

Human Capital vs. Social Capital – Influences on Egg Productivity in Southern Ethiopia

Guy Innes

University of San Francisco
2130 Fulton Street
San Francisco, CA 94117
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ABSTRACT: This study explores the relationships extension services, formal education and social networks have with egg production in Southern Ethiopia. A cross section survey of 112 farming households was collected and, using a semi-log linear production model, a detailed analysis was undertaken to evaluate these relationships. The data suggests social membership has a positive and significant influence on egg production but no discernable association was found between production and extension services. A weak, biased and unsupportive extension service was offered as a possible explanation. Possessing some primary education was also observed to have a positive and significant association with egg yields. Furthermore, the interaction between social members with different levels of education suggests that increasing levels of education have an increasing partial effect on the influence social capital has on egg production. This concurs with theory. Conclusions are that social capital and primary education are important to the productivity of female egg producers in Southern Ethiopia, but extension services are not.

1.0 INTRODUCTION

Agriculture is considered by many as the “key driver for mass poverty reduction and rural development for most of the developing world” (World Bank, 2008). An important feature of the agricultural sector is its ability to directly meet tangible, basic human needs. In Africa, this sector’s connection to development is undisputed. For many African economies, agriculture is the largest contributor to the economic base and is typically also its largest employer. This could not be truer for Ethiopia. Ethiopia’s agriculture sector employs 80% of its population and contributes the highest share to the country’s GDP (CIA, 2009; Dercon, Gilligan, Hoddinott, & Woldehanna, 2006; Belay & Abebaw, 2004).

A foundational key to most developing, industrializing economies is an efficient and productive agricultural sector. A crucial economic challenge facing Africa is rooted in this sector’s underdevelopment. Its failure was, and continues to be, related to the “failure to invest in the productivity of its farmers” (The Hunger Project, 2000). Ethiopia is no exception (CSA, 2008; Getinet, Tesfaye, & Kiflu, 1996). Belay and Abedaw (2004) characterize Ethiopia’s agricultural sector as “virtually small scale, subsistence-oriented and crucially dependent on rainfall” (i.e. virtually no watershed management) and cite these, along with environmental shocks, fragmented/small plots and a reliance on traditional tools and farming techniques, as major factors in its ongoing food-deficit over the past 40 years. Characterizing the Ethiopia agriculture sector as largely subsistence-level farming implies that efficiency and productivity gains may go well beyond simple economics and that opportunities to improve production efficiency of the agriculture sector can mean the difference between life or death for the farming household.

The productivity and efficiency of agricultural workers and producers is a key determinant for reducing poverty in rural areas of developing countries (Dao, 2004). Productivity and efficiency gains can be converted into more leisure time and/or larger incomes for rural households. Effective

information/knowledge pathways offer opportunities for these gains by facilitating the acquisition of new technical skills, technology and best practices in production. In rural areas, two main pathways exist for adults to acquire new agriculture information – informal education through social networks and through the non-formal, adult education system known as extension. These pathways play a role in linking farmers with knowledge, technology and skills, and each have a place of importance in improving on-farm productivity and efficiency.

The importance and value of effective agricultural information pathways to productivity gains has not been lost on the development community. In its quest to reduce poverty, bilateral and multi-lateral economic cooperation agencies contribute substantial resources to capacity building of both rural civil society organizations and agricultural extension systems. In developing countries today, one is hard-pressed to find a grant or loan project that does not include, in one form or another, emphasis on agriculture extension capacity building or NGO/civil society development.

One of these projects is the Improving Productivity and Market Success (IPMS) for Ethiopian Farmers Project, a Canadian funded development assistance initiative working to support the efforts of the Ethiopian Government to build a stronger, more efficient agricultural sector. The long term goal of the project is “to contribute to improved agricultural productivity and production through market-oriented agricultural development, as a means for achieving improved and sustainable livelihoods for the rural population” (IPMS Project, 2008). The sample for this research was drawn from a group of poultry producers that indirectly or directly benefitted from the work of IPMS.

With the aid community and local governments devoting a great deal of attention to efficient and productive knowledge transfer in their efforts to support development of the agricultural sector and rural areas, it is important that we have a clear understanding of what specific bottlenecks restrict these information flows. In many rural areas, particularly in developing countries, farming

households suffer from a knowledge deficit. Extension services can be systemically problematic – under-resourced, driven by political agendas and susceptible to cultural and gender biases – its presence can lead to further marginalization and greater income gaps for those that most need this type of support. It is under these circumstances that, perhaps, social networks and social connectedness may offer a viable alternative for technical information flows between farmers. Thus, an interesting question would be:

Is social capital more important than human capital as a determinant of egg yields amongst female egg producers in Southern Ethiopia?

Using a semi-log, multiple linear regression model and data collected through a cross section survey of egg producers, I compare the effects social networks, formal education and extension services have on egg production. I also test the inter-relationships between extension services, social capital and formal education.

The objective of this research is to contribute to the growing body of knowledge regarding the determinants of agriculture productivity – particularly those factors that might bring greater efficiency to subsistence farming. This research will also serve as feedback to the IPMS Project on the specific determinants of egg productivity in Dale Woreda of Southern Ethiopia. At the time this data was collected, the project had completed the first cycle (of three) designed to improve the supply chain for “exotic” breeds (in this case, the Brown Bovan breed of egg layers) within the region. The intent is to bring greater productivity to Dale’s egg producers. For successive cycles to be effective, it is important for project implementers to have a clear understanding of what factors are most influential in egg productivity in this region. Leveraging this knowledge will contribute to improving the impact this important initiative has to farming households in Dale Woreda.

2.0 LITERATURE REVIEW

This review covers the relevant literature on information pathways through social networks, formal education and agriculture extension in five sections. The first introduces the notion that the quality and quantity of information pathways are drivers of development. The second and third sections look more closely at theoretical and empirical evidence relating human capital accumulation and social capital accumulation to productivity gains. The fourth examines the relationship formal education has with both extension services and social networks. The last section provides a brief discussion of productivity measures and gender as they relate to the scope of this study.

2.1 Information Pathways – A Driver of Development

The information highway is a common, contemporary term used to describe the movement of information via the internet. It is not, however, the only information highway. Information has been flowing through more traditional channels for ages – through a range of education systems, social interactions, business relationships and the arts. Pathways for information flows between the sender and receiver are fundamental to human growth and development – socially, economically and intellectually. The number of available information pathways for this transfer to occur is important for accessibility. Equally, if not more important, is the quality of those pathways that move information about.

Cotlear (1990) describes three categories of education (or pathways for knowledge transfer) – formal, non-formal and informal. Formal education refers to what is commonly known as schooling or classroom education. Non-formal or vocational education covers transfers of specific knowledge and/or skills (i.e. agriculture extension). Informal education is said to mainly shape beliefs, attitudes and habits through peer exchange. This study addresses all three forms of these information pathways.

2.2 Human Capital and Productivity

2.2.1 Non-Formal Education - Agriculture Extension & Productivity

Cotlear (1990) characterizes non-formal education as a means to “impart specific information about innovations or sound practices”. For the purposes of this study, non-formal education herein refers exclusively to agricultural extension.

In its simplest form, agriculture extension is a mechanism of “two-way exchange of information that is meant to “...reduce the differential between potential and actual yields in farmers’ fields by accelerating technology transfer [i.e. reduce the technology gap] and helping farmers become better farm managers [i.e. reduce the management gap]” (Belay & Abebaw, 2004). Extension agents are typically trained professional adult educators that often serve as a communication “hub”. They also act as a coordinator, communicator, educator and translator; connecting rural communities to government, NGOs, credit mechanisms, and other related services. Extension is delivered in a variety of ways - demonstrations, field days, seminars, workshops, radio shows, publications and one-on-one counseling – but the goal is always the same: transfer important technical information and technology to the producer/farmer.

There is ample evidence that extension offers valuable gains to farmers’ productivity through improving access to technical knowledge and new skills. The system has also been shown to be an effective determinant of new technology adoption (Birkhaeuser, Evenson, & Feder, 1991). The productivity returns from public spending on research and extension for the agricultural sector have been found to be as high as 88% (Ali, 2000). Given these statistics, the extension system is viewed as an important mechanism for economic change in rural areas, and there is little dispute that it is valued and, for the most part, effective. For these reasons, extension is a popular poverty reduction tool for aid programs targeting agricultural and rural areas (Prowse & Chimhowu, 2007).

Agriculture extension, however, is not without its shortcomings. A common failing is a “one size fits all” approach to technology and technical skills transfer. The problem with this approach is that it does not take into account differences in farming capabilities, gender, levels of education, and/or experience amongst farmers/producers.

In developing countries, where the system is often under-resourced, extension typically caters to the middle-income farmer. In many of these countries, middle to high income male-managed farms – in some cases, representing less than 20% of the population (Hoang, Castella, & Novosad, 2006) - are intentionally or unintentionally targeted by the extension agent. This is the path of least resistance to an extension agent, whose time is at a premium. The prevalence of this method of selecting clients has been attributed to the extension agent’s lack of knowledge and skills to support poorer, less educated, marginalized clients. Moreover, an extension agent’s performance is typically tied to the performance of their farmers, a clear disincentive to support poor, less educated, or marginalized farmers.

2.2.2 Formal Education and Productivity

Formal education has been methodically studied regarding its relationship to labor productivity and efficiency (Weir, 1999; Alene & Manyong, 2007; Cotlear, 1990; Lin, 1997). It is widely believed that education increases farm output and productivity in two important ways. The first is that with an improved general learning and knowledge base, technical and allocative inefficiencies in production will be reduced. The second is that attitudes acquired in school encourage the adoption of new technologies, which can lead to an outward shift in the production frontier.

Empirical results from the agriculture sector, however, are mixed. Studies show support for positive, neutral, and even negative returns to education for the sector (Asadullah, 2005). This anomaly flies in the face of prevailing growth theories and common intuition. Formal education or

schooling is thought to provide people with non-cognitive and cognitive, general and specific skills and proficiencies that improve work productivity.

Although difficult to elucidate, the sketchy and inconsistent evidence relating productivity to formal education is reconciled with the notion that perhaps returns to education in rural settings are context-dependent with technology and modernization being the determining feature. That is, those areas with higher rates of modernization and/or increased levels of technology tend to have greater returns to schooling and formal education (Asadullah, 200; Lockheed, Jamison, & Lau, 1980; Alene & Manyong, 2007; Weir, 1999).

In Ethiopia, the research is less clear. Traditional and antiquated farming techniques are widespread across rural Ethiopia – particularly amongst small, subsistence farmers – where school enrollment is low. Despite these enrollment figures, Weir (1999) found that there are substantial private returns to education in terms of farmer productivity. Resolving some of this apparent inconsistency with other research, she did identify a threshold effect – four years of primary schooling – with the observed data indicating a significant positive effect on productivity only after a base level of schooling was reached. After this threshold is reached, however, increasing levels of education offered no further gains to productivity. Others have supported this same threshold in their own research (Lockheed, Jamison, & Lau, 1980). Moreover, in more recent studies, Weir suggests that the uniqueness of the Ethiopian context – one of unpredictability over a wide range of environmental, political, and economic variables – and that these features, rather than innovation, may be what determines a positive relationship between education and productivity. This argument, however, has yet to be empirically proven.

In her 2000 study, Weir augmented her earlier work and suggested that education does influence the timing of adoption of new technology (fertilizer). Further she found that more

educated farmers are better “copiers” of users of technology (i.e. through social networks, neighbors, etc.). Other research lends support to this notion (Alene & Manyong, 2007) .

In her most recent work, Weir investigates the external benefits schooling has on productivity and efficiency – again reinforcing this argument that schooling is an important change agent for rural communities. She identifies technology adoption and innovation as the source of externalities to schooling (Weir & Knight, 2006).

2.3 Social Capital and Productivity

The concept of social capital and its influence on productivity is a relatively new field in the study of economics and sociology. The idea that social relations can impact our rational individual behavior was not considered a part of the “economic equation” until about 22 years ago with the work of the University of Chicago based economists James Coleman. Coleman (1988) is one of the first to popularize the term “social capital” which he defines as the embodiment of “relations amongst people” for the purposes of “productive activity”. He also centers on the idea that this “productive activity” is really information exchange using “social relations that are maintained for other purposes” (Coleman, 1988). Dinda (2008) offers a more general definition, calling social capital “a broad term containing the social networks and norms that generate shared understandings, trust and reciprocity, which underpin cooperation and collective action for mutual benefits, and creates the basis for economic prosperity”.

The properties of social capital are quite distinct from physical and human capital. Unlike physical capital but similar to human capital, social capital accumulates from its use (Chou, 2006) – the more we use it, the more social capital we accumulate. Social capital is also uniquely dependent on relations between two people and, as such, there are externalities associated with it (with both positive and negative possibilities).

There is no question that, at a macro-economic level, social capital and evidence of its abundance are associated with positive economic growth. Utilizing a newly developed model that incorporates social capital accumulation into the standard Cobb-Douglas production function and applying it to a dataset of 63 countries, Dinda (2008) concludes that social capital does have an important association with incomes and growth rates. Dinda's view, however, is that social capital indirectly affects aggregate productivity through its relationship with human capital formation, more specifically formal education.

At the microeconomic level, studies have demonstrated a positive and significant relationship between social capital and business ownership amongst Brazilian immigrants (Siqueira, 2007), self-employment earnings amongst Canadian microfinance borrowers (Gomez & Santor, 2007) and crop production in Ethiopia (Pender & Gebremedhin, 2007).

Social capital may manifest its influence on productivity in a number of different ways. Hoang, Castella, & Novosad (2006) suggest that productivity gains amongst rice farmers in Vietnam rely on social capital as an alternate information pathway for the exchange of technical and production information. Pender and Gebremedhin (2007) suggest and prove that social capital offers improvement in land management through better access to information and technologies. Others suggest that social capital may be a mechanism for enhancing the utilization of human and physical capital that can lead to increases in productivity (Chou, 2006). Lastly and more recently, social capital has been found to be an unconventional form of collateral, resolving asymmetric information issues that are associated with extending credit to the poor.

For this paper, I utilize Chou's (2006) definition of micro social capital, that is, the mutual benefits derived from bonds between individuals that can have both positive and negative externalities.

2.4 Inter-relationships between Formal Education, Social Capital and Extension

2.4.1 Formal Education Externalities

There is evidence that the direct, internal impact of formal education has spillover effects. For example, there is evidence that higher educated farmers offer productivity gains for their uneducated neighbors based on proximity alone (Weir & Knight, 2006; Foster & Roenzweig, 1995). This suggests an important relationship between formal education and the efficiency of information movement through agriculture extension and social networks. In the context of this present research, formal education externalities may, therefore, act as mechanisms for enhancing the respective efficiencies and effectiveness of information flows through social networks and extension.

2.4.2 Formal Education and Social Capital

Theory, backed by solid research, posits that formal education serves to enhance social capital formation and, later in life, this capacity to form quality social connections may offer alternative and valuable pathways for information flows. Rupasingha et al (2006) found that more educated individuals better recognize the value of social capital; both its private and public returns. They go on to suggest that going to school “promotes social interaction, networking and social responsibility among individuals and produces generally more informed individuals” (Rupasingha, Goetz, & Freshwater, 2006). Many support the notion of Dinda (2008); that the relationship between social capital formation and human capital formation is reciprocal and mutually reinforcing. That is, staying in school improves the depth and quality of social capital later on in life while, at the same time, social capital improves the chances of staying in school.

2.4.3 Formal Education and Extension Services

Intuitively, it seems reasonable to expect that farmers with higher levels of formal education will have an easier time understanding technical information and skills being delivered through non-formal education channels later on in life (i.e. agriculture extension). Jamison and Lau’s (1982)

review of 16 separate studies evaluates the relationship between education, extension and productivity, and they found that, for half of the studies, “extension was significantly and positively related to productivity” but for the other half, “there was no significance”. They also presented conflicting findings within their study that indicated a negative and significant relationship. In all cases, however, the interaction between education and extension services was found to be insignificant in its influence on production.

Understanding this relationship can have important policy implications. These include better understanding how and when extension is most effective. It also serves to re-emphasize the important relationship different forms of education have with one another.

2.4.4 Social Capital and Extension Services

Exploiting the positive externality properties of social networks for efficiency gains in agriculture extension has been the subject of much applied research. The integration of the “contact farmer” as a mechanism of extension delivery is a case in point (Hoang, Castella, & Novosad, 2006). Contact farmers are selected on the basis of their social position or status within the community. The principle is that, leveraging this status, these farmers would receive technical information from the extension agent and then disseminate this information through social channels to other neighboring farmers, including the marginalized poor (Saito, 1991). This assumption, however, has proven to be contextual. Social and cultural stigmas (particularly gender biases) coupled with inappropriate or unattainable technical skills and technology constrain information flows between farmers (Saito, 1991; Hoang, Castella, & Novosad, 2006). This is a case of negative externality and the consequence is that the use of select contact farmers by the extension system may actually prove to further marginalize the poor and needy.

In order to draw out the positive externalities of the “contact farmer”, it is important that these systemic biases be removed. As such, if the extension services were to target a wider range of

contact farmer types, creating information channels for more groups of “like-people”, it is possible that this could lead to a more effective system. Lack of resources in many developing countries limits this possibility.

2.4.5 A Note on Temporal Issues

Formal education, extension services and social capital are temporally distinct from one another. Formal education, for this research, is considered to be a part of the past. That is, most if not all of the poultry managers no longer attend school. The influence information flows from schooling have on production, therefore, are derived from the efficiency and effectiveness of past flows and the ability of the individual to draw on this knowledge now. Information that flows through extension services and social capital, on the other hand, could be considered more “current” with regards to their influences on production outcomes (i.e. the application of either and their consequent outcomes on productivity are closer together in time than for formal education). In the context of this study, therefore, formal education is considered a “base” for the other two forms of information flow. This is not to say education is not important to productivity in its own right, but that its influence on production may also be exerted indirectly through its relationship with extension and social capital.

2.5 Other Considerations

2.5.1 Productivity

Productivity or production efficiency is the product of technical and allocative efficiencies. Technical efficiencies are measured by how well the producer manages inputs in order to maximize outputs. Allocative efficiency is a measure of the producers’ “ability to choose optimal input levels for a given factor price” (Alene & Hassan, 2008). For the purposes of this study, changes in total overall productivity, as measured by production yields, will be treated as one (Belay & Abebaw, 2004).

2.5.2 A Note on Gender

The data for this study is drawn primarily from interviews with women (81%) – usually the female spouse within the family constellation - who are typically designated poultry manager within the household. Productivity gains, therefore, have particular importance in this context.

People have a finite amount of time for work, family, and leisure. In many countries, non-income generating, but equally important, household duties are deemed exclusively women's work. The demands of these duties are exacerbated by lack of infrastructure and limited access to labor saving devices. As such, any gain in terms of efficiency or productivity in women's farm or non-farm work would bring about improvements in their lives overall.

Advances in farming offer the potential for such improvements. Accessing and using appropriate and cost-effective technology and farming technical skills could lead to greater efficiency, offering opportunities to earn more income or more leisure time. The problem is that most women, given their status in many societies, including Ethiopia, are often marginalized by the formal and non-formal education systems.

The success of microfinance programs amongst women groups (Wydick, 2008) provides evidence that social capital may have a significant important influence in their adult lives.

3.0 RESEARCH SITE and the BROWN BOVAN INITIATIVE

Dale Woreda is one of ten woredas that make up the Southern Nation's, Nationalities and People's Region (SNNPR) of southern Ethiopia. Comprised of an area of 1400 square kilometers, the woreda is divided up into 77 geo-political Peasant Areas (PAs - the equivalent of a municipality or district). The population of Dale is close to 450,000 people divided nearly equally in half between women (51%) and men (49%). There are three main categories of land: the largest of which is arable, cultivatable land (81%), followed by unproductive land (15%) and forested areas (2.7%). The backbone of the woreda's economy is agriculture.

There are two principle systems of agriculture production in Dale. The first is a combined livestock, coffee, and enset (a local grain) production, located in the hilly regions of the woreda. The second is a combined livestock and haricot bean production system found in flatter regions. These two systems are split roughly, east-west, by a major road that bisects the length of the woreda. Throughout the woreda, backyard egg production is a common, well understood, but very informal form of production. Most flocks are composed of the local breed of chicken whose genetic mix is unknown due to generations of inbreeding and cross breeding.

A Participatory Rural Appraisal (PRA) conducted by IPMS revealed that there were significant gaps in the supply of exotic pullets (egg-type hens that are less than one year old) in Dale. Principal amongst these was that demand seemed to be outstripping available supply for high-yield chickens. In response, the Dale Office of Agriculture and Rural Development (OoARD), in collaboration with the IPMS Project, developed and delivered the first of three cycles of a Brown Bovan pullet improvement initiative. In this cycle, 80 women from five different kebeles (smallest unit of political administration levels) in Dale were selected to raise and then sell or keep high egg yielding Brown Bovan chickens. The objective of the IPMS/OoARD Brown Bovan initiative was to:

1. Introduce a high-yield breed of egg layers to Dale Woreda in an effort to improve the supply of these types of pullets.
2. Strengthen the capacity of private poultry producers to raise chicks to egg-laying age.
3. Enhance overall poultry production in Dale Woreda.

The 80 women raised the chicks over a period of 5 months. At the end of this period, the women either:

- a. Kept the pullets for their own-farm egg production;
- b. Sold the pullets on the open market to egg producers;
- c. Sold the pullets back to the OoARD to be re-distributed and sold on the open market and/or distributed to select recipients of the Food Security Program;
- d. Or a combination of any of the above.

It is from these groups of pullet, egg producers and food security participants that the sample was drawn for this research.

4.0 ANALYTICAL FRAMEWORK & VARIABLE DESCRIPTION

4.1 Analytical Framework

The analytical framework selected for this research is a reduced form linear model based on the adapted human capital earnings model used by Gomez and Santor (2007). The model makes use of a mix of level and log-transformed explanatory variables.

The model to be estimated is as follows:

$$Q_i = \beta_0 + \beta_1 \text{extser}_i + \beta_2 \text{educ}_i + \beta_3 \text{socnet}_i + \beta_4 \text{interaction}_i + \beta_5 Z_i + u_i$$

with Q_i representing egg yields per household, per week, per hen for observation i ; β_0 is a constant (intercept); β_1 is the scale coefficient on the extension service dummy of observation i ; β_2 is the scale coefficient for education levels of observation i ; β_3 is the scale coefficient for social membership of observation i ; β_4 is the scale coefficient for interaction between the three different explanatory variables of interest; and β_5 is a scale coefficient for a vector of control variables for observation i .

4.2 Description of Variables

4.2.1 Dependent Variable

Egg Yields

Egg yield data was measured using recollection of egg yields by the poultry manager. Poultry managers were asked to provide yield data at three different points in the past. In the data cleaning process, the selection rule was “the later the better” when assembling yield data. That is, the most recent data was used but if no data was available for that period, the next earliest was used.

4.2.2 Independent Variables

Social networks

In this study, social network and social connectedness is measured by membership in non-commercial (i.e. non-profit) community organizations and sector associations. This network and the degree and depth of the poultry manager’s involvement will serve as a proxy for their level of social

capital. The premise is that the more involved the poultry manager is in their community organizations, the more social capital they would possess.

Respondents were questioned about the depth and breadth of social organizations they belonged to and participated in. Seven different types of organizations were listed on the survey; association, marketing cooperative, peasant association council, savings club, burial society (*idir*), religious group or church and women's associations/groups. Respondents were asked whether they were a member or leader of the organization and how frequently they participated in the activities of that organization. Three dummy categories were created: Social Leaders (*soclea*), Social Member/Regular (*socmem*) that participated regularly in activities and Social Member/Non-regular that did not participate regularly in organization activities (*socnrm*).

In addition to these dummies, a cumulative, weighted index of social connectedness was also employed (a similar index was used by Kaske (2007)). The index was constructed using a point system. A leadership role in a social group earned the manager two points vs. being a regular member which earned only one point. Similarly, attending regular meetings was given more weight (two points) than attending less than regularly (one point).

Extension Services (extser)

Respondents were questioned about the level of extension services they received. This is a dummy variable that indicates whether they received extension services (*extser*=1) or not (*extser*=0).

Control Variables

Using the work of Saito Mekonnen & Sperling (1994) as a guide, and giving due consideration to the objective of this research, the following control variables were included in this analysis:

Education (*educd/edprim, edsec, edpostsec*) was measured as an ordinal variable with four different categories representing illiteracy/no education, primary education, secondary education and post-secondary education. Individuals fell into one of these four groups based on their response.

Household wealth (*hwealth*) is a cumulative total of select assets, including land, crops, home style/type and a range of farm and household assets. The value of these assets was based on estimations provided by the supervising enumerator (in birr).

HH Income (*linc*) – Respondents supplied income information. To aid in the accurate recollection of income, a list of possible income sources was used by the enumerator to sub-divide income into more easily manageable pieces.

Family size of household (*famsize*) was a measure the number of people living on the property at the time of the survey.

Household Flock size (*hflocksiz*) was the measure of total number of birds per household.

Bird ratio (*brdratio*) is the ratio of flock composition between local breeds and the Brown Bovan breed; 0=all local breed, 1=all Brown Bovan breed

Poultry Experience (*pouexp*) is a control variable that measures, in years, the poultry experience of the poultry manager. This experience is also meant to act as a proxy to a variety of physical input variables including feeding, watering and general care and husbandry of the birds. Input data (i.e. general feeding practices, water practices, etc.) that was collected was decidedly homogenous across the observations due in part to the line of questioning that was used but also due to the informal nature of backyard egg production (i.e. everyone consistently watered their chickens every day). More concrete specifics on input data were beyond the scope of this research.

Group Control

GROUP 1 – Pullet Producers (pull)

GROUP 2 - Egg Producers (eggpro)

GROUP 3 - Food Security Group (Default)

5.0 HYPOTHESES

Utilizing the above model as a framework, the following hypotheses will be evaluated:

Hypothesis 1: Social networks are of greater importance to egg production in Ethiopia than extension services or formal education.

$$Q_i = \beta_0 + \beta_1 \text{extser}_i + \beta_2 \text{educ}_i + \beta_3 \text{socnet}_i + \beta_4 Z_i^a + u_i$$

H₀: There is no difference in the influence of social capital, education and extension services on productivity amongst poultry managers.

$$H_0: \beta_1 = \beta_2 = \beta_3$$

H₁: Social capital has a greater importance to productivity amongst poultry managers.

$$H_1: \beta_3 > \beta_1, \beta_2$$

Hypothesis 2: If theory is correct and there is a reciprocal and mutually reinforcing relationship between education and social capital, and one serves to enhance the other, a test of whether there is a partial effect of the interaction between education and social networks would reveal whether or not this association is, in turn, associated with variation in productivity. That is, the quality of the information pathways, trust and reciprocity that is embodied in social networks would have a greater influence on productivity amongst the more educated.

Similarly, given the applied theory that is captured in the concept of the “contact farmers” in extension delivery, the relationship between social networks and extension services will also be tested. The expectation is that the association will be positive.

Lastly, theory and other empirical work suggest that formal education enhances the effectiveness of extension services. As such, it is expected that the partial effect succeeding levels of

education have on the effectiveness of extension delivery (as evidenced by egg yields) will be positive.

A second hypothesis, therefore, is:

$$Q_i = \beta_0 + \beta_1 \text{extser}_i + \beta_2 \text{educ}_i + \beta_3 \text{socnet}_i + \beta_4 \text{interaction}_i + \beta_5 Z_i^a + u_i$$

H₀: The interaction between the three measures of social capital and human capital do not have a partial effect on egg yields.

$$H_0: \beta_4 = 0$$

H₁: Inter-acting the three different elements of social capital and human capital has a positive partial effect on egg production.

$$H_1: \beta_4 > 0$$

6.0 EMPIRICAL PROCEDURES

Cross section household data was collected using a survey. The survey instrument was composed of two sections. The first section assessed the Brown Bovan pullet production and information collected from this section was not used in this study. The second, longer section of the survey was designed to collect data on egg production along with basic household characteristics including composition, age, income, and resource endowments. Egg production data included yields, flock size, breeds used, and some of the different practices used by the producers in egg production. Lastly, the survey asked questions related to household time distribution and technical support from extension services. This second survey section was the source of data for this research.

A survey sample was generated from the following three different groups:

- Group 1a: 40 women randomly selected from a group of 80 that received the pullet production packages.
- Group 1b: 20 women were selected from a group of 47 women who wanted to participate in the pullet production initiative but were not selected to do so.
- Group 2a: 54 poultry producers randomly selected from a group of 112 that purchased nine or fewer Brown Bovan pullets for egg production from Group 1.
- Group 2b: 46 poultry producers (the entire population) that purchased 10 or more Brown Bovan pullets for egg production from Group 1.
- Group 3: 40 randomly selected recipients of benefits under the Ethiopian Government's Food Security Program. The sample was drawn from the 274 food-insecure households that each received 2 Brown Bovan pullets.

A random number generator was used to select which households would be surveyed from the total "population" of the three different groups of households. In cases where the selected

household was impossible to locate (for the most part, due to poor record keeping of addresses), the next randomly selected household was surveyed.

The survey was administered through interviews conducted by eight enumerators and one supervisor. The length of each interview ranged from 15 minutes to 2.5 hours depending on the individual's responses. Most interviews were conducted in the Amharic language. There are, however, several different dialects in Dale so, in some cases, a local translator was needed. Each survey was collected from the enumerators, reviewed, and if required, corrected/revised through repeat visits when possible.

A total of 200 surveys were collected from households across Dale Woreda, drawing from a mix of both urban and rural regions. Of the 200 surveys, 112 surveys, with non-missing yield and poultry manager characteristic data, were used in this final analysis.

7.0 RESULTS

7.1 Summary Statistics

Table 1 summarizes the dependent and independent variables for this sample. To summarize, the average poultry manager is female, 34 years old with some primary education, has 13 years of poultry experience, lives with four other people under the same roof, and has a total household annual income averaging 28,000 birr (US\$2154). The average flock size per household was approximately 5 birds, half of which are Brown Bovan, generating just over 4 eggs per week per bird. Note that the mean/median differential is small suggesting a fairly normal distribution for each of the different variables. Wealth, income and flock size were log transformed generating a relatively normal distribution as compared to their highly skewed (rightward) level forms. All this suggests that MLR.1 holds and a linear regression model is appropriate for analysis.

The composition of the sample is also worthy of comment – particularly the fact that a majority of the sample are female egg producers, most of whom have some primary education and are regular members of social groups and associations.

Table 2 provides summary statistics for observations from each of the three different groups that were sampled. The groups appear to be quite similar to one another; particularly in age and family size. As would be expected, considerable differences exist between the groups in flock size and bird ratio.

7.2 Regressions

7.2.1 Social Networks, Extension Services and Education

Human Capital - Extension Services

Table 3 provides OLS estimations of the model using robust standard errors for the sample data. Consistently, all estimations suggest that extension services have no impact on mean egg yields for this sample – while the coefficient is of the expected sign, it lacks any statistical significance.

As mentioned, one of the primary challenges of agriculture extension in Ethiopia is its susceptibility to cultural, religious and gender biases. The system is male-centric and this, coupled with an already patriarchal society, might explain this lack of influence the system has on female poultry managers.

More generally, overall weaknesses in Ethiopia's extension system may limit its influence on egg productivity. Ousman (2007), in his thesis on the effectiveness of extension services in a neighboring woreda, supports this notion, citing large gaps in matching the content of training to the identified needs of poultry farmers. He places the blame on the lack of a participatory needs assessment, a top down management approach of extension delivery, shallow yet largely passive training with little monitoring, and the lack of evaluation process of the activities of the extension agents. Most farmers reported little or no improvement in yields as a result of their participation in extension training events. Belay and Abebaw (2004), in their study of 85 extension workers in Ethiopia, back this up and found that extension services were truly non-participatory in nature in Ethiopia, citing weaknesses in practical skills of the extension agent (specifically, their communication skills and technical knowledge) and a tendency for extension agents to ignore or give little consideration to farmers' knowledge and experiences. They also found the extension agents to be selective, focusing only on the more sophisticated and successful, male-run farms.

Reciprocally, it may be that even if the extension system was effective, poultry production, by its very informal nature, may not be responsive to information provided through this system. Backyard egg production in Ethiopia follows very traditional methods and, consequently, education, either formal or non-formal, may have little influence on productivity. This offers some support for the theory introduced in the literature review that suggests that a modernizing or innovative context is important to the influences education, including extension, have on productivity.

Note, however, that these conclusions may also be due to the lack of power from this sample size to generate enough variation in egg yields to be able to measure a true effect from the influence of extension. Using the power calculation, the minimum detectable effect to achieve 80% power at the 5% significance level for this sample would require a coefficient value on extension services greater than 0.8624 (estimation=0.342). That is, to reject the null that extension services have no influence on egg productivity at 80% power requires a coefficient on extension to be at least 0.8624.

Human Capital - Formal Education

Comparing egg yields between those with some education (regardless of level) and those with none suggest that education has little association with egg yields and productivity. Disentangling the variable through the use of education level dummies for primary, secondary and post-secondary education, offered an opportunity for deeper analysis. The results suggest that, while there is no statistically verifiable association between poultry managers with some secondary or post-secondary education and egg yields, there appears to be a positive and significant association for those with primary education.

This corroborates with current theory and literature. Moreover, this finding lends some support to this concept of a primary education threshold in agriculture productivity that was

introduced in the literature review. That is, egg production, by its traditional nature, does not offer any returns to education once the most basic education requirements are met.

Social Capital - Social Networks

The data suggests that the dummy term “social member/regular” have an economically positive, statistically significant relationship with egg productivity. Setting endogeneity aside for the moment and given the deficiencies of Ethiopia’s agriculture extension services outlined above, one explanation might be that social networks may default as the information pathway of choice for technical information related to egg production. Kaske (2007), in his examination of technical information networks for 160 farming women living in Dale woreda, found that the women ranked neighbors/friends and other farmers as their first and second most important sources of agriculture information respectively. Development agents were ranked third while the woreda district extension officer was ranked fourth. Accounting for both proximity and perceived value, he found that, in terms of credibility, “other farmers” were considered the information source of choice amongst the 160 women.

Greater access to technical information through social relations can translate into improvements and adoption of best practices in flock management and animal husbandry. Social capital can also offer greater opportunities for sharing of responsibilities and duties amongst producers. In other words, even though there may be little support to poultry managers through conventional education channels (i.e. extension), informal, social channels may compensate for this by providing an alternative pathway through which technical information and support can flow.

Without any qualitative data regarding the nature of the relationships forged through the different social networks of the poultry managers, however, it is difficult to identify what specific social force might be at play – i.e. technical information exchange, trust and reciprocity in chicken rearing or other elements of social connectedness that influences productivity. Kaske (2007)

demonstrates, however, that social participation is a positive and significant influence on the level of dairy technical knowledge amongst the farming women he studied. This offers some credibility to the claim being made here - that social networks facilitate information flows.

The number of groups a poultry manager belongs to may be a proxy for the degree of their social connectedness. This may have implications on egg production. To test this, three additional estimations were generated – one for each category of social membership i.e. social leader, social member/regular and social member/non-regular. These estimations included “number of groups” that poultry managers belonged to as an additional regressor. The results indicate that there are no within group differences in mean yields when number of groups is included in the model. That is, by deduction, it can be posited that it is not necessarily the number of groups one belongs to that is important, but rather it is the quality of the individual associations that is the determining influence on egg yields.

Returning to the endogeneity issue, education and age offer some control for endogeneity of social networks. It is still likely, though, that relevant variables that are associated with both social capital and egg yields have been omitted from the model because they were unobserved or unobservable. As such, it is difficult to say with any certainty which direction this influence runs – that is, are higher egg yields associated with greater social capital or is greater social capital associated with higher yields? Regardless, a connection exists and further study to determine the nature of this connection is warranted.

7.2.2 Hypotheses

Responding to the hypothesis - which is more effective, social membership or extension services - the data suggests that social networks are more important simply because social member/regular have such a strong association with egg production while extension services do not. The discussion above serves as support for this conclusion.

It is difficult to conclude, however, which is more important – social networks or formal education. The coefficients on primary education and social member/regular are both positive and significant (at the 5% level). The difference in value of each coefficient is marginal – with social member have a slightly larger value than primary education. A larger sample size with more comprehensive control inputs could alter any conclusions drawn from this current estimation and, as such, it is difficult to conclusively suggest that one is more important than the other.

7.3 Interactions

7.3.1 Formal education and Social Networks

Theory implies that with more formal education, the effectiveness of the poultry manager to form useful and mutually beneficial social bonds (and the various positive benefits derived from these bonds) will be enhanced. To test this theory, an interaction term was added to the model to estimate any partial effects education has on the influence between social networks and egg yields. Estimations of this revised model are summarized below:

Summary of Interaction between Social Membership and Education Levels

Variable	Social Member		Social Leader	
	Partial Effect (PE) on Egg Yields Coefficient/Significance	Total Effect on Egg Yields	Partial Effect (PE) on Egg Yields Coefficient/Significance	Total Effect on Egg Yields
Primary Education	$PE_{pr} < PE_{sec}, PE_{post}$ Joint Significance $p=0.06$	+	$PE_{pr} > PE_{sec}, PE_{post}$ Joint Significance $p=0.07$	++
Secondary Education	$PE_{pr} < PE_{sec} < PE_{post}$ Joint Significance $p=0.06$	++	$PE_{pr} > PE_{sec} > PE_{post}$ Joint Significance $p=0.07$	+
Post Secondary Education	$PE_{pr}, PE_{sec} < PE_{post}$ Joint Significance $p=0.06$	+	$PE_{pr}, PE_{sec} < PE_{post}$ Joint Significance $p=0.07$	+

Two trends emerged from these estimations. The first is that, for the social member/regular, the partial effect succeeding levels of education have on egg yields increases. That is, being a social member with higher levels of education is associated with increasingly higher levels

of egg yields. This concurs with theory and empirics. To reiterate, education offers opportunities for information flow and knowledge transfer but attending school also contributes to socialization. The social skills we develop from interacting with others at school are utilized throughout our life. It stands to reason and theory that the more education we have, the more finely tuned our social skills will be and the more benefits we may garner from these skills.

The second trend, for social leaders, is opposite and contrary to theory. The partial effect on egg yields of increasing levels of education decreases for the social leader. It must be acknowledged that this effect may be an artifact of the data (the same could be said for the positive trend of social members discussed above). If a relevant variable is missing from the specification, it would lead to biases of the coefficients and spurious conclusions.

If the interaction coefficients are, however, unbiased and efficient, it may be that education has no partial effect for this level of social membership. Social leaders are typically the most productive (i.e. causality is reversed). As such, the inter-relationship between education and social networks may fail to show any conclusive and consistent results simply because the relationship to egg yields is less dependent on these variables and, perhaps, more dependent on other unobserved or unobservable variables. Support for this is the fact that the data failed to show any significant relationship between social leaders and egg yields.

7.3.2 Extension services and social networks

The weakness of the extension service coefficient is likely the reason why no significant results (Table 5) were obtained when estimating the influence the combination of social networks and extension have on egg yields. The estimations lack any significance, joint or otherwise, and no conclusions can be drawn based on these results.

7.3.3 Formal education and extension services

Similarly, very weak estimations that include an interaction variable between formal education and extension services (Table 6) prohibit any concrete conclusions regarding the partial effects education may have on egg yields through extension services.

7.4 Additional Results – Table 1 Regressions

7.4.1 Endogeneity, Causality and the Distance to Highway IV

The sample likely suffers from endogeneity – particularly amongst the key explanatory variables of interest. It is difficult, therefore, to empirically establish/confirm causality between these variables and egg yields. A 2SLS estimation was generated to evaluate endogeneity of extension services using the instrument “distance to highway”. “Distance from highway” is the distance the household sits from a major, sealed road/highway. The results are presented in Table 7. The selection of this variable was based on the notion that it is both exogenous and relevant. That is, the level of extension services would be negatively associated with the distance the farm/household sits from the highway while having no effect on egg yields and no association with any omitted variable (i.e. $Cov(extser, u) \neq 0$; $Cov(dishwy, u) = 0$ and $Cov(extser, dishwy) \neq 0$). Unfortunately, these conditions did not hold for this estimation. Distance from the highway was found to be negatively and significantly associated with mean egg yields while having no significant association with extension services. It was, therefore, discarded as an instrument.

One suggested explanation for its association with egg yields is that the further the household/farm sits from a major highway the less incentive there might be to produce more eggs to sell at the market (the coefficient was negative and significant when included in the original model). For most of the households surveyed, egg production was split between those consumed in-house and those sold at the market so this influence would diminish with increasing family size. Pender and Gebrenedhin (2007) found that this association was ambiguous in terms of crop

production. In any case, the distance from highway variable improved the fit of the model (increased adjusted R-squared) and it was added as an independent variable to the final regression.

7.4.2 Breed Ratio

Chicken breed, representing technology differences, is strongly associated with egg yields in this sample – with the OLS regression rendering a coefficient that is positive and highly significant. The Brown Bovan breed was associated with an average of 2.06 more eggs (49% of mean yield). This significance may be attributed to other factors and not just a more productive breed. These influential factors include differences in clutch cycles between local and Brown Bovan breeds and temporal differences in the data sources for yields (see Measurement Errors).

7.4.3 Producer Groups

As described in the introduction, the sample was drawn from three different sources of poultry producers. That is, Group 1 is composed of pullet producers, Group 2 is composed of egg producers and Group 3 is made up of Food Security Recipients. The estimations reveal a significant, positive and economically important association between the egg producer group and mean egg yields. On average, egg producers are associated with 1.2 more eggs (29% of mean egg yield) as compared to the food security group. Belonging to the pullet producer group offers a statistically insignificant 0.78 more eggs over food security participants.

These results are expected. The poultry managers voluntarily bought Brown Bovan chickens for egg production. This suggests that they are both early adopters (a sign of production proficiency) and committed egg producers. Interestingly, there is no remarkable correlation between the number of years of poultry experience and belonging to the egg producers group.

7.5 Research Challenges

7.5.1 Measurement Errors – Yield Data

One possible source of unobserved variation may be the ability to accurately recollect actual egg yields by the poultry managers. This could lead to biased and inefficient coefficients (See Figure 1) caused by individual differences in memory capacity. Another problem is that hens do not lay eggs continuously throughout the year. They lay in 2-5 clutches per year, each clutch lasting approximately 26 days (Mekonnen, 2006). Using Mekonnen's data and assuming a clutch occurs throughout the month, an approximation of average per week egg yields is 4.01 eggs per hen. This is similar to the yields observed under this study (4.16). Two procedural changes to the methods could, however, bring greater precision to the estimations presented in this study. One is to conduct a physical count of yield over a sufficiently long period to accurately estimate egg production per week per bird. Alternatively, increasing the sample size would smooth this variation. Both were not feasible given time and budgetary constraints.

7.5.2 Misspecification and Omitted Variable(s)

There is reason to believe that omitted and relevant variables may be the source of bias and inefficiency in the data. Collection of specific and exact physical input data was unfeasible. A review of other studies indicates that these variables might be important independent variables when evaluating productivity (Jamison & Lau, 1982). As mentioned in the description of variables, this was beyond the scope of this research.

7.4.3 External Validity

Selecting specific groups for the cross sectional survey limits the external validity and, thereby, the interpretation of the data from this research.

8.0 CONCLUSIONS

This study set out to evaluate the different influences social network, formal education and extension services may have on egg production in Dale region of Southern Ethiopia. Estimations suggest primary education and social membership are more important determinants of egg yields than extension services. The inter-relationships between formal education and social membership were also found to be important and, in terms of the benefits (i.e. egg yields) derived from social membership, more education is better.

Based on these results, the following conclusions were made:

1. Extension service in Dale cannot or do not cater to egg production.
2. Social channels may duplicate the function of extension services by minimizing weaknesses (biases, approaches) found in Ethiopia's extension system and offering a viable alternative for information exchange and support in egg production.
3. Basic education is important to egg production for Dale's poultry managers but, beyond this level (i.e. secondary education or higher), there are no further direct gains to productivity. Higher levels of education, however, appear to improve the production benefits derived from social connections.

The non-randomness of the data, small sample size and endogeneity impose constraints on the conclusions drawn here and the degree to which any policy recommendations can be made. For the IPMS Project and Dale Woreda's OoARD, however, this study offers some insight into how better to support egg producers in this region.

Two recommendations are offered. The first is that Dale's extension services should consider leveraging this strong association between social capital and egg production to support productivity and efficiency improvements of female poultry managers in Dale. The second is that formal education is important at all levels of production and should always remain a priority.

Further study that considers both changes in technology and social networks as they relate to education, both formal and non-formal, in Dale Woreda is recommended. Moreover, future study/initiatives on egg productivity should focus on the “egg producer” group. They tend to be the most proficient in production and are, generally, the early adopters of new technology.

9.0 BIBLIOGRAPHY

- Abdelali-Martini, M., Amri, A., Ajlouni, M., Assi, R., Sbeih, Y., & Khnifes, A. (2008). Gender dimension in conservation and sustainable use of agro-biodiversity in West Asia. *The Journal of Socio-Economics* (37) , 365-383.
- Alene, A. D., & Hassan, R. M. (2008). Efficiency of food production under old and new technology: the case of farmers within and outside extension package program in Ethiopia. *Journal of Developing Areas* (Vol 41, No. 2) , 233-49.
- Alene, A. D., & Manyong, V. M. (2007). The effects of education on agriculture productivity under traditional and improved technology in northern Nigeria: an endogenous switching of regression analysis. *Empirical Economics* , 141-159.
- Ali, S. (2000). *Productivity Growth in Pakistan's Agriculture Sector: 1990-1996 (Ph D Thesis)*. Ottawa: Government of Canada.
- Anderson, D. P., Chaisantikulawat, T., Guan, A. T., Kebbeh, M., Lin, N., & Shumway, C. R. (May 1996). Choice of Functional Form for Agricultural Production Analysis. *Agricultural & Applied Economics Association* (18:2) , 223-231.
- Angrist, J. D., & Pischke, J.-S. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton: Princeton University Press.
- Asadullah, M. N. (2005). *Farm productivity and efficiency in rural Bangladesh" the role of education revisited*. Oxford: Centre for the Study of African Economics.
- Belay, K., & Abebaw, D. (2004). *Challenges Facing Agricultural Extension Agents: A Case Study from South-western Ethiopia*. Oxford: Blackwell Publishing.
- Birkhaeuser, D., Evenson, R., & Feder, G. (1991). The economic impact of agriculture extension: A review. *Economic Development and Cultural Change* (39:3) , pp. 607-650.
- Bishop-Sambrook, C. (2004). *IPMS Gender Analysis and Strategy*. Addis Ababa: IPMS.
- Browne, A., & Barrett, H. (1991). Federal education in Sub-Saharan Africa: The Key to Development. *Comparative Education* (27) , 275-285.
- Buvnic, M., Margaret, L., & William, M. (1987). *Women and Poverty in the Third World*. Washington: The John Hopkins University Press.
- Capalbo, S. M., & Antle, J. M. (1988). *Agricultural Productivity: Measurement and Explanation*. Washington: Resources for the Future, Inc.
- Chou, Y. K. (2006). Three simple models of social capital and economic growth. *The Journal of Socio-Economics* (35) , 889-912.

- CIA. (2009, April 23). *Ethiopia*. Retrieved April 24, 2009, from Central Intelligence Agency - The World Factbook: <https://www.cia.gov/library/publications/the-world-factbook/geos/et.html>
- Coleman, J. (1988). Social Capital in the creation of Human Capital. *American Journal of Sociology* (94) , S95-S120.
- Cotlear, D. (1990). The effects of education on farm productivity. In K. Griffin, & J. Knights, *Human Development and the International Development Strategy for the 1990s*. London: MacMillan.
- CSA. (2008, October 10). *2008 National Statistics (Abstract)*. Retrieved April 24, 2009, from Central Statistics Agency - Ethiopian Government: <http://www.csa.gov.et/National%20Statistics%202008.htm>
- Dao, M. Q. (2004). Rural poverty in developing countries: an empirical analysis. *Journal of Economic Studies* (Vol. 31, No. 6) , 500-508.
- Dercon, S., Gilligan, D. O., Hoddinott, J., & Woldehanna, T. (2006). *The impact of roads and agriculture extension on consumption growth and poverty in fifteen Ethiopian villages*. Oxford: Centre for the Study of African Economics.
- Dinda, S. (2008). Social capital in the creation of human capital and economic growth: A productive consumption approach. *Journal of Socio-Economics* (37) , 2020-2033.
- Egziabher, M. (2007). *Characterization of Smallholder Poultry Production and Marketing Systems of Dale, Wonsho and Loka Abaya Weredas of Southern Ethiopia*. Hawassa, Ethiopia: IPMS, Hawassa University.
- Foster, D. E., & Roenzweig, M. R. (1995). Learning by doing and learning from others: human capital and technical change in agriculture. *Journal of Political Economy* (Vol. 103, No. 6) , 1176-1209.
- Frischmuth, C. (1997). *Gender is not a sensitive issue: Institutionalising a gender oriented participatory approach in Siavonga, Zambia*. London: International Institute for Environment and Development.
- Getinet, G., Tesfaye, K. A., & Kiflu, B. (1996). The Institute of Agriculture Research: Its Role in the Development of Ethiopian Agriculture. *Achieving Greater Impact from Research Investment in Africa* , 89-103. (S. Breth, Ed.) Mexico City: Sasakawa Africa Association.
- Gomez, R., & Santor, E. (2007). The Effect of Social Capital and Neighbourhood Characteristics on the Earnings of Microfinance Borrowers. *The Canadian Journal of Economics* (34:4) , 943-966.
- Griffin, R. C., Montgomery, J. M., & Rister, M. E. (1987). Selecting Functional Form in Production Function Analysis. *Western Journal of Agricultural Economics* (12(2)) , 216-227.
- Hoang, L. A., Castella, J.C., & Novosad, P. (2006). Social networks and information access: Implications for agriculture extension in a rice farming community in Northern Vietnam. *Agriculture and Human Development* (23) , pp. 513-527.
- Improving Productivity and Market Success Project Team. (2005). *Project Implementation Plan*. Addis Ababa: IPMS.

- IPMS Project. (2008). *Proposed Program of Work and Budget Year 4 (2008-2009)*. Addis Ababa: IPMS.
- Jamison, D. T., & Lau, L. J. (1982). *Farmer Education and Farm Efficiency*. Washington: Johns Hopkins University Press.
- Jamison, D. T., & Moock, P. R. (1984). Farmer Education and Farmer Efficiency in Nepal: The Role of Schooling, Extension Services and Cognitive Skills. *World Development* (12:1) , 67-86.
- Karami, E., & Mansoorabadi, A. (2008). Sustainable agriculture attitudes and behaviors: a gender analysis of Iranian farmers. *Environment, Development and Sustainability* , 883-898.
- Kaske, D. K. (2007). *Agriculture Information Networks of Farm Women and Role of Agricultural Extension: The Case Dale Woreda, Southern Nations, Nationalities and People's Region*. Addis Ababa: Unpublished.
- Kongolo, M., & Bamgose, O. (2002). Participation of rural women in development: a case study of Tsheseng, Thintwa, and Makhalaneng Villages, South Africa. *Journal of International Women's Studies* Vol. 4 #1 , 79-92.
- Lin, S. (1997). Education and economic development: Evidence from China. *Comparative Economic Studies* (39, 3/4) , 66-85.
- Lockheed, M., Jamison, D., & Lau, L. (1980). Farmer Education and Farm Efficiency: A Survey. *Economic Development and Cultural Change* (29:1) , 37-76.
- Lohr, L., & Park, T. A. (2006). Technical Efficiency of US Organic Farmers: The Complementary Roles of Soil Management Techniques and Farm Experience. *Agricultural and Resource Economics* , 327-338.
- Mekonnen, G. (2006). *Characterization of smallholder poultry production and marketing system of Dale, Wonsho, Loka Abaya Weredas of Southern Ethiopia*. Addis Ababa: IPMS.
- Ousman, S. O. (2007). *Effectiveness of Agriculture Development Training Program: The Case of Teff and Livestock Farmers of Alaba Woreda, Southern Ethiopia*. Addis Ababa: IPMS/Haramaya University.
- Pender, J., & Gebremedhin, B. (2007). Determinants of Agricultural and Land Management Practices and Impact on Crop Production and Household Incomes in the Highlands of Tigray, Ethiopia. *Journal of African Economies* (17:3) , 395-450.
- Prowse, M., & Chimhowu, A. (2007, October). Making Agriculture Work for the Poor. *National Resource Perspectives* , pp. 1-4.
- Psacharopoulos, G., & Ng, Y. C. (1994). Earnings and Education in Latin America. *Education Economics* (2:2) .
- Rupasingha, A., Goetz, S. J., & Freshwater, D. (2006). The production of social capital in US counties. *The Journal of Socio-Economics* (35) , 83-101.

- Saito, K. A. (1991). Extending help to women farmers in LDCs: What works and why. *Finance and Development* , 3.
- Saito, K., Mekonnen, H., & Spurling, D. (1994). *Raising the Productivity of Women Farmers in Sub-Saharan Africa*. Washington, DC: World Bank.
- Sen, A. (1999). *Development as Freedom*. Oxford: Oxford University Press.
- Siqueira, A. C. (2007). Entrepreneurship and Ethnicity: The Role of Human Capital and Family Social Capital. *Journal of Developmental Entrepreneurship* (12:1) , 31.
- Soloaga, I. (1999). *The Treatment of Non-essential Inputs in a Cobb Douglas Technology: An Application to Mexican Rural Household Level Data*. Washington: World Bank Development Research Group.
- The Hunger Project. (2000). *The African Woman Food Farmer: Her Future is Africa's Future*. New York: The Hunger Project.
- Verwhimp, P. (1999). Measuring the quality of education at two levels: A case study of primary schools in rural Ethiopia. *International Review of Education* (45:2) , 167-196.
- Weir, S. (1999). *The effects of education on farmer productivity in Ethiopia*. Oxford: Centre for the Study of African Economics (Working Paper Series).
- Weir, S. (1999). *The Effects of Education on Farmer Productivity in Rural Ethiopia*. Oxford: Centre for the Study of African Economics.
- Weir, S., & Knight, J. (2000). *Adoption and diffusion of agriculture innovations in Ethiopia: the role of education*. Oxford: Centre for the Study of African Economics.
- Weir, S., & Knight, J. (2006). Production Externalities of Education: Evidence from Rural Ethiopia. *Journal of African Economics* , 134-165.
- World Bank. (2008). *Gender in Agriculture Sourcebook*. Washington, DC: World Bank.
- Wydick, B. (2008). *Games in Economic Development*. Cambridge: Cambridge University Press.
- Zepeda, L. (. (2001). *Agriculture Investment and Productivity in Developing Countries - FAO Paper#148*. Rome: Food and Agriculture Organization .

Figure 1:

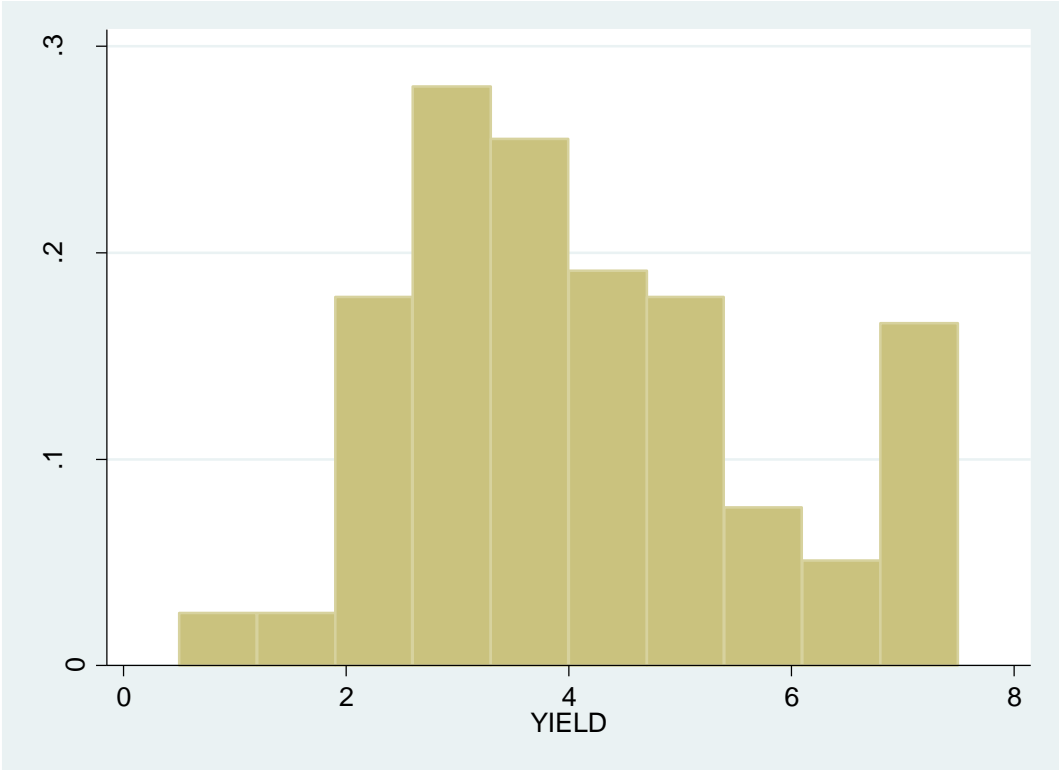


Table 1: Summary Statistics of Dependent and Independent Variables

Variable	Name	Type	Observations	Mean/Median	Std. Dev.
Dependent Variable					
yield	Egg Yields	Continuous	112	4.16/3.75	1.6
Independent Explanatory Variables					
age	Age	Discrete	112	33.29/32	10.92
educ	Education	Discrete	112	2.38/2	0.97
pouexp	Poultry Experience	Continuous	112	12.97/10	8.64
socnet	Social Networks	Discrete	112	7.98/7	3.65
famsize	Family Size	Discrete	112	5.65/6	2.02
linc	Income (Log) ¹	Continuous	112	8.45/8.38	1.62
lwealth	Wealth (Log) ¹	Continuous	112	11.94/11.88	1.36
brdratio	Bird Ratio	Continuous	112	0.51/0.57	0.47
lflocksiz	Flock Size (Log) ¹	Discrete	112	1.18/1.10	0.85
Variable	Name	Type	Observations	Frequency	Per Cent Total
Dummy Variables					
extser	Ext Service - Yes	Dummy		65	58%
	Ext Services - No	Dummy		47	42%
pull	Pullet Producers	Dummy		49	44%
eggpro	Egg Producers	Dummy		44	39%
	Food Security	Dummy		19	17%
soclea	Social Leader	Dummy		32	29%
socmem	Social Member - Regular	Dummy		65	58%
socnrm	Social Member/Non-Regular	Dummy		15	13%
gndr	Male	Dummy		21	19%
	Female	Dummy		91	81%
edill	Education - Illiterate/No Ed	Dummy		18	16%
edprim	Primary Education	Dummy		53	47%
edsec	Secondary Education	Dummy		20	18%
edpostsec	Post Secondary Education	Dummy		21	19%

¹ Note: Wealth, income and flocks size data were rightward skewed. As such, each of these variables was log-transformed to bring greater “normality” to their respective distributions.

Table 2: Select Summary Statistics of Dependent and Independent Variables by Group

Variable	Name	Type	Observations	Mean	Std. Dev.
Egg Producers					
age	Age	Discrete	44	34.52	8.78
educ	Education	Ordinal	44	3.15	0.94
pouexp	Poultry Experience	Continuous	44	12.25	8.34
socnet	Social Networks	Discrete	44	7.36	2.89
famsize	Family Size	Discrete	44	5.15	2.36
linc	Income (Log)	Continuous	44	9.51	1.48
lwealth	Wealth (Log)	Continuous	44	11.61	1.77
brdratio	Bird Ratio	Continuous	44	0.73	0.39
lflocksiz	Flock Size (Log)	Discrete	44	1.43	1.03
Pullet Producers					
age	Age	Discrete	49	31.39	10.89
educ	Education	Ordinal	49	2	0.58
pouexp	Poultry Experience	Continuous	49	13.89	8.32
socnet	Social Networks	Discrete	49	8.61	4.16
famsize	Family Size	Discrete	49	6.35	1.69
linc	Income (Log)	Continuous	49	8.21	1.02
lwealth	Wealth (Log)	Continuous	49	12.51	0.86
brdratio	Bird Ratio	Continuous	49	0.23	0.39
lflocksiz	Flock Size (Log)	Discrete	49	1.16	0.68
Food Security					
age	Age	Discrete	19	35.32	14.79
educ	Education	Ordinal	19	1.58	0.51
pouexp	Poultry Experience	Continuous	19	12.26	10.26
socnet	Social Networks	Discrete	19	7.79	3.72
famsize	Family Size	Discrete	19	5	1.41
linc	Income (Log)	Continuous	19	6.57	1.25
lwealth	Wealth (Log)	Continuous	19	11.25	0.58
brdratio	Bird Ratio	Continuous	19	0.72	0.42
lflocksiz	Flock Size (Log)	Discrete	19	0.64	0.47

Table 3: OLS Regressions – Education, Extension Services, Social Membership and Yields

Variable	Social Network Index/Education Dummy	Education Category/ Social Index	Social Category/ Education Category	Social Category/ Education Category incl. Distance to Highway
	yield	yield	yield	yield
Extension Services (D)	0.389 (0.313)	0.384 (0.313)	0.342 (0.301)	0.342 (0.308)
Education – Primary (D)		0.695* (0.392)	0.709* (0.385)	0.723** (0.363)
Education Secondary (D)		0.307 (0.477)	0.334 (0.473)	0.292 (0.481)
Education - Post Secondary (D)		0.0814 (0.544)	0.0836 (0.538)	0.110 (0.531)
Social Network (Index)	0.0354 (0.0313)	0.0426 (0.0312)		
Income (Log)	-0.225** (0.107)	-0.184 (0.113)	-0.136 (0.115)	-0.148 (0.122)
Bird Ratio	1.905*** (0.364)	1.914*** (0.357)	2.019*** (0.352)	2.040*** (0.336)
Pullet Producers (D)	0.886* (0.528)	0.934* (0.533)	0.822 (0.529)	0.756 (0.519)
Egg Producers (D)	1.499*** (0.492)	1.700*** (0.523)	1.431*** (0.544)	1.202** (0.574)
Education (D)	0.594 (0.386)			
Social Leader (D)			0.687* (0.402)	0.613 (0.399)
Social Member (Regular) (D)			0.861** (0.378)	0.796** (0.372)
Distance from Highway				-0.0992** (0.0457)
Constant	2.107* (1.194)	2.200* (1.178)	1.047 (1.386)	1.161 (1.366)
Observations	112	112	112	109
R-squared	0.377	0.389	0.407	0.442

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Insignificant Independent Variables not included: Family Size, Flock Size, Poultry Experience & Wealth

Multicollinearity Check

Variable	VIF	1/VIF
eggpro	4.95	0.202087
pull	3.62	0.276073
soclea	2.95	0.339465
postsec	2.93	0.341268
socmem	2.75	0.364094
linc	2.48	0.403642
edsec	2.38	0.419459
edprim	2.27	0.439594
lwealth	1.75	0.570493
brdratio	1.70	0.589095
extser	1.51	0.660119
dishwy	1.50	0.667916
famsize	1.41	0.709778
pouexp	1.34	0.743813
lflocks	1.32	0.754754
Mean VIF	2.32	

Table 4: Interaction – Education and Social Capital

VARIABLES	(1) yield	(2) yield	(3) yield
Extension Services (D)	0.336 (0.321)	0.318 (0.314)	0.364 (0.314)
Primary Ed (D)	1.681 (1.248)	1.407*** (0.495)	0.513 (0.469)
Secondary Ed (D)	2.383 (1.692)	0.533 (0.698)	0.634 (0.642)
Post Secondary Ed (D)	0.203 (1.411)	-0.234 (0.887)	0.211 (0.597)
Social Leader (D)	1.877 (1.298)	1.436** (0.706)	0.758* (0.383)
Social Member (Regular) (D)	1.361 (1.271)	0.686 (0.428)	0.431 (0.614)
Poultry Experience	-0.0220 (0.0179)	-0.0205 (0.0169)	-0.0200 (0.0172)
Family Size	-0.0286 (0.0756)	-0.0288 (0.0737)	-0.0230 (0.0756)
Wealth (Log)	0.169 (0.108)	0.163 (0.105)	0.147 (0.103)
Income (Log)	-0.133 (0.123)	-0.138 (0.122)	-0.141 (0.123)
Flock Size (Log)	-0.124 (0.184)	-0.110 (0.186)	-0.0762 (0.171)
Bird Ratio	1.809*** (0.362)	1.872*** (0.338)	1.815*** (0.344)
Pullet Producers (D)	0.551 (0.556)	0.673 (0.544)	0.488 (0.527)
Egg Producers (D)	1.087* (0.591)	1.262** (0.591)	1.064* (0.579)
Distance from Highway	-0.102** (0.0441)	-0.107** (0.0435)	-0.107** (0.0457)
INT – Primary/Member	-1.412 (1.353)	-1.175 (0.712)	
INT – Secondary/Member	-2.121 (1.801)	-0.371 (0.976)	
INT – Post/Member	0.0197 (1.509)	0.318 (1.009)	
INT – Primary/Leader	-0.362 (1.307)		0.806 (0.572)
INT – Secondary/Leader	-2.283 (1.745)		-0.553 (0.811)
INT – Post/Leader	-0.479 (1.720)		-0.577 (1.123)
Constant	0.353 (1.760)	0.802 (1.339)	1.552 (1.488)
Observations	109	109	109
R-squared	0.490	0.472	0.468

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Interaction – Extension Services and Social Capital

VARIABLES	(1) yield	(2) yield	(3) yield	(4) yield
Extension Services (D)	0.617 (0.570)	0.342 (0.308)	0.401 (0.320)	0.251 (0.516)
Education (D)	0.593 (0.366)			
Social Network (Index)	0.0511 (0.0431)			
Poultry Experience	-0.0142 (0.0157)	-0.0172 (0.0172)	-0.0159 (0.0177)	-0.0164 (0.0184)
Family Size	0.00557 (0.0663)	-0.0220 (0.0746)	-0.0237 (0.0745)	-0.0218 (0.0748)
Wealth (Log)	0.146 (0.105)	0.157 (0.0997)	0.145 (0.105)	0.153 (0.106)
Income (Log)	-0.237** (0.114)	-0.148 (0.122)	-0.146 (0.122)	-0.148 (0.123)
Flock Size (Log)	-0.157 (0.175)	-0.118 (0.172)	-0.123 (0.174)	-0.121 (0.173)
Bird Ratio	1.949*** (0.354)	2.040*** (0.336)	2.078*** (0.340)	2.046*** (0.337)
Pullet Producers (D)	0.832 (0.529)	0.756 (0.519)	0.813 (0.533)	0.773 (0.525)
Egg Producers (D)	1.257** (0.526)	1.202** (0.574)	1.200** (0.573)	1.203** (0.572)
Distance from Highway	-0.103** (0.0461)	-0.0992** (0.0457)	-0.0998** (0.0461)	-0.0991** (0.0458)
INT – Social/Extension	-0.0317 (0.0564)			
Social Leader (D)		0.613 (0.399)	1.033 (0.684)	0.652* (0.373)
Social Member (Regular) (D)		0.796** (0.372)	0.778** (0.377)	0.736 (0.549)
Education – Primary (D)		0.723** (0.363)	0.719* (0.363)	0.726** (0.361)
Education Secondary (D)		0.292 (0.481)	0.232 (0.518)	0.279 (0.513)
Education - Post Secondary (D)		0.110 (0.531)	0.121 (0.533)	0.114 (0.531)
INT – Leader/Extension			-0.520 (0.709)	
INT – Member/Extension				0.126 (0.614)
Constant	2.032 (1.256)	1.161 (1.366)	1.240 (1.385)	1.225 (1.516)
Observations	109	109	109	109
R-squared	0.414	0.442	0.444	0.442

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Interaction – Extension Services and Education

VARIABLES	(1) yield	(2) yield	(3) yield	(4) yield
Extension Services (D)	0.643 (0.780)	0.0149 (0.411)	0.518 (0.329)	0.429 (0.353)
Education (D)	0.797 (0.606)			
Social Leader (D)		0.647 (0.401)	0.645* (0.383)	0.628 (0.408)
Social Member (Regular) (D)		0.836** (0.382)	0.828** (0.358)	0.806** (0.383)
Poultry Experience	-0.0139 (0.0159)	-0.0169 (0.0169)	-0.0172 (0.0175)	-0.0168 (0.0174)
Family Size	-0.00173 (0.0663)	-0.00708 (0.0767)	-0.0177 (0.0759)	-0.0186 (0.0741)
Wealth (Log)	0.148 (0.106)	0.151 (0.101)	0.154 (0.102)	0.150 (0.0996)
Income (Log)	-0.228** (0.111)	-0.182 (0.125)	-0.159 (0.123)	-0.154 (0.123)
Flock Size (Log)	-0.159 (0.174)	-0.0987 (0.176)	-0.134 (0.168)	-0.0987 (0.179)
Bird Ratio	1.938*** (0.352)	1.974*** (0.338)	2.045*** (0.337)	2.002*** (0.342)
Pullet Producers (D)	0.807 (0.521)	0.675 (0.505)	0.750 (0.516)	0.715 (0.526)
Egg Producers (D)	1.205** (0.518)	1.245** (0.551)	1.168** (0.557)	1.201** (0.574)
Distance from Highway	-0.107** (0.0502)	-0.0866* (0.0485)	-0.0953** (0.0472)	0.0994** (0.0461)
Social Network (Index)	0.0297 (0.0314)			
INT – Ed/Extension	-0.319 (0.803)			
Education – Primary (D)		0.268 (0.471)	0.745** (0.364)	0.729** (0.363)
Education Secondary (D)		0.305 (0.484)	0.849 (0.614)	0.316 (0.485)
Education - Post Secondary (D)		0.125 (0.534)	0.205 (0.546)	0.353 (0.614)
INT – Ext/Primary		0.736 (0.551)		
INT – Ext/Secondary			-1.000 (0.663)	
INT – Ext/Post Sec				-0.439 (0.709)
Constant	1.995 (1.305)	1.587 (1.462)	1.116 (1.338)	1.217 (1.382)
Observations	109	109	109	109
R-squared	0.415	0.452	0.455	0.444

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7: – IV 2SLS Regressions – Extension Services & Distance from Highway

Variable	First Stage	Second Stage - IV
	ext service	Distance from Highway yield
Education – Primary (D)	-0.104 (0.124)	1.834 (2.697)
Education Secondary (D)	-0.270 (0.166)	3.178 (6.267)
Education - Post Secondary (D)	-0.0668 (0.182)	0.824 (2.423)
Social Leader (D)	0.478*** (0.147)	-4.500 (11.49)
Social Member/Regular (D)	0.119 (0.138)	-0.474 (3.438)
Poultry Experience	-0.00627 (0.00550)	0.0498 (0.160)
Family Size	0.0216 (0.0246)	-0.253 (0.555)
Wealth (Log)	-0.0764* (0.0389)	0.974 (1.855)
Income (Log)	0.0356 (0.0399)	-0.529 (0.934)
Flock Size (Log)	0.103* (0.0553)	-1.223 (2.482)
Bird Ratio	0.137 (0.114)	0.577 (3.442)
Pullet Producers (D)	0.174 (0.157)	-1.103 (4.447)
Egg Producers (D)	-0.314* (0.186)	4.560 (7.111)
Distance from Highway	-0.00928 (0.0194)	
Extension Services (D)		11.03 (23.27)
Constant	0.927* (0.496)	-8.748 (21.74)
Observations	109	109
R-squared	0.340	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1