of land compared to such characteristics as high soil quality and very remoteness of plot location, respectively.

Moving to the switch part (Table 10, specification 1 & 2), we find that distance to asphalt road is positively associated with low aspirations a result in line with expectations. In contrast, results suggest that age and education level of household head, plot size, and size of household, subjective wellbeing and trust are negatively and significantly associated with low

aspirations. Similarly, we find that female headed households, age of household head, closeness of farm land, subjective wellbeing and remoteness of market are negatively associated with having very-narrow/very-wide aspirations-gap. In contrast, results suggest household size, distance to cooperative office and distance to FTC are positively associated with having very-narrow/very-wide aspirations-gap.

Result 3.2. Effect of aspirations on intensity of fertilizer use: by crop type

Further attempt is made to see if the effect of aspirations or the effect of aspirations-gap varies by type of main crop planted. As shown in Table 11 and Table 12, regressions are run for each crop separately. Yet, we do not find any evidence on the effect of low aspirations or having very-narrow/very-wide aspirations gap on the intensity of fertilizer use. Although specification 4 in Table 12 seems to indicate the importance of aspirations gap for intensity of fertilizer use when crop is maize, the result is not robust for other specifications.

<<Table 11. Determinants of intensity of fertilizer use by crop type, household level (low aspirations as explanatory variable)>>

<<Table 12. Determinants of intensity of fertilizer use by crop type, household level (aspirations gap as explanatory variable)>>

Other factors such as female headed households and distance to input dealer are found to be negatively associated with intensity of use of fertilizer when crop is teff (Table 11). Results for wheat crop indicate that having experienced negative shock in the past is associated with reduced use of fertilizer per hectare of land. For the switch part in Table 11, we find that the two identifying variables (subjective wellbeing and trust), education level of household head, household size, and plot size are negatively associated with low aspirations in most of the specifications that are run for the three crops separately

Result 3.3. Effect of aspirations on intensity of fertilizer use: at household level

To have a general picture on the effect of aspirations on total fertilizer use per hectare of land at household level, the data is further examined disregarding plot level characteristics and the type of crops cultivated. As results presented in Table 13 clearly indicate, households with low aspirations are associated with a lower use of fertilizer per hectare of land compared to an average household with high aspirations. The average gap of fertilizer use between households in the two aspirations category is in the order of 43-46 kg/ha under endogeneity assumptions and 15 kg/ha under exogeneity assumptions (of aspirations). Adding or

excluding those households who did not at all use fertilizer from the analysis did not change results qualitatively, again confirming the robustness of the findings.

<<Table 13. Determinants of intensity of fertilizer use, household level>>

Moving on to other factors, only distance to input dealer is negatively and significantly associated with total fertilizer use per hectare of total land holdings. The result related to this distance variable is in line with expectations. Age of household head is also negative and significant in some of the specifications but the result lacks robustness. However, results for two district dummies (coefficients not reported) suggest both districts which are predominantly either teff or wheat growing are negatively associated with the intensity of fertilizer use compared to the one which grows maize predominantly.

For the switch part, results confirm findings in the preceding sections on plot level and crop level analysis and also are in line with expectations. The identifying variable (subjective wellbeing), education of head, and size of land holdings are negatively and significantly associated with low aspirations. These results are all robust to different specifications. We also find average distance to asphalt road negatively associated with low aspirations.

Result 4: Effect of aspirations on the adoption sustainable natural resource management practices (SNRMPs)

The last innovation indicator examined in this study is the adoption of SNRMPs measured as a count outcome[12] at individual plots. As shown in Table 14, results suggest that low aspirations are negatively and significantly associated with use of SNRMPs. We also find other factors including plot size and status of land tenure (dummy for own land) are positively associated with adoption of multiple SNRMPs. Perhaps, these two indicators represent wealth/or availability of resources at the household's disposal and the importance of tenure security. Dummy for maize crop is also positively associated with the adoption of multiple SNRMPs. Further, despite the very small magnitude of estimated coefficients, other indicators such as age, education, having had negative shock in the past, and proximity of plot to residence and distance to input dealer are negatively associated with adoption of SNRMPs.

[12] In general, individual resource management practices are not equally important and treating them as a count outcome may not do justice. However, as it was presented in Table 5, households adopted, on average, less than two practices (with a standard deviation of 1) out of the nine that were asked. Hence, this lack of variation do not seem to warrant a use of other techniques such as multinomial logit or ordered probit. We employ alternative approach using principal component analysis but that did not turn in meaningful results either.

<<Table 14. Determinants of sustainable natural resource management practices, plot level>>

Result 5: Correlation of aspirations and other psychosocial indicators

As discussed before, other internal factors or beliefs (such as self-esteem, locus of control, perception on causes of poverty, attitude to change, competitiveness/envy, trust in others, subjective wellbeing, time and risk preferences) are likely to be correlated with aspirations, thus increasing the channels through which aspirations might affect innovations. Yet, as Angrist and Pischke (2008: p.84) argue "…correlation can sometimes provide pretty good evidence of a causal relation." In this context, an indirect approach is followed to infer the likely importance of psychosocial factors for innovations through their correlations with aspirations. Consequently, the aspirations index is separately regressed on each of these internal factors and other determinants of innovations (Table 15). Results suggest that indicators for self-esteem, trust in others, and subjective wellbeing are positively and significantly correlated with high aspirations while the indicator for perception on poverty caused by external factors is negatively and significantly correlated with high aspirations. Each of these strong results is in line with theoretical predictions and also with results from descriptive analysis as well as other studies such as Kosec et al (2012).

<<Table 15. Correlation of aspirations and psychosocial indicators>>

A similar attempt is also made to see correlation of one's expectation status against each of the internal factors and other controls. As shown in Table 16, results from separate regressions suggest that high expectations are strongly and positively correlated with self-esteem, internal locus of control, trust in others, and subjective wellbeing, whereas perception on causes of poverty to be external is found to be negatively correlated with expectations level.

<<Table 16. Correlation of expectations and psychosocial indicators>>

6. Conclusions

Beliefs or sense of control individuals have over their life shape their preferences. An internally constrained person may fail to aspire and hence may not put too much effort to change things for the better. In this study, we examine whether low aspirations and very-narrow/wide aspirations gap determine innovation behavior. Descriptive results suggest that individuals in the poorest income and wealth groups, and those with less education reveal low aspirations strengthening the notion that the poor may lack the resources or the 'capacity' to

aspire. These results are also confirmed by regression analysis which control for other potential determinants of aspirations. We use adoption of agricultural technologies such as improved seed, chemical fertilizer, herbicides/pesticides and adoption of improved planting method and other resource management practices as innovation indicators. We conduct plot level and household level analysis. We find that low aspirations are strongly associated with low innovativeness/or low adoption of innovation products and practices. We also find that having a very-narrow/wide aspirations gap is strongly associated with low innovativeness/or low adoption of innovation products and practices. Findings in this study are in line with the theory and empirical evidence from related literature. Based on the findings in this paper, we conclude that policies that promote agricultural innovations should incorporate aspirations raising strategies in addition to the ones that may relax resource deprivation. These strategies, for example, might include provision of- information, trainings, incentives, and/or in general techniques that might help alter behavior including by way of 'nudges.'[13]

[13] Thaler and Sunstein (2009), for example, offer four different strategies that might influence behavioral change. These include putting restrictions, offering incentives, persuasion or provision of information, and nudging (or making it easy for people to accomplish the desired choice).

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Appendix

Table 1. Total sample size

	Bakko- Siree site (Maize crop)		Lume-Adaa site (Tef crop)		Hettosa-Tiyyo site (Wheat crop)		Sample size
District	Bakko	Sibu Siree	Lume	Adaa	Hettosa	Tiyyo	Total
Sample size at baseline (2006)	65	65	65	65	65	65	390
Sample size (2014)	64	63	63	64	62	63	379

Table 2. Descriptive statistics on demographics, endowment, membership in groups, and other factors

	Bakko-Sire (N=115)		Hitossa-Tiyo (N=124)		Adda-Lume (N=124)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Sex of household head (1 if Female)	0.04	0.20	0.14	0.35	0.10	0.30
Age of household head (in years)	45.2	13.1	54.2	13.2	51.7	12.2
Number of years of schooling completed by household head	5.31	3.94	4.55	4.39	3.98	3.89
Household size (number of household members)	7.46	2.39	6.50	2.23	6.47	2.32
Dependency ratio (number of dependents divided by number of working adults	0.45	0.20	0.38	0.20	0.33	0.21
Household head participates in business or wage labor (1 yes)	0.57	0.50	0.44	0.50	0.44	0.50
Livestock holdings (in Tropical livestock unit, TLU)	8.29	6.05	7.74	4.49	8.67	5.09
Total land size accessed by household (hectare)	2.92	2.20	3.18	1.96	2.98	1.66
Total land size used for main crop (hectare)	2.09	1.83	2.66	1.91	2.70	1.62
Number of days of contact with extension agent	7.62	8.11	8.19	9.22	10.54	12.46
Number of groups household belong to	6.27	2.71	7.89	3.28	6.36	2.84
Household was project beneficiary in the past (1 yes)	0.69	0.47	0.71	0.46	0.70	0.46

Table 3. Share of household heads with low aspirations and low expectations (%)

	Low Aspirations	Low Expectations
All	0.33	0.41
By sex		
Male	0.30	0.39
Female	0.56	0.65
By age group		
age 15-30	0.55	0.50
age 31-50	0.27	0.35
age 51+	0.36	0.47
By education group		
education		
none	0.47	0.61
0-4 grade	0.41	0.55
5-8 grade	0.19	0.29
9+ grade	0.21	0.16

	Low Aspirations	Low Expectations
By wealth quintile		
Q1 poorer	0.64	0.65
Q2	0.34	0.53
Q3	0.31	0.37
Q4	0.23	0.33
Q5 richer	0.15	0.20
By per-capita expenditure quintile		
Q1, poorer	0.56	0.59
Q2	0.33	0.52
Q3	0.23	0.36
Q4	0.29	0.38
Q5, richer	0.23	0.23

Table 4. Comparison of innovation/adoption by sex of household head (M=329, F=34)

	Male (N=329)		**Female (N=34)**		**t-test: mean difference**
	Mean	Std. Dev.	Mean	Std. Dev.	p-value
Innovation/adoption (1 Yes, 0 otherwise)					
Innovativeness	0.92	0.27	0.82	0.39	**0.069**
Fertilizer use	0.98	0.13	0.94	0.24	0.126
Herbicides/Pesticides use	0.94	0.24	0.91	0.29	0.533
Improved seed use	0.57	0.50	0.47	0.51	0.246
Conditional intensity of innovation/adoption (unit/ha)					
Innovation index [1,12]	5.58	2.89	5.18	2.58	0.479
Fertilizer use (kg/ha)	176	87	145	70	**0.051**
Herbicides/Pesticides use (Lt/ha)	1.40	1.70	1.67	2.36	0.417

Share of land with improved seed (%)	0.66	0.29	0.61	0.33	0.555
Plot level indicators (N=1595)					
SNRMP* (Index [0,9])	1.70	0.99	1.60	0.80	0.305
Planting method (1, row-planting)	0.31	0.46	0.21	0.41	**0.033**

*SNRMP= composite index of sustainable natural resource management practices employed at each plot. These practices comprise of mulching, terraces, reduced tillage, use of crop residue, water harvesting, use of drip irrigation, compost, manure and crop rotation.

Table 5. Comparison of innovation/adoption by aspirations and expectations status

		High Asp.		Low Asp.		t-test	High Exp.		Low Exp.		t-test
	N	Mean	Std. Dev.	Mean	Std. Dev.	(p-value)	Mean	Std. Dev.	Mean	Std. Dev.	(p-value)
Innovation/adoption (1 Yes, 0 otherwise)											
Innovativeness	363	0.93	0.25	0.86	0.35	**0.014**	0.95	0.21	0.85	0.36	**0.001**
Fertilizer use	363	1.00	0.06	0.94	0.24	**0.001**	0.98	0.14	0.97	0.16	0.615
Herbicides/Pesticides use	363	0.95	0.22	0.91	0.29	0.106	0.95	0.22	0.92	0.27	0.276
Improved seed use	363	0.62	0.49	0.45	0.50	**0.002**	0.60	0.49	0.52	0.50	0.150
Conditional intensity of innovation/adoption (unit/ha)											
Innovation index [1,12]	330	5.69	2.93	5.23	2.70	0.181	5.99	2.82	4.84	2.80	**0.000**
Fertilizer use (kg/ha)	355	180	87	160	82	**0.040**	179	89	166	82	0.164
Herbicides/Pesticides use (Lt/ha)	340	1.43	1.78	1.40	1.76	0.866	1.50	1.89	1.30	1.58	0.301
Share of land with improved seed (%)	205	0.62	0.30	0.75	0.25	**0.006**	0.62	0.31	0.72	0.26	**0.021**
Plot level indicators (N=1595)											
SNRMP (Index [0,9])		1.68	0.98	1.73	0.96	0.389	1.73	0.97	1.61	0.97	**0.014**
Planting method (1 row-planting, 0 otherwise)		0.31	0.45	0.28	0.46	0.318	0.29	0.45	0.31	0.46	**0.397**

Table 6. Description of variables used in the regressions

Dependent variables	**Definition (measurement)**	**Type of data**
Innovation index	Sum of dummies for 12 value chain innovations [0,12]	Count
Fertilizer use	Dummy for fertilizer use (0/1)	Binary
Intensity of fertilizer use	Quantity of fertilizer used in kg/ha of land	Continuous
Herbicides & pesticides	Dummy for use of herbicides & pesticides (0/1)	Binary
Improved seed use	Dummy for use of improved seed (0/1)	Binary
Use of row-planting	Dummy whether row-planting was used (0/1)	Binary
SNRMPs	Sum of dummies for use of 9 SNRMPs (mulching, terraces, minimum tillage, crop residue, water harvesting, drip irrigation, compost, manure, crop rotation) at each plot [0,9]	Count
Explanatory variables		
Aspirations of head	(a) Dummy for low aspirations (**lowAsp**) (0/1) (b) Aspirations index (**Aspindex**) continuous variable)	Both
Aspirations-gap (of hh head)[14]	Dummy for very- narrow or wide aspirations gap (***narrowidAsp_gap***)(0/1)	Binary
Expectations of head	Dummy for low expectations (0/1)	Binary
Instruments		
Subjective wellbeing index and Trust index	Construction of both indices are described below	Continuous
Demographic and other characteristics		
Sex of head (**femhhd**)	Dummy for female head (0/1)	Binary
Age of head (**agehhd**)	Age in years; and the square of age (**agesqhhd**)	Continuous
Education of head (**educhhd**)	Number of years of education attained by household head	Continuous
Household size (**hhsize**)	Number of household members	Continuous
Past beneficiary (**benefit**)	Household participated in project intervention in the past, dummy (0/1)	Binary

[14] Aspirations-gap is the difference between the aspired outcome and current level on each of the four dimensions discussed in the previous section. The individual aspirations-gap index is calculated by dividing the aspirations gap with the aspired outcome of each dimension. The weighted sum of the individual aspirations-gap indices from the four dimensions give the aggregate aspirations-gap index. The dummy for narrow/wide aspirations gap is then constructed as follows. First, the aggregate aspirations-gap index is classified into 5 quintiles. The bottom 1 and top 1 quintiles represent very-narrow aspirations-gap and very-wide aspirations-gap, respectively. Since theory suggests both very narrow- and very wide aspirations-gap are detrimental for proactive behavior (or innovation), they are put together to form one category (taking value of 1). The middle 3 quintiles represent moderate aspirations-gap and they are put together to form the second category (taking value of 0).

Land size/plot size (**plotsize**)	Size of agricultural land household had access to (in hectare)	Continuous
Perceived soil quality	Perceived soil fertility of plots: high, **medium**, **low**. Dummy for each (0/1)	Binary
Plot distance (**Plot dist**)	Distance to plot from residence: <1min; 1-30 min; 31-60 min; >60min: (dummy for each)(0/1)	Binary
Tenure status (**tenure**)	Tenure status of cultivated plot, dummy for own plot (0/1)	Binary
Access to institutions/services		
Distance to market	Distance to the nearest weakly market in minutes(in log)	Continuous
Distance to coop office	Distance to the cooperative office in minutes(in log)	Continuous
Distance to input dealer	Distance to the nearest input dealer in minutes (in log)	Continuous
Distance to FTC	Distance to farmer training center (FTC) in minutes (in log)	Continuous
Distance to asphalt road	Distance to the nearest asphalt/tar road in minutes (in log)	Continuous
Main crop	Dummy for each crop: Teff, Maize, Wheat	Binary
Village/district	Dummy for each village/site	Binary
Other internal factors	Each of these factors is constructed from responses on different statements read to the respondent about their lives. Most of the responses were coded on a 4 point scale as: *strongly disagree, disagree, agree or strongly agree*. Others with asterisk had only 2 choices, and the rest as defined below.	
Self-esteem	Standardized index constructed from 6 items. Responses were recoded to reflect higher self- esteem	Continuous
Internal locus of control	A standardized index constructed from 14 items which reflect the respondent's perception that life outcomes are controlled by: (1) oneself (internality), (2) powerful people (powerful others), (3) chance. Responses were recoded to reflect internal locus of control	Continuous
Perception of cause of poverty as external	A standardized index constructed from 12 items which reflect the respondent's perception that causes of poverty are: (1) individual, (2) fate, (3) structural. Responses were recoded to reflect causes of poverty are external factors	Continuous
Openness to change*	A standardized index constructed from 7 items which reflect the respondent's attitude to change and adherence to community norms. Responses were coded to reflect more openness to change.	Continuous
Competition/envy*	A standardized index constructed from 3 items which reflect the respondent's sense of Rivalry/envy/competition. Responses were coded to reflect more envy.	Continuous
Trust in others	A standardized index constructed from 2 items which reflect the respondent's sense of trust in others. Responses were coded to reflect higher trust.	Continuous
Subjective wellbeing	A standardized index constructed from 2 items which reflect the respondent's perception about own life condition using (a) "best/worst life" and (b) "happy/miserable life" definitions on a scale of 10. Responses were coded to reflect higher subjective wellbeing.	Continuous
Time preference (impatience)	An index constructed from 4 choices about receiving a certain amount of money today or more amount at later date. Responses were recoded to reflect impatience.	Continuous
Risk aversion	An index constructed from results of two hypothetical decisions: (1) lottery choices with pay-outs determined by coin toss, and (2) choices among selling price of a bag of maize with same structure as the lottery pay-outs x 100. Responses were recoded to reflect less risk aversion.	Continuous

Table 7. Determinants of farmer innovativeness

Dependent variable: Innovation index (count outcome)

	(1)	(2)	(3)	(4)	(5)	(6)
	Neg.Bin.	Structural eqn.	Structural eqn.	Neg.Bin.	Structural eqn.	Structural eq.
Aspindex				**-0.0743**	**1.291****	**1.254****
				(0.054)	(0.504)	(0.488)
lowAsp	**-0.144***	**-1.210*****	**-1.196*****			
	(0.078)	(0.363)	(0.353)			
femhhd	-0.120	-0.00715	-0.00305	-0.141	-0.159	-0.165
	(0.143)	(0.170)	(0.175)	(0.144)	(0.169)	(0.169)
agehhd	0.00579	0.000232	-0.00256	0.00790	0.00719	0.00404
	(0.017)	(0.023)	(0.023)	(0.017)	(0.034)	(0.034)
agesqhhd	-0.0000581	-0.0000301	-0.00000458	-0.0000706	-0.000136	-0.000106
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
educhhd	0.0134	-0.0106	-0.0128	0.0190**	-0.0242	-0.0272
	(0.009)	(0.015)	(0.015)	(0.009)	(0.024)	(0.025)
hhsize	-0.0234	-0.0500**	-0.0527**	-0.0173	-0.0687**	-0.0725**
	(0.016)	(0.023)	(0.023)	(0.016)	(0.033)	(0.032)
Land size	0.0382**	-0.00727	-0.00312	0.0513***	-0.0835	-0.0742
	(0.016)	(0.028)	(0.028)	(0.016)	(0.055)	(0.051)
Benefit	0.0311	0.0644	0.0758	0.0269	-0.0253	-0.00320
	(0.067)	(0.089)	(0.090)	(0.066)	(0.116)	(0.115)

shock	-0.0198	0.0565	0.0739	-0.0293	0.0707	0.0956
	(0.074)	(0.089)	(0.092)	(0.074)	(0.145)	(0.153)
Dist. Market	0.0545		0.0726	0.0514		0.0647
	(0.044)		(0.054)	(0.045)		(0.074)
Dist. Coop	-0.0912**		-0.0712	-0.0903**		-0.130*
	(0.043)		(0.067)	(0.042)		(0.077)
Dist. dealer	-0.0604*		-0.107**	-0.0504		-0.129
	(0.035)		(0.051)	(0.035)		(0.080)
Dist. FTC	0.0324		-0.00786	0.0416		0.0271
	(0.049)		(0.072)	(0.048)		(0.092)
Dist. Road	-0.00864		0.00709	-0.0123		0.0174
	(0.013)		(0.018)	(0.013)		(0.035)
Predicted error		1.164***	1.152***		-1.447***	-1.407***
		(0.372)	(0.364)		(0.510)	(0.491)
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes
_cons	1.642***	2.346***	2.763***	1.398***	1.875**	2.509**
	(0.522)	(0.726)	(0.794)	(0.514)	(0.937)	(1.074)
lnalpha (_cons)	-1.671***			-1.661***		
	(0.211)			(0.212)		
N	377	377	377	377	377	377

Standard errors (bootstrap for the structural equation approach) in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 8. Determinants of the use of improved seed, herbicides/pesticides and row-planting techniques
(Endogenous switching regression, Dummy dependent variables)

	(1) Improved seed	(2) Improved seed	(3) Row-planting	(4) Row-planting	(5) Herbicides	(6) Herbicides
lowAsp	-0.954***	-0.778***	-0.936***	-0.890***	0.0252	0.0888
	(-3.79)	(-2.84)	(-3.83)	(-3.63)	(0.06)	(0.20)
femhhd	0.327**	0.314**	0.156	0.163	0.279	0.247
	(2.19)	(2.04)	(0.87)	(0.89)	(1.28)	(1.12)
agehhd	-0.0699***	-0.0655***	0.00000307	-0.00347	-0.0297	-0.0231
	(-3.37)	(-3.01)	(0.00)	(-0.12)	(-1.08)	(-0.81)
agesqhhd	0.000663***	0.000628***	-0.000133	-0.000112	0.000205	0.000156
	(3.39)	(3.07)	(-0.49)	(-0.40)	(0.79)	(0.58)
educhhd	0.0192	0.0216	-0.0240	-0.0266*	-0.0104	-0.0111
	(1.30)	(1.48)	(-1.60)	(-1.75)	(-0.60)	(-0.60)
hhsize	0.0163	0.0230	0.00528	0.00563	-0.00204	0.000352
	(0.77)	(1.07)	(0.22)	(0.23)	(-0.08)	(0.01)
Plot size	0.478***	0.490***	0.378***	0.376***	0.795***	0.782***
	(4.94)	(5.04)	(3.23)	(3.19)	(5.55)	(5.50)
Benefit	0.152*	0.161*	0.203**	0.202*	0.242**	0.230**
	(1.82)	(1.86)	(1.97)	(1.91)	(2.32)	(2.13)
Shock	0.127	0.128	0.128	0.150	-0.0513	-0.0125
	(1.56)	(1.52)	(1.29)	(1.47)	(-0.50)	(-0.12)
Low fertile soil	-0.00967	0.0133	-0.221	-0.208	-0.0319	-0.0163
	(-0.08)	(0.11)	(-1.40)	(-1.29)	(-0.20)	(-0.10)
med fertile soil	-0.0744	-0.0570	-0.145	-0.154	-0.162	-0.152
	(-0.90)	(-0.67)	(-1.45)	(-1.50)	(-1.51)	(-1.39)
Plot dist.<1min	-0.210	-0.194	0.311	0.365	-0.396	-0.496
	(-0.78)	(-0.70)	(0.70)	(0.79)	(-0.99)	(-1.17)
Plot dist. 1-30”	0.161	0.200	0.751*	0.831*	-0.227	-0.312
	(0.68)	(0.82)	(1.79)	(1.89)	(-0.61)	(-0.79)
Plot dist. 30-60”	0.0489	0.113	0.647	0.730	-0.231	-0.276
	(0.19)	(0.43)	(1.49)	(1.61)	(-0.59)	(-0.67)
Maize (dummy)	1.180***	1.213***	2.369***	2.471***	-2.382***	-2.408***
	(9.58)	(10.11)	(13.55)	(14.10)	(-15.61)	(-15.55)
Wheat (dummy)	0.289**	0.300***	0.580***	0.622***	-0.0862	-0.0720
	(2.56)	(2.59)	(4.15)	(4.32)	(-0.60)	(-0.49)
Dist. Market		0.0621		0.132**		0.182***
		(1.23)		(2.13)		(2.88)
Dist. Coop		-0.160***		0.0562		-0.129*
		(-2.72)		(0.88)		(-1.95)
Dist. dealer		-0.0446		-0.245***		-0.00929
		(-0.86)		(-4.05)		(-0.14)
Dist. FTC		0.113*		-0.181***		0.0382

		(1.82)		(-2.61)		(0.54)
Dist. road		-0.0196		0.00343		-0.0202
		(-0.95)		(0.14)		(-0.75)
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes
_cons	0.0477	-0.157	-2.438***	-1.770*	1.977**	1.398
	(0.07)	(-0.20)	(-2.60)	(-1.74)	(2.25)	(1.36)
Switch (low aspirations dummy)						
femhhd	0.399***	0.394***	0.399***	0.396***	0.380***	0.376***
	(2.85)	(2.80)	(2.79)	(2.75)	(2.66)	(2.62)
agehhd	-0.0573***	-0.0572***	-0.0581***	-0.0599***	-0.0566***	-0.0586***
	(-2.68)	(-2.66)	(-2.79)	(-2.84)	(-2.71)	(-2.77)
agesqhhd	0.000466**	0.000452**	0.000474**	0.000478**	0.000455**	0.000460**
	(2.27)	(2.20)	(2.39)	(2.38)	(2.29)	(2.29)
educhhd	-0.0934***	-0.0943***	-0.0956***	-0.0964***	-0.0968***	-0.0987***
	(-7.83)	(-7.74)	(-8.03)	(-7.94)	(-8.03)	(-7.98)
hhsize	-0.0880***	-0.0947***	-0.0833***	-0.0909***	-0.0891***	-0.0965***
	(-4.28)	(-4.52)	(-4.13)	(-4.42)	(-4.35)	(-4.63)
Plot size	-0.237**	-0.215*	-0.218*	-0.198*	-0.191*	-0.171
	(-2.11)	(-1.87)	(-1.95)	(-1.74)	(-1.73)	(-1.54)
benefit	0.172**	0.183**	0.165**	0.177**	0.184**	0.199**
	(2.04)	(2.16)	(1.97)	(2.11)	(2.18)	(2.35)
Shock	0.163*	0.173**	0.153*	0.168*	0.132	0.154*
	(1.92)	(1.99)	(1.78)	(1.92)	(1.54)	(1.76)
Low fertile soil	-0.0905	-0.0776	-0.105	-0.0905	-0.108	-0.0933
	(-0.70)	(-0.59)	(-0.80)	(-0.69)	(-0.83)	(-0.71)
Med fertile soil	-0.105	-0.0985	-0.0824	-0.0855	-0.0809	-0.0812
	(-1.23)	(-1.14)	(-0.97)	(-0.99)	(-0.95)	(-0.94)
Plot dist.<1min	0.154	0.150	0.0964	0.114	0.131	0.149
	(0.55)	(0.54)	(0.35)	(0.41)	(0.47)	(0.54)
Plot dist. 1-30”	0.0108	0.00221	-0.0421	-0.0272	-0.0267	-0.0104
	(0.04)	(0.01)	(-0.18)	(-0.11)	(-0.11)	(-0.04)
Plot dist. 30-60”	-0.242	-0.260	-0.315	-0.306	-0.282	-0.276
	(-0.91)	(-0.98)	(-1.22)	(-1.17)	(-1.08)	(-1.05)
Maize (dummy)	0.00247	0.00659	0.0201	0.0249	-0.0261	-0.0167
	(0.02)	(0.06)	(0.17)	(0.21)	(-0.22)	(-0.14)
Wheat (dummy)	0.0250	0.0241	0.0473	0.0377	0.0213	0.0180
	(0.22)	(0.21)	(0.41)	(0.33)	(0.18)	(0.16)
Subj. wellbeing	-0.361***	-0.379***	-0.377***	-0.391***	-0.356***	-0.371***
	(-7.55)	(-7.68)	(-7.89)	(-7.93)	(-7.10)	(-7.20)
Dist. Market		0.0375		0.0304		0.0272
		(0.73)		(0.59)		(0.53)
Dist. Coop		0.0232		0.0308		0.0311
		(0.44)		(0.59)		(0.59)
Dist. dealer		-0.0540		-0.0836		-0.0868
		(-0.97)		(-1.55)		(-1.61)
Dist. FTC		-0.114**		-0.113*		-0.119**
		(-1.99)		(-1.95)		(-2.05)
Dist. road		0.0808***		0.0889***		0.0852***
		(3.57)		(3.76)		(3.72)
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes
_cons	2.051***	2.200***	2.087***	2.379***	2.066***	2.418***
	(3.51)	(3.31)	(3.68)	(3.63)	(3.62)	(3.68)
load _cons	1.690	1.055	1.394	1.177	-0.00981	-0.0633
	(1.04)	(1.47)	(1.41)	(1.62)	(-0.03)	(-0.17)
sigma _cons	1	1	1	1	1	1
	(.)	(.)	(.)	(.)	(.)	(.)
N	1595	1595	1595	1595	1595	1595

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 9. Determinants of the use of fertilizer (plot level)
(Endogenous switching regression)

	(1)	(2)	(3)	(4)
Dependent variable: fertilizer use (dummy)			*Dependent variable: fertilizer use (dummy)*	
lowAsp	0.366	0.273	narrowidAsp_gap	0.754	0.622
	(0.316)	(0.341)		(0.483)	(0.551)
femhhd	-0.181	-0.141	femhhd	-0.0274	-0.0211
	(0.210)	(0.213)		(0.216)	(0.223)
agehhd	0.0310	0.0321	agehhd	0.0558*	0.0559
	(0.028)	(0.029)		(0.033)	(0.038)
agesqhhd	-0.000307	-0.000326	agesqhhd	-0.000551*	-0.000559
	(0.000)	(0.000)		(0.000)	(0.000)
educhhd	0.0299	0.0246	educhhd	0.0162	0.0141
	(0.019)	(0.019)		(0.015)	(0.016)
hhsize	-0.00348	-0.00601	hhsize	-0.0363	-0.0337
	(0.029)	(0.030)		(0.027)	(0.029)
Plot size	1.203***	1.190***	Plot size	1.158***	1.165***
	(0.213)	(0.217)		(0.221)	(0.221)
benefit	0.0894	0.0992	benefit	0.0791	0.0924
	(0.118)	(0.121)		(0.114)	(0.118)
Shock	0.0406	0.0393	Shock	0.0475	0.0551
	(0.119)	(0.123)		(0.114)	(0.116)
Low fertile soil	0.285	0.279	Low fertile soil	0.300*	0.294*
	(0.179)	(0.182)		(0.173)	(0.178)
Med fertile soil	0.129	0.110	Med fertile soil	0.104	0.0857
	(0.119)	(0.121)		(0.115)	(0.119)
Plot dist.<1min	-1.111**	-1.158**	Plot dist.<1min	-0.878	-0.981*
	(0.532)	(0.540)		(0.539)	(0.556)
Plot dist. 1-30″	-0.297	-0.309	Plot dist. 1-30″	-0.134	-0.172
	(0.520)	(0.527)		(0.503)	(0.524)
Plot dist. 30-60″	-0.193	-0.219	Plot dist. 30-60″	-0.0907	-0.114
	(0.542)	(0.548)		(0.516)	(0.539)
Maize (dummy)	-0.569***	-0.585***	Maize (dummy)	-0.547***	-0.572***
	(0.135)	(0.136)		(0.139)	(0.140)
Wheat (dummy)	0.291*	0.295*	Wheat (dummy)	0.283*	0.291*
	(0.176)	(0.178)		(0.170)	(0.174)
Dist. Market		-0.0262	Dist. Market		0.00310
		(0.072)			(0.079)
Dist. Coop		-0.0296	Dist. Coop		-0.0610
		(0.080)			(0.084)
Dist. dealer		0.0000543	Dist. dealer		-0.00470
		(0.077)			(0.075)
Dist. FTC		-0.0667	Dist. FTC		-0.0963
		(0.084)			(0.082)
Dist. Road		-0.0226	Dist. Road		-0.0147
		(0.031)			(0.029)
Village dummies	Yes	Yes	Village dummies	Yes	Yes
_cons	0.455	1.008	_cons	-0.409	0.257
	(0.956)	(1.096)		(1.215)	(1.459)
Switch (low aspirations dummy)			*Switch (narrowide aspirations gap dummy)*		
femhhd	0.0964	0.0487	femhhd	-0.396***	-0.420***
	(0.148)	(0.150)		(0.147)	(0.149)
agehhd	-0.0343	-0.0299	agehhd	-0.120***	-0.136***
	(0.022)	(0.022)		(0.020)	(0.020)
agesqhhd	0.000257	0.000203	agesqhhd	0.00114***	0.00130***
	(0.000)	(0.000)		(0.000)	(0.000)
educhhd	-0.0912***	-0.0912***	educhhd	0.00307	0.00640
	(0.012)	(0.013)		(0.010)	(0.010)
hhsize	-0.113***	-0.125***	hhsize	0.0989***	0.107***
	(0.021)	(0.022)		(0.017)	(0.018)
Plot size	-0.268**	-0.242**	Plot size	-0.167**	-0.143*
	(0.115)	(0.117)		(0.084)	(0.084)
benefit	0.112	0.121	benefit	0.0662	0.0769
	(0.087)	(0.088)		(0.075)	(0.076)
Shock	0.0879	0.121	Shock	0.0361	0.00132
	(0.089)	(0.091)		(0.075)	(0.076)
Low fertile soil	-0.121	-0.105	Low fertile soil	-0.146	-0.129
	(0.136)	(0.139)		(0.117)	(0.117)
Med fertile soil	-0.0668	-0.0688	Med fertile soil	0.0543	0.0799
	(0.088)	(0.090)		(0.076)	(0.077)
Plot dist.<1min	0.219	0.230	Plot dist.<1min	-0.467*	-0.465*

	(0.288)	(0.291)		(0.244)	(0.249)
Plot dist.1-30 min	0.0679	0.0759	Plot dist.1-30”	-0.392*	-0.441**
	(0.256)	(0.258)		(0.210)	(0.215)
Plot dist. 30-60”	-0.282	-0.295	Plot dist. 30-60”	-0.302	-0.392*
	(0.275)	(0.278)		(0.223)	(0.228)
Maize (dummy)	-0.0608	-0.0541	Maize (dummy)	0.0158	0.0226
	(0.119)	(0.121)		(0.102)	(0.103)
Wheat (dummy)	-0.00393	-0.0127	Wheat (dummy)	-0.0103	-0.0226
	(0.119)	(0.120)		(0.103)	(0.104)
Subj. wellbeing	-0.437***	-0.469***	Subj. wellbeing	-0.219***	-0.235***
	(0.052)	(0.054)		(0.043)	(0.044)
Trust	-0.473***	-0.514***	Trust	-0.00969	-0.0131
	(0.050)	(0.052)		(0.040)	(0.041)
Dist. Market		0.0954*	Dist. Market		-0.132***
		(0.054)			(0.047)
Dist. Coop		0.00518	Dist. Coop		0.156***
		(0.055)			(0.048)
Dist. dealer		-0.0332	Dist. dealer		-0.00204
		(0.057)			(0.048)
Dist. FTC		-0.110*	Dist. FTC		0.124**
		(0.061)			(0.052)
Dist. Road		0.114***	Dist. Road		0.0115
		(0.024)			(0.019)
Village dummies	Yes	Yes	Village dummies	Yes	Yes
_cons	1.697***	1.381**	_cons	2.909***	3.041***
	(0.590)	(0.687)		(0.528)	(0.609)
load _cons	-0.501	-0.405	load _cons	-0.927	-0.650
	(0.381)	(0.375)		(1.033)	(0.798)
sigma _cons	1	1	sigma _cons	1	1
	(.)	(.)		(.)	(.)
N	1595	1595	N	1595	1595

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 10. Determinants of intensity of use of fertilizer (kg/ha), at plot level
(Endogenous treatment effects)

	(1)	(2)		(3)	(4)
fertilizer use (kg/ha)			***fertilizer use (kg/ha)***		
lowAsp	-25.92***	-22.88***	narrowidAsp_gap	-64.06***	-49.70**
	(9.166)	(8.520)		(15.499)	(21.308)
femhhd	-4.775	-5.542	femhhd	-16.38**	-14.98*
	(6.814)	(6.798)		(7.865)	(7.870)
agehhd	-0.423	-0.645	agehhd	-2.500**	-2.465*
	(0.925)	(0.939)		(1.209)	(1.384)
agesqhhd	0.000484	0.00275	agesqhhd	0.0207*	0.0205
	(0.009)	(0.009)		(0.012)	(0.013)
educhhd	0.161	0.193	educhhd	0.839	0.816
	(0.511)	(0.506)		(0.516)	(0.497)
hhsize	-0.772	-0.556	hhsize	1.700*	1.590
	(0.795)	(0.795)		(0.927)	(1.010)
Plot size	1.325	1.324	Plot size	-1.670	-0.794
	(3.839)	(3.858)		(4.300)	(4.196)
benefit	7.110**	6.917*	benefit	8.574**	7.864*
	(3.556)	(3.578)		(4.137)	(4.060)
Shock	-2.170	-2.159	Shock	-1.619	-2.681
	(3.572)	(3.587)		(4.047)	(3.881)
Low fertile soil	-8.865	-8.037	Low fertile soil	-11.69*	-10.15*
	(5.467)	(5.448)		(6.023)	(5.828)
Med fertile soil	-10.39***	-9.339***	Low fertile soil	-9.322**	-8.215**
	(3.633)	(3.612)		(3.930)	(3.747)
Plot dist.<1min	-47.24***	-45.38***	Plot dist.<1min	-60.65***	-55.27***
	(13.869)	(13.528)		(16.068)	(15.063)
Plot dist.1-30”	-1.709	-1.308	Plot dist.1-30”	-12.29	-10.02
	(11.333)	(11.014)		(13.090)	(12.382)
Plot dist.30-60”	1.860	2.132	Plot dist.30-60”	-4.589	-4.081
	(11.751)	(11.436)		(13.354)	(12.624)
Maize (dummy)	90.16***	90.07***	Maize (dummy)	90.88***	90.53***

	(7.478)	(7.445)
Wheat (dummy)	48.29***	48.45***
	(5.368)	(5.357)
Dist. Market		1.745
		(2.045)
Dist. Coop		-0.309
		(2.144)
Dist. dealer		-2.365
		(2.141)
Dist. FTC		4.002*
		(2.383)
Dist. road		-0.250
		(0.903)
Village dummies	Yes	Yes
_cons	185.5***	180.3***
	(27.449)	(31.027)
Switch (low aspirations dummy)		
femhhd	0.0383	-0.0157
	(0.160)	(0.163)
agehhd	-0.0430*	-0.0395*
	(0.023)	(0.024)
agesqhhd	0.000356*	0.000309
	(0.000)	(0.000)
educhhd	-0.0917***	-0.0927***
	(0.014)	(0.014)
hhsize	-0.115***	-0.129***
	(0.022)	(0.023)
Plot size	-0.247**	-0.232*
	(0.121)	(0.119)
benefit	0.0439	0.0676
	(0.090)	(0.093)
Shock	0.0707	0.0970
	(0.088)	(0.091)
Low fertile soil	-0.160	-0.133
	(0.135)	(0.136)
Low fertile soil	-0.127	-0.125
	(0.096)	(0.097)
Plot dist.<1min	0.0817	0.0988
	(0.303)	(0.304)
Plot dist.1-30”	-0.0133	0.0156
	(0.246)	(0.245)
Plot dist.30-60”	-0.318	-0.316
	(0.267)	(0.268)
Maize (dummy)	-0.175	-0.166
	(0.158)	(0.158)
Wheat (dummy)	0.0297	0.0167
	(0.126)	(0.126)
Subj. wellbeing	-0.451***	-0.490***
	(0.053)	(0.052)
Trust	-0.481***	-0.527***
	(0.056)	(0.059)
Dist. Market		0.0634
		(0.059)
Dist. Coop		-0.0156
		(0.055)
Dist. dealer		-0.0237
		(0.055)
Dist. FTC		-0.0649
		(0.060)
Dist. road		0.130***
		(0.025)
Village dummies	Yes	Yes
_cons	1.983***	1.692**
	(0.630)	(0.769)
athrho _cons	0.212**	0.187**
	(0.096)	(0.089)
lnsigma _cons	4.076***	4.071***
	(0.021)	(0.021)
N	1450	1450

	(7.870)	(7.632)
Wheat (dummy)	47.73***	47.85***
	(5.832)	(5.634)
Dist. Market		-0.853
		(2.392)
Dist. Coop		2.011
		(2.473)
Dist. dealer		-1.799
		(2.204)
Dist. FTC		6.894***
		(2.660)
Dist. road		-0.675
		(0.942)
Village dummies	Yes	Yes
_cons	256.5***	233.8***
	(38.042)	(46.458)
Switch (narrowidAsp_gap dummy)		
femhhd	-0.385**	-0.415***
	(0.151)	(0.157)
agehhd	-0.111***	-0.131***
	(0.021)	(0.021)
agesqhhd	0.00106***	0.00124***
	(0.000)	(0.000)
educhhd	0.00317	0.00488
	(0.011)	(0.011)
hhsize	0.0845***	0.0965***
	(0.018)	(0.019)
Plot size	-0.142	-0.121
	(0.089)	(0.093)
benefit	0.129	0.143*
	(0.081)	(0.082)
Shock	0.0488	0.0146
	(0.080)	(0.083)
Low fertile soil	-0.215*	-0.187
	(0.123)	(0.126)
Low fertile soil	0.0158	0.0390
	(0.080)	(0.081)
Plot dist.<1min	-0.625**	-0.598**
	(0.293)	(0.282)
Plot dist.1-30”	-0.496**	-0.528**
	(0.240)	(0.229)
Plot dist.30-60”	-0.372	-0.444*
	(0.252)	(0.240)
Maize (dummy)	-0.0262	-0.0179
	(0.136)	(0.137)
Wheat (dummy)	-0.0221	-0.0338
	(0.110)	(0.110)
Subj. wellbeing	-0.231***	-0.258***
	(0.044)	(0.046)
Trust	-0.0488	-0.0498
	(0.037)	(0.042)
Dist. Market		-0.129***
		(0.049)
Dist. Coop		0.136***
		(0.049)
Dist. dealer		-0.00739
		(0.050)
Dist. FTC		0.140***
		(0.052)
Dist. road		0.0126
		(0.019)
Village dummies	Yes	Yes
_cons	2.908***	3.093***
	(0.580)	(0.644)
athrho _cons	0.680***	0.513**
	(0.179)	(0.238)
lnsigma _cons	4.181***	4.133***
	(0.053)	(0.060)
N	1450	1450

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 11. Determinants of intensity of fertilizer use by crop, household level

	Teff				Maize				Wheat			
	-1 Fertilizer (kg/ha)	(Switch) Low Asp. (dummy)	-2 Fertilizer (kg/ha)	(Switch) Low Asp. (dummy)	-3 Fertilizer (kg/ha)	(Switch) Low Asp. (dummy)	-4 Fertilizer (kg/ha)	(Switch) Low Asp. (dummy)	-5 Fertilizer (kg/ha)	(Switch) Low Asp. (dummy)	-6 Fertilizer (kg/ha)	(Switch) Low Asp. (dummy)
Low Asp.(dummy).	**1.309**		**-3.665**		**-5.965**		**14.35**		**-11.58**		**-13.84**	
	-28.41		*-29.162*		*-33.357*		*-25.06*		*-13.423*		*-12.389*	
Subjective wellbeing (index)		-0.470***		-0.487***		-0.451***		-0.471***		-0.365***		-0.419***
		-0.137		*-0.137*		*-0.123*		*-0.118*		*-0.134*		*-0.142*
Trust index		-0.550***		-0.627***		-0.339**		-0.395***		-0.454***		-0.460***
		-0.158		*-0.16*		*-0.137*		*-0.138*		*-0.129*		*-0.134*
Female head (dummy)	-32.85**	0.397	-33.82**	0.362	-3.708	0.184	-11	0.0848	11.29	-0.203	12.25	-0.216
	-14.657	*-0.412*	*-14.818*	*-0.43*	*-11.085*	*-0.327*	*-11.484*	*-0.335*	*-13.05*	*-0.329*	*-13.182*	*-0.347*
Age head (years)	-0.209	-0.0261	-1.136	-0.0301	1.176	0.0222	0.341	0.0293	-0.456	0.0239	-0.0338	0.00702
	-1.778	*-0.056*	*-1.901*	*-0.057*	*-2.01*	*-0.052*	*-2.069*	*-0.054*	*-2.069*	*-0.056*	*-1.997*	*-0.057*
Age square	-0.00063	0.000193	0.00786	0.000223	-0.0094	-0.00028	-0.00095	-0.00035	0.00271	-0.00031	-0.00097	-0.00018
	-0.017	*-0.001*	*-0.018*	*-0.001*	*-0.018*	*0*	*-0.018*	*0*	*-0.018*	*-0.001*	*-0.017*	*-0.001*
Education (years)	0.349	-0.103***	0.234	-0.109***	0.774	-0.0802***	1.155	-0.0772***	1.298	-0.108***	1.143	-0.119***
	-1.281	*-0.033*	*-1.316*	*-0.034*	*-1.478*	*-0.028*	*-1.407*	*-0.027*	*-1.142*	*-0.033*	*-1.151*	*-0.034*
Household size	0.399	-0.0837*	0.521	-0.0858	2.671	-0.105**	3.386*	-0.111**	0.497	-0.0863*	0.597	-0.106**
	-1.897	*-0.05*	*-1.934*	*-0.053*	*-2.049*	*-0.052*	*-1.773*	*-0.052*	*-1.659*	*-0.052*	*-1.673*	*-0.053*
Teff farm size (ha)	1.287	-0.477***	0.85	-0.493***								
	-4.661	*-0.151*	*-4.666*	*-0.155*								
Beneficiary (dummy)	6.175	0.286	6.944	0.321	14.87*	0.0374	13.45	0.0578	9.087	0.0282	8.543	0.0789
	-7.923	*-0.223*	*-7.863*	*-0.232*	*-8.455*	*-0.207*	*-8.195*	*-0.209*	*-7.781*	*-0.226*	*-7.98*	*-0.24*
shock experience (dummy)	-2.144	0.325	0.0484	0.387*	-2.929	0.124	-4.652	0.167	-12.82*	0.0504	-14.20*	0.095
	-8.021	*-0.216*	*-7.787*	*-0.221*	*-7.748*	*-0.202*	*-8.169*	*-0.205*	*-7.755*	*-0.212*	*-7.643*	*-0.224*
Distance to market, minutes(log)			4.112	0.241			-2.588	0.250*			-1.331	0.0376
			-4.185	*-0.155*			*-4.862*	*-0.143*			*-4.422*	*-0.144*
Distance to coop office (log)			2.784	-0.109			-8.373	-0.0584			1.174	-0.0524
			-5.327	*-0.172*			*-6.625*	*-0.137*			*-4.156*	*-0.116*
Distance to input dealer (log)			-10.09**	-0.105			-7.686	-0.0224			-2.952	-0.161
			-5.003	*-0.152*			*-6.702*	*-0.141*			*-4.843*	*-0.125*
Distance to FTC (log)			-1.054	-0.0447			17.06***	-0.0762			-0.786	-0.139
			-5.092	*-0.154*			*-5.86*	*-0.157*			*-5.073*	*-0.144*
Distance to asphalt road (log)			2.017	0.084			1.708	0.106*			-2.409	0.136**
			-1.859	*-0.054*			*-2.655*	*-0.062*			*-2.104*	*-0.055*
Maize farm size (ha)					-2.251	-0.103	-2.365	-0.0897				
					-2.923	*-0.154*	*-2.797*	*-0.151*				
Wheat farm size (ha)									1.964	-0.411**	1.347	-0.386*
									-2.476	-0.188	-2.459	-0.2
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
_cons	80.16	0.855	110.8*	0.645	172.9***	-0.152	188.5***	-1.085	70.21	0.641	83.2	1.983
	-49.355	*-1.443*	*-58.279*	*-1.625*	*-57.43*	*-1.336*	*-69.118*	*-1.627*	*-61.199*	*-1.512*	*-66.736*	*-1.661*

athrho (_cons)	-0.146	-0.107	-0.0196	-0.275	-0.00447	0.0307
	-0.358	*-0.38*	*-0.379*	*-0.279*	*-0.121*	*-0.112*
lnsigma (_cons)	3.896***	3.879***	3.997***	3.989***	3.931***	3.926***
	-0.06	*-0.057*	*-0.076*	*-0.083*	*-0.055*	*-0.054*
N	225	225	257	257	228	228

Standard errors in *italic*. * p<0.10, ** p<0.05, *** p<0.01

Table 12. Determinants of intensity of fertilizer use by crop, household level

	Teff				Maize				Wheat			
	-1 Fertilizer (kg/ha)	(Switch) Asp. gap (dummy)	-2 Fertilizer (kg/ha)	(Switch) Asp. gap. (dummy)	-3 Fertilizer (kg/ha)	(Switch) Asp. gap (dummy)	-4 Fertilizer (kg/ha)	(Switch) Asp. gap (dummy)	-5 Fertilizer (kg/ha)	(Switch) Asp. gap (dummy)	-6 Fertilizer (kg/ha)	(Switch) Asp. gap (dummy)
NarrowideAsp gap (dummy).	-28.01		-17.24		9.64		-76.38***		-18.44		-22.88	
	-44.78		*-37.451*		*-49.314*		*-22.384*		*-29.474*		*-30.531*	
Subjective wellbeing (index)		-0.215*		-0.234*		-0.169		-0.162*		-0.334***		-0.337***
		-0.117		*-0.12*		*-0.119*		*-0.088*		*-0.116*		*-0.117*
Trust index		-0.0437		0		0.128		0.0774		0.00848		-0.00055
		-0.168		*(.)*		*-0.113*		*-0.093*		*-0.1*		*-0.104*
Female head (dummy)	-36.2***	-0.449	-37.22***	-0.453	-2.837	-0.463	-23.77*	-0.42	10.81	0.00731	11.67	-0.0148
	-13.88	*-0.37*	*-13.55*	*-0.38*	*-14.91*	*-0.34*	*-12.93*	*-0.29*	*-13.19*	*-0.33*	*-13.49*	*-0.34*
Age head (years)	-1.314	-0.108**	-1.845	-0.126**	1.666	-0.159***	-3.874	-0.169***	-1.172	-0.140**	-0.938	-0.147***
	-2.42	*-0.05*	*-2.38*	*-0.05*	*-3.45*	*-0.05*	*-2.61*	*-0.04*	*-2.48*	*-0.05*	*-2.56*	*-0.06*
Age square	0.0101	0.00105**	0.0148	0.00121**	-0.0136	0.00142***	0.0367	0.00146***	0.0106	0.00144***	0.00897	0.00150***
	-0.02	*0.00*	*-0.02*	*0.00*	*-0.03*	*0.00*	*-0.02*	*0.00*	*-0.02*	*0.00*	*-0.02*	*0.00*
Education (years)	0.482	0.0165	0.422	0.0154	0.952	-0.0145	0.644	-0.0195	1.818	0.0232	1.787	0.0228
	-1.15	*-0.03*	*-1.13*	*-0.03*	*-1.21*	*-0.03*	*-1.38*	*-0.03*	*-1.19*	*-0.03*	*-1.19*	*-0.03*
Household size	0.92	0.072	0.979	0.0809	2.676	0.0909**	4.568**	0.0866**	1.342	0.112**	1.774	0.121***
	-2.04	*-0.05*	*-1.91*	*-0.05*	*-1.96*	*-0.04*	*-1.93*	*-0.04*	*-1.89*	*-0.04*	*-1.95*	*-0.05*
Teff farm size (ha)	0.348	-0.0556	0.785	-0.0348								
	-4.95	*-0.11*	*-4.60*	*-0.11*								
Beneficiary (dummy)	9.118	0.275	8.311	0.267	14.17*	0.132	17.03*	0.15	9.35	0.132	8.325	0.116
	-9.80	*-0.21*	*-8.99*	*-0.22*	*-8.39*	*-0.19*	*-9.60*	*-0.18*	*-8.05*	*-0.20*	*-8.26*	*-0.21*
shock experience (dummy)	-2.565	-0.104	-0.784	-0.118	-3.933	0.178	0.393	0.121	-12.71	0.104	-14.62*	0.0612
	-7.64	*-0.20*	*-7.36*	*-0.20*	*-8.27*	*-0.18*	*-9.55*	*-0.18*	*-7.83*	*-0.21*	*-7.66*	*-0.21*
Distance to market, minutes (log)			3.442	-0.0897			-5.04	-0.149			-2.566	-0.168
			-4.54	*-0.14*			*-5.70*	*-0.11*			*-5.04*	*-0.12*
Distance to coop office (log)			3.046	0.0365			-4.979	0.114			2.152	0.107
			-5.42	*-0.14*			*-7.91*	*-0.14*			*-4.43*	*-0.11*
Distance to input dealer (log)			-10.90**	-0.181			-8.464	-0.0574			-1.456	0.047
			-4.96	*-0.13*			*-7.51*	*-0.13*			*-4.90*	*-0.13*
Distance to FTC (log)			-0.232	0.125			20.24***	0.117			1.282	0.171
			-5.13	*-0.14*			*-6.68*	*-0.13*			*-5.36*	*-0.13*
Distance to asphalt road (log)			2.077	0.0242			2.775	0.0828			-2.867	-0.00498

			-2.06	*-0.06*			*-3.15*	*-0.06*			*-2.20*	*-0.05*
Maize farm size (ha)					-1.661	-0.126	-6.904**	-0.134				
					-3.97	*-0.12*	*-3.44*	*-0.10*				
Wheat farm size (ha)									2.888	0.0374	2.237	0.0208
									-2.29	*-0.08*	*-2.33*	*-0.09*
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
_cons	111.5*	130.2**	153.2	323.0***	78.81	84.18	1.477	2.236	3.372***	3.691***	2.011	1.699
	-62.25	*-65.68*	*-108.69*	*-85.27*	*-69.20*	*-73.86*	*-1.22*	*-1.39*	*-1.22*	*-1.28*	*-1.47*	*-1.65*
athrho (_cons)	0.423		0.274		-0.0761		0.970***		0.152		0.2	
	-0.57		*-0.46*		*-0.54*		*-0.32*		*-0.36*		*-0.37*	
lnsigma (_cons)	3.942***		3.901***		4.000***		4.167***		3.940***		3.939***	
	-0.13		*-0.09*		*-0.08*		*-0.13*		*-0.06*		*-0.06*	
N	225		225		257		257		228		228	

Standard errors in *italic*. * p<0.10, ** p<0.05, *** p<0.01

Table 13. Determinants of intensity of fertilizer use, household level

	OLS	Endog. Treatment effects		Endog. Treatment effects	
	(1)	(2)	(Switch)	(3)	(Switch)
	Fertilizer	Fertilizer	Low Asp.	Fertilizer	Low Asp.
	(kg/ha	(kg/ha	(dummy)	(kg/ha	(dummy)
Low Asp. (dummy).	-15.19*	-45.84**		-42.64**	
	-8.92	*-19.97*		*-20.43*	
Subjective wellbeing (index)			-0.313***		-0.328***
			-0.10		*-0.10*
Female head (dummy)	-8.919	-5.431	0.241	-6.791	0.222
	-12.30	*-11.67*	*-0.27*	*-11.65*	*-0.27*
Age head (years)	2.521	2.455	-0.0383	2.212	-0.0482
	-2.01	*-1.96*	*-0.04*	*-1.97*	*-0.04*
Age square	-0.0206	-0.0208	0.00027	-0.0186	0.000349
	-0.02	*-0.02*	*0.00*	*-0.02*	*0.00*
Education (years)	1.469	0.906	-0.0960***	0.705	-0.104***
	-1.44	*-1.43*	*-0.03*	*-1.47*	*-0.03*
Household size	0.284	-0.457	-0.0434	-0.395	-0.0473
	-2.08	*-2.13*	*-0.04*	*-2.17*	*-0.04*
Total land size (ha)	-2.469	-3.951	-0.250***	-3.84	-0.255***
	-2.79	*-2.79*	*-0.09*	*-2.78*	*-0.09*
Beneficiary (dummy)	9.206	10.83	0.136	11.11	0.176
	-8.16	*-8.29*	*-0.17*	*-8.29*	*-0.17*
shock experience (dummy)	0.0132	0.796	0.134	1.58	0.131
	-8.49	*-8.17*	*-0.17*	*-8.27*	*-0.18*
Distance to market in minutes (log)	1.117			1.678	0.0699
	-4.44			*-4.41*	*-0.11*
Distance to coop office (log)	-4.057			-3.594	0.0333
	-4.15			*-4.14*	*-0.10*
Distance to input dealer (log)	-6.617			-8.011*	-0.198**
	-4.51			*-4.48*	*-0.10*
Distance to FTC (log)	3.584			2.363	-0.104
	-5.23			*-5.33*	*-0.11*
Distance to asphalt road (log)	-0.602			-0.102	0.0903**
	-1.73			*-1.70*	*-0.04*
Village dummies	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes
_cons	237.4***	189.0***	1.169	218.6***	1.842
	-55.16	*-52.63*	*-1.12*	*-57.50*	*-1.27*
athrho (_cons)		0.286*		0.255*	
		-0.15		*-0.16*	
lnsigma (_cons)		4.242***		4.234***	
		-0.08		*-0.08*	
N	355	355		355	

Standard errors in Italic. * p<0.10, ** p<0.05, *** p<0.01

Table 14. Determinants of sustainable natural resource management practices, plot level

	Structural equation approach (Two-step estimation)	
	(1)	(2)
	SNRMP index+	SNRMP index+
Low Aspirations (dummy)	**-0.619*** **	**-0.532*** **
	(0.199)	**(0.184)**
Female head (dummy)	0.0299	0.0132
	(0.0528)	(0.0521)
Age head	-0.0127	-0.0190**
	(0.00994)	(0.00957)
Square of age head	0.0000554	0.000114
	(0.0000914)	(0.0000883)
Education (years)	-0.0146**	-0.0151**
	(0.00740)	(0.00692)
Household size	-0.0118	-0.0112
	(0.00960)	(0.00921)
Plot size (ha)	0.135***	0.137***
	(0.0464)	(0.0451)
Past project beneficiary (dummy)	-0.0162	-0.0126
	(0.0351)	(0.0334)
Negative shock (dummy)	-0.0775**	-0.0750**
	(0.0335)	(0.0332)
Tenure status (own land dummy)	0.323***	0.323***
	(0.0463)	(0.0439)

Low fertile soil (dummy)	-0.0221	-0.00643
	(0.0508)	(0.0481)
Medium fertile soil (dummy)	-0.0537	-0.0366
	(0.0335)	(0.0328)
Plot distance, <1 minute (dummy)	0.0787	0.134
	(0.112)	(0.101)
Plot distance, 1-30 minutes (dummy)	-0.242**	-0.201**
	(0.0954)	(0.0862)
Plot distance, 31-60 minute s (dummy)	-0.329***	-0.287***
	(0.0993)	(0.0927)
Maize (dummy)	0.262***	0.259***
	(0.0487)	(0.0472)
Wheat (dummy)	0.0233	0.0236
	(0.0497)	(0.0468)
Predicted error	0.683***	0.585***
	(0.199)	(0.185)
Distance to market in minutes (log)		0.0261
		(0.0214)
Distance to Coop office in minutes (log)		-0.0225
		(0.0202)
Distance to input dealer in minutes (log)		-0.155***
		(0.0193)
Distance to FTC in minutes (log)		0.0273
		(0.0221)
Distance to asphalt road in minutes (log)		0.0168**
		(0.00856)
Village dummies	Yes	Yes
_cons	1.163***	1.724***
	(0.335)	(0.343)
N	1595	1595

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01
Note: + Bootstrap standard errors

Table 15. Correlation of aspirations and psychosocial indicators (OLS regression)

Dependent variable: Aspirations index- (standardized score of four components: Income, Wealth, Social status and Children's education)									
	-1	-2	-3	-4	-5	-6	-7	-8	-9
Female head (dummy)	0.0526	0.0478	0.0421	0.0465	0.0394	0.0532	0.0373	0.0363	0.036
	(-0.115)	(-0.119)	(-0.113)	(-0.123)	(-0.123)	(-0.122)	(-0.119)	(-0.122)	(-0.123)
Age head	0.00704***	0.00664***	0.00678***	0.00653***	0.00604**	0.00568**	0.00633**	0.00589**	0.00593**
	(-0.003)	(-0.003)	(-0.003)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.003)
Education (years)	0.0345***	0.0340***	0.0350***	0.0362***	0.0372***	0.0358***	0.0394***	0.0363***	0.0366***
	(-0.009)	(-0.01)	(-0.009)	(-0.009)	(-0.009)	(-0.009)	(-0.009)	(-0.009)	(-0.009)
Married (Dummy)	0.0547	0.0556	0.0664	0.068	0.0657	0.0271	0.0657	0.0639	0.0638
	(-0.09)	(-0.095)	(-0.089)	(-0.099)	(-0.097)	(-0.099)	(-0.096)	(-0.097)	(-0.097)
Household size	0.0394***	0.0405***	0.0397***	0.0374***	0.0392***	0.0440***	0.0341***	0.0395***	0.0395***
	(-0.013)	(-0.013)	(-0.013)	(-0.013)	(-0.013)	(-0.013)	(-0.013)	(-0.013)	(-0.013)
Total value of assets	8.18E-07	8.06E-07	7.87E-07	9.49E-07	9.29E-07	1.01E-06	7.13E-07	9.05E-07	9.08E-07
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Livest. holdings(TLU)	0.0223***	0.0231***	0.0232***	0.0259***	0.0262***	0.0259***	0.0209***	0.0266***	0.0265***
	(-0.007)	(-0.007)	(-0.007)	(-0.007)	(-0.007)	(-0.007)	(-0.007)	(-0.007)	(-0.007)
Self-esteem	**0.221*** (-0.078)**								
Internal locus of control		**0.142 (-0.104)**							
Perception of cause of poverty as external			**-0.191* (-0.1)**						
Openness to change				**0.0848 (-0.062)**					
Competition/envy					**0.00436 (-0.029)**				
Trust on others						**0.0889*** (-0.028)**			
Subjective wellbeing							**0.103*** (-0.029)**		
Time preference (impatience)								**0.00467 (-0.015)**	
Risk aversion (less risk averse)									**-0.00045 (-0.011)**
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
_cons	-0.780***	-0.765***	-0.781***	-0.756***	-0.739***	-0.759***	-0.654***	-1.071***	-1.061***
	(-0.205	(-0.203	(-0.202	(-0.204	(-0.204	(-0.204	(-0.2	(-0.21)	(-0.224)

N	378	378	378	378	378	378	378	376	376
R-sq	0.259	0.245	0.253	0.24	0.237	0.252	0.253	0.236	0.236
adj. R-sq	0.224	0.21	0.218	0.205	0.201	0.216	0.218	0.2	0.2

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

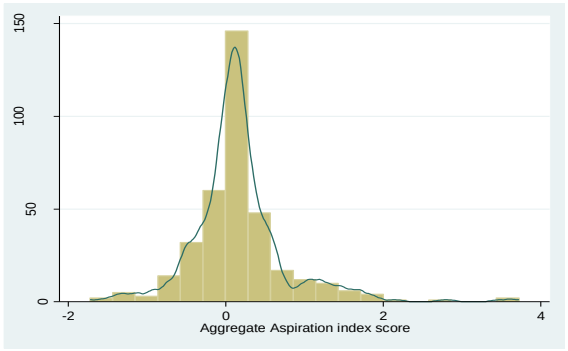
Table 16. Correlation of expectations and psychosocial indicators (OLS regression)

Dependent variable: Expectations index- standardized score of four components (Income, Wealth, Social status and Children's education)									
	-1	-2	-3	-4	-5	-6	-7	-8	-9
Female head (dummy)	-0.132	-0.127	-0.147	-0.154	-0.158	-0.132	-0.153	-0.156	-0.127
	(-0.148)	(-0.148)	(-0.144)	(-0.152)	(-0.154)	(-0.151)	(-0.147)	(-0.154)	(-0.156)
Age head	0.00148	0.00163	0.00109	-3.1E-05	9.29E-05	-0.00042	0.0004	-0.00029	0.000184
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
Education (years)	0.0509***	0.0462***	0.0517***	0.0549***	0.0550***	0.0527***	0.0571***	0.0524***	0.0551***
	(-0.008)	(-0.008)	(-0.008)	(-0.008)	(-0.008)	(-0.008)	(-0.008)	(-0.008)	(-0.008)
Married (Dummy)	-0.111	-0.12	-0.0947	-0.0991	-0.107	-0.149	-0.0962	-0.0973	-0.0893
	(-0.118)	(-0.12)	(-0.113)	(-0.123)	(-0.125)	(-0.122)	(-0.121)	(-0.124)	(-0.123)
Household size	0.0324*	0.0354**	0.0329*	0.0331*	0.0339*	0.0387**	0.0265	0.0325*	0.0315*
	(-0.017)	(-0.017)	(-0.017)	(-0.018)	(-0.018)	(-0.017)	(-0.018)	(-0.018)	(-0.018)
Total value of assets	5.76E-08	-1.2E-07	1.81E-08	2.25E-07	2.66E-07	3.27E-07	-2.68E-08	1.2E-07	7.66E-08
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Livest. holdings(TLU)	0.0285***	0.0259***	0.0298***	0.0339***	0.0333***	0.0335***	0.0279***	0.0353***	0.0353***
	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Self-esteem	**0.312*** **								
	(**-0.079**)								
Internal locus of control		**0.373*** **							
		(**-0.082**)							
Perception of cause of poverty as external			**-0.265*** **						
			(**-0.074**)						
Openness to change				**-0.0191**					
				(**-0.056**)					
Competition/envy					**-0.021**				
					(**-0.031**)				
Trust on others						**0.122*** **			
						(**-0.04**)			
Subjective wellbeing							**0.117*** **		
							(**-0.038**)		
Time preference (impatience)								**0.00872**	
								(**-0.018**)	
Risk aversion (less risk averse)									**0.0171**
									(**-0.012**)
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
_cons	-0.594**	-0.603**	-0.594**	-0.535**	-0.543**	-0.564**	-0.441*	-0.808***	-0.915***
	(-0.24)	(-0.237)	(-0.234)	(-0.24)	(-0.241)	(-0.239)	(-0.243)	(-0.253)	(-0.259)
N	378	378	378	378	378	378	378	376	376
R-sq	0.309	0.321	0.299	0.274	0.274	0.296	0.29	0.275	0.278
adj. R-sq	0.276	0.289	0.266	0.239	0.24	0.262	0.256	0.24	0.244

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Fig. 1. Distribution of aspirations and expectations indices

1.a. Distribution of aspirations index score



1.b. Distribution of expectations index score

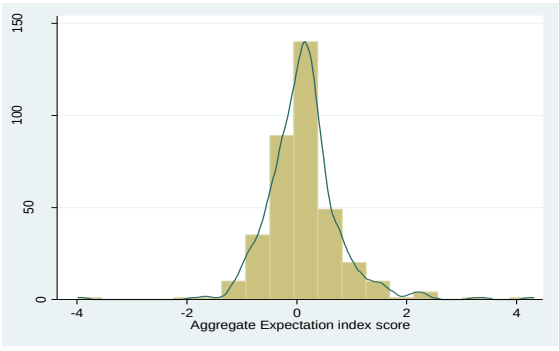
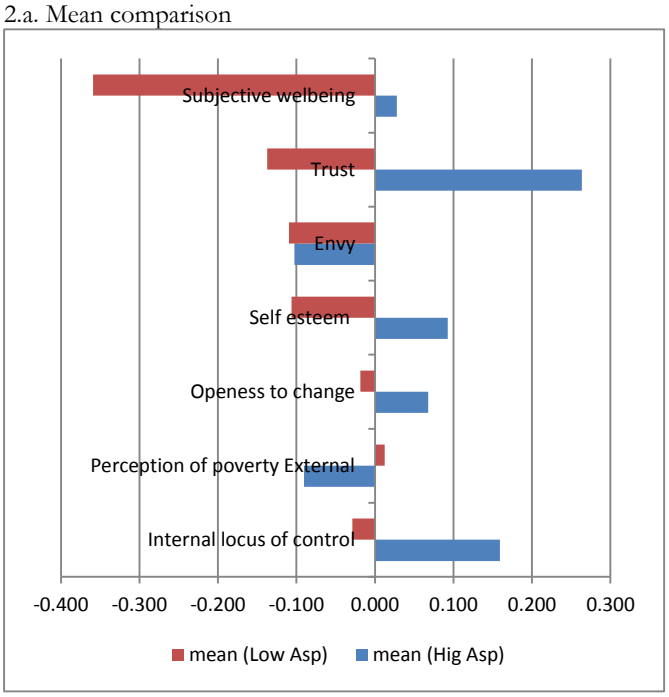


Fig. 2. Descriptive statistics on cognitive indicators

2.a. Mean comparison



2.b. Mean comparison test

	High Asp. (N=245)	**Low Asp. (N=118)**	**t test**
Index	mean	mean	p-value
Internal locus of control	**0.16**	**-0.03**	**0.000**
Perception on causes of poverty - External	**-0.09**	**0.01**	**0.033**
Openness to change	0.07	-0.02	0.105
Self-esteem	**0.09**	**-0.11**	**0.000**
Envy	-0.10	-0.11	0.945
Trust	**0.26**	**-0.14**	**0.000**
Subjective wellbeing	**0.03**	**-0.36**	**0.000**
Impatient	2.28	2.25	0.877
Less risk averse	**6.19**	**5.56**	**0.036**