Influence of Micro-Finance Services on Farm Households Income: *The Case of Oromia Credit and Saving Share Company–Kuyu Branch, Ethiopia*

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Abstract

The paper analyzes the influence of microfinance services in improving economic performance of farm households using data collected from 100 randomly selected households. Descriptive analysis of the changes in income level between the baseline and survey year was made whereas binary logit model was used to analyze the determinant of incremental income.

The results revealed the existence of improvement in the household income of the clienteles. Microfinance service related variables such as proper utilization of the disbursed loan, average loan size, appropriateness of loan disbursement schedule, and access to required amount of loan were found to be significant factors influencing the incremental income of the clientele. Other determining factors include land holding, shortage of draught animals, and distance to market.

The policy implications of the results tend to emphasize on the importance of supervision of loan service, improved loan schedules, proper identification of feasible business plan, income diversification of the clientele, and strengthening market access.

Keywords: Determinants, micro-finance, clientele, credit, logit model, Ethiopia

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1. INTRODUCTION

Similar to the other sub-Saharan African countries, the socio-economic situation of Ethiopia is characterized by low growth of income, inadequate social services, high population growth, economic inefficiency, and high unemployment rate, etc. resulting in severe poverty. As a result, diseases, malnutrition, and illiteracy are wide spread affecting more seriously women and children (Tsehay and Mengistu, 2002). Poverty also severely affects investment, which further leads to vicious poverty cycle due to lack of investment capital.

As poverty is a multidimensional problem, its solutions are multifaceted. In the Agricultural Development Led Industrialization (*ADLI*) strategy of Ethiopia, rural finance has been considered as an important tool for agricultural development and food security. Moreover, the Ethiopian Sustainable Poverty Reduction Strategy (SPRSP, 2002) underlines the importance of micro-finance institutions in poverty reduction and sustainable development. From the assessment of the Grameen Bank and even the experiences of some Micro-finance Institutions (*MFIs*) of Ethiopia, one can identify a number of best bet practices as well as challenges in the sector (Belay, 2001). Even though it cannot be a panacea – universal-remedy for poverty and related development challenges, micro finance is an important tool in the poverty eradication program. It can play an important role in facilitating the realization of rural development, and empowering the poor through provision of financial means to increase income and access to social services thereby creating confidence and self-esteem (Wolday, 2002). Micro-finance institutions provide suitable financial and other services using innovative methodologies and systems at low cost to meet the needs of low income sections of the population and act as intermediaries in a genuine sense (Wolday, 2000).

Oromia Credit and Saving Share Company (OCSSC), which was established in 1997, is one of the 21 licensed MFIs in the country with 70 branches and 50,815 clienteles and loan outstanding of about 43.4 million (OCSSCOAR, 2002). The company operates in 190 districts in Oromia and About 99% of the clientele of the company are from rural areas.

2. STATEMENTS OF THE PROBLEM

The major objective of the OCSSC is improving the living conditions of rural households through mobilization of saving and provision of credit. Hence, it is expected that the income of clientele households would increase. Some anecdotal observations[1] on the ground, however, show that there are mixed influences of credit provisions on the incremental income of the clienteles. USAID (1995) revealed that financial schemes of institutions that do not follow sound, sustainable financial principles and facilitate real economic growth might cause more harm than good. A similar study by Pischke et al. (1966) recommended that NGOs offering credit and other financial services should be subjected to national standards and adoption of appropriate standards.

Limited access by rural farm households to financial services is widely recognized in Ethiopia. According to the Microsoft Project Document of UNDP (1999), the economically active but poor in Ethiopia who can potentially access financial services are about 6 million out of which about 8.3% have gained access to the licensed microfinance institutions. Scaling up of the financial services provided by microfinance institutions requires identification of supportive features that are acceptable to the clienteles. Accordingly, it is imperative to analyze the influences of microfinance parameters and other factors affecting the household income in order to provide empirical evidences on the extent of influence of microfinance services. The major question to be answered is whether variables associated with microfinance service significantly contribute to incremental household income or not.

This study was, therefore, designed with the objectives of analyzing the influence of micro-finance services on the incremental income of the target households and identify instruments of microfinance services such as loan size, loan scheduling, utilization, etc. that would affect the performance of microfinance services.

[1] *The major author worked for the company and had informal discussions with the clienteles regarding the benefits of the loan disbursed.*

3. MICROFINANCE SERVICES IN ETHIOPIA

Provision of financial services could be made through saving and credit functions. Both functions could be provided from informal and formal financial markets. Micro-finance institutions are among the formal financial institutions targeting the poor both in urban and rural areas. Micro finance institutions started operations in the country following the issuance of Proclamation No. 40/96, which regulates the businesses of micro finance in the country. The National Bank of Ethiopia, that is the licensing authority, has since then been issuing a number of guidelines that underpin the operation of micro finance institutions in the country. The major target groups of most of the MFIs operating in urban areas are women while the lion's share of the target groups are men in rural areas. These institutions have been trying to enlarge their client and area outreach for the last almost five years (Tsehay and Mengistu, 2002).

Even though few MFIs are being involved in managing the pension fund of Social Security Authority and money transfer, the provision of credit and saving products are the two most important financial products/services delivered by all MFIs in Ethiopia (Woldy, 2002). Loan products of MFIs in the country can be divided into two general categories: viz. agricultural loans and micro-business loans. The agricultural loans are loans for agricultural inputs, livestock production, bee-keeping, etc. The loans are usually term loans; the principal and interest are paid at the end of the loan term, which varies from one week to one year for all MFIs in the country.

Micro-business loans are loans for petty trade, handicraft, and other services, which are repaid weekly, bi-weekly, or monthly on a regular basis. The micro-business loans do have lower risks to MFIs portfolio management and loan loss as compared to agricultural loans, and they diversify household income. Saving is a precondition for investment and consumption smoothing and as a result, it can be an effective instrument to overcome economic shocks. The saving products include center savings, compulsory group savings, individual voluntary savings, and institutional voluntary savings.

Owing to small loan sizes and short loan period, which are major features of informal credit in both rural and urban areas of Ethiopia, the demand for products of MFI has been growing. According to Wolday (2000), delivery of microfinance services has been considered as one of the policy instruments to enable rural and urban poor

increase output and productivity, induce technology adoption, improve input supply, increase incomes, reduce poverty and attain food security.

Microfinance institutions have a surmountable outcome and impacted individual households thereby raising their income level elsewhere and in Ethiopia. The Grameen bank in Asia is a case in point. In Ethiopia, few studies have established a relationship between microfinance institutions and household income. Samson (2002) has indicated that Busa Gonfa Share Company of MFI operating around Modjo areas could increase household income through its lending scheme. However, only 30% of the households in the study area were able to access the service one of the reasons being resource constraint.

Grameen bank based lending methodology, which includes "center", group and individual structures, has been employed. "Center" savings are fixed amount of savings (at least one Birr) by each member per month at center level while group saving is a certain portion of the required loan (10% for OCSSCO) that is deducted and saved with the institution. Individual saving (which can be of compulsory and voluntary) is the amount (minimum of Birr two per member per month), saved by the clientele with the company. Other organizations, associations, and any body having legal entity with company make institutional saving.

The Oromia Credit and Saving Share Company (OCSSCO) was established in 1997, evolving from Oromia Rural Credit and Saving Scheme Development Project. The project had almost the same mandate as that of OCSSCO today, and commenced its operation in four districts/branches in four Oromia zones in February 1996. The branches were Kuyu of North Showa zone, Sinana-Dinsho of Bale zone, Hetosa of Arsi zone, and Shashamene of East Showa zone. This study was conducted in Kuyu branch of the company to assess the influence of the micro-finance services of the company on household economic situation between the year of establishment (1996) and the survey year (2002).

4. CONCEPTUAL FRAMEWORK

Rural incomes fluctuate from season to season in response to weather shocks and related agricultural activities. Due to the risks affecting income levels and

consumption, poor rural households in developing countries demand access to financial services to help stabilize income and consumption, and alleviate food insecurity (Zeller, et al., 1997).

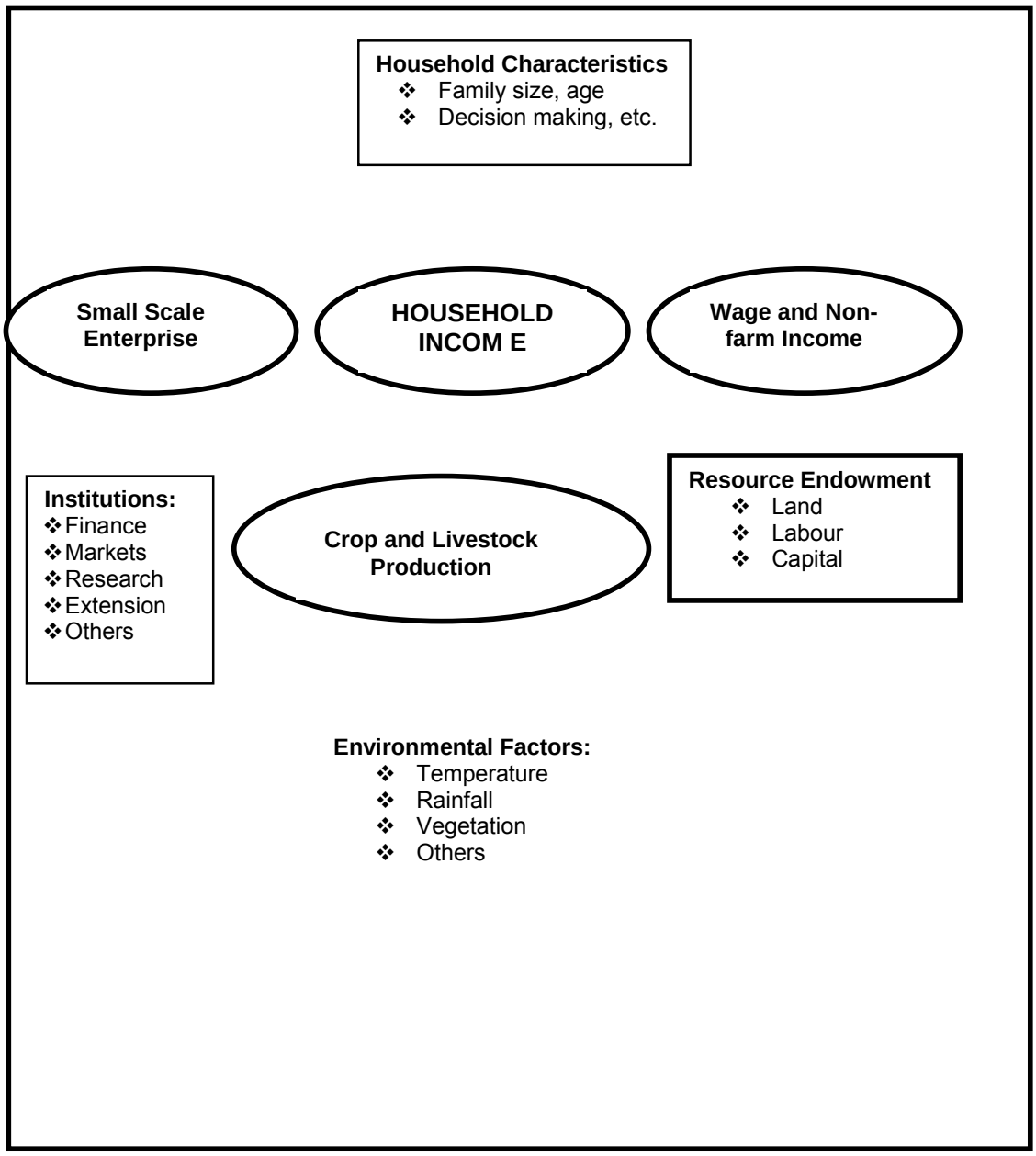
Since farm households earn income from different sources, it is important to aggregate the income from different sources and include the different factors responsible for income generation in the incremental income model described in section 5.2, with major focus on the features of microfinance services. The major source of income is crop and livestock production the level of which is affected by environmental factors such as soil, rainfall and temperature. The amount of production is also a function of the different factors of input such as land, labour and capital. Moreover, the decision-making and management skill of the household affects the factor combination and enterprise selection, thereby affecting the level of agricultural production and income. The level of output and the price of inputs and cost of production, which are determined through institutional factors and market forces, determine the income from agricultural production.

Another source of income is wage income which is affected by institutional factors such as labour market, labour mobility, wage policy, etc. Institutional factors play key roles in terms of finance, markets and research and extension services, which affect innovation and use of technologies, both in production and business sectors with ultimate impact on the utilization of credit received from microfinance institutions.

Another key factor determining the household income is micro-business or small scale enterprises which provide alternative or complementary job opportunities for both women and men in the rural and urban areas. The role of micro-finance institutions is considerable in creating access to financial services to enable income generation activities by engaging in small scale enterprises and use of production technologies to increase household income.

The extent to which microfinance services affect the income changes and improvements in the livelihoods of the clienteles is determined by the company policies such as loan size, loan purposes, repayment schedules and other parameters. In this study, key variables illustrated in Figure 1 were included in the econometric model of incremental household income to determine the extent to which the microfinance services and associated policies contribute to the increase in household income.

Figure 1: Schematic Representation of Factors Affecting Household Income


Household Characteristics
Family size, age
Decision making, etc.
Small Scale Enterprise
HOUSEHOLD INCOM E
Wage and Non-farm Income
Institutions:
Finance
Markets
Research
Extension
Others
Crop and Livestock Production
Resource Endowment
Land
Labour
Capital
Environmental Factors:
Temperature
Rainfall
Vegetation
Others

5. METHODOLOGY

5.1 Data

The data used in this paper were collected from farm households who have been clienteles of the OCSSCO for five subsequent years. In order to analyze the changes in the income of the clienteles, two types of data were collected and analyzed. Firstly, primary data were collected from 100 randomly selected from 2197 clienteles of the OCSSCO-Kuyu branch during the year 2002. Structured questionnaire consisting of variables relevant for attaining the objectives of the study were used for data collection.

Moreover, the baseline data that was collected by OCSSCO-Kuyu branch at the very beginning of client-ship of the two parties in the year 1996 were collected from the files of the sample households at the branch office of the company. The major data included in baseline survey were annual income, family size, total land holding, total livestock holding, land use pattern, housing condition, health, access to financial services, farm household characteristics such as sex of the head, age and education level, etc. The data sets are consistent with the data requirement of the study.

5.2 Analytical Model

In this study, both descriptive and econometric analyses were conducted. The descriptive statistics was used to evaluate the significances of changes in some key parameters between the year of first intervention and the study period. Accordingly, frequency distribution, mean, minimum, and maximum values of some important variables were computed to compare the changes in relevant parameters over the five years.

Contribution of MFIs services to poverty alleviation is determined by institutional factors such as loan purposes, loan term, loan size, land size, intensity of off-farm economic activities, marketing services, etc. Variation in the contribution of MFIs services to incremental incomes of the target groups may be due to any or all of these factors, which also vary spatially and temporally. In order to analyze the influences of these factors and identify the relative importance of these variables, a binary model was used. Accordingly, a logit distribution model was defined following Liao (1994), Gujarati (1988) and Aldrich and Nelson (1984):

$$Pi = \frac{1}{(1+e^{-Zi})} = \frac{e^{Zi}}{(1+e^{Zi})} \qquad (1)$$

Where P_i: is a probability that the income of i^{th} farmer is improved.

e^{Zi}: stands for the irrational number *e* to the power of Zi

Z_i: is a function of N-explanatory variables which is also expressed as:

$$Z_i = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + ... + \beta_n X_{ni} \qquad (2)$$

Where $X_1, X_2, \ldots, X_n$ = Explanatory variables

βo - is the intercept

$\beta_1, \beta_2, ---, \beta_n$ are the logit parameters (slopes) of the equation in the model.

The slopes tell how the Log-odds in favor of improved income changes as independent variables change. The unobservable stimulus index Z_i assumes any values and is actually a linear function of factors influencing improvement in income. The Z_i ranges form $-\infty$ to $+\infty$, P_i ranges between *0* and *1* and that P_i is non-linearly related to the explanatory variables. P_i is non-linear in X_j, and in the β's as well.

It can be shown that $\frac{P_i}{1-P_i}$ is simply the odds ratio in favor of improvement in income level. It is the ratio of the probability that the farmer would have increased income to the probability that he/she would not have improved income. Finally, taking the natural log of odds ratio can be written as:

$$Li = Ln(\frac{Pi}{1-Pi}) = Ln(e^{\beta_0 + \sum_{j=1}^{n} \beta_j X_{ji}}) = Zi = \beta_0 + \sum_{j=1}^{n} \beta j X_{ji} \quad (3)$$

Where L_i is log of the odds ratio in favor of increased income, which is not only linear in X_j, but also linear in the parameters. This model can be estimated using the iterative maximum likelihood estimation procedure.

5.2.1 Definition of Variables and Hypothesis

Dependent variable

The incremental income of the clientele of the company was defined as binary dependent variable, where a dichotomous variable takes *1* for those with increased income and *0* otherwise. The incremental income was defined taking two points in time, i.e. the survey year and the baseline year. The base year is the year in which the clientele joined the company, i.e. year 1996, whereas the survey year is the year of data collection, i.e. year 2002.

Explanatory variables

In this paper, the explanatory variables included in the econometric model could be categorized into socioeconomic and institutional factors, which are hypothesized to have influences on the household income of the clientele. Based on the review of literature and actual conditions of the study area, the following explanatory variables were expected to explain the probability of having increased income situation (Belay and Belay, 1998, Asfaw, et al., 1997; Zeller, et al., 2001).

1. Appropriateness of loan disbursement time (discrete variable). In the world of banking in general, and micro finance services in particular, loan by its nature is both time and purpose sensitive. The clientele of the company would be more benefited if loan processing is made in accordance with these conventional views. Therefore, appropriate loan disbursement schedule is expected to have direct influence on the financial performance of clientele. The variable is discrete assuming a value of *1* if the clientele indicates appropriateness of loan disbursement and *0* otherwise.

2. Appropriateness of loan term (discrete variable). Loan term is a schedule, which fixes duration of the loan and specific date of loan repayment, which is governed by the lending institution with agreement of the borrower. In most cases

loan term is a function of loan size and loan purpose. Accordingly, the lending institution and the borrowers attempt to convince one another to set terms of the loan. Missing this concept will lead to setting repayment schedule for a given purpose quite before or after its maturity, which in turn leads to loan default. Therefore, appropriate loan terms can have positive effect on the success of loan purposes, improving the economic condition of the clienteles. In this paper, this variable is discrete assuming a value of *1* if the clientele indicates appropriate loan term and *0* otherwise.

3. Average loan size of the client (continuous variable). Loan size depends on the purpose of the loan. In the study area, where capital is scarce as compared to labour and land, larger loan size is needed to acquire productive factors of production and engage in micro-business activities. Hence, the magnitude of loan the clientele received over the last five years is expected to have direct relationship with the improvement in income of the household.

4. Acquiring required amount of the loan (discrete variable). In principle, borrowers are expected to propose loan size along with loan purpose(s). However, there are cases in which local community representatives or committees together with branch staff(s) determine the loan size, based on production capacity, repayment capacity, social characteristics, etc. of the borrower and his loan purpose(s). Failure to provide the required loan size is expected to have negative repercussion on the loan performance. It is, therefore, hypothesized that provision of the required loan size would have high probability of increasing the income of the clienteles. In this study, the variable assumed a value of *1* if the client received the amount he/she requested and *0* otherwise.

5. Utilization of the loan for the intended purpose (discrete variable). Upon loan processing, all clienteles specify their respective loan purpose(s), for which they use the loan, and they are not allowed to divert the loan to other purposes. But some times, clienteles are found to divert the loan to other purpose(s), may be due to incompatibility of loan size, unexpected circumstances, social problems, etc. This will have an impact on the loan performance. Basically, in addition to their indigenous knowledge, the clienteles are given training on all aspects of micro finance services, feasible loan purposes(s), utilization of the loan, etc. before loan processing by the company. Therefore, utilization of the loan received, for the intended purpose(s) has

direct relationship with the improvement in income level. The variable assumes a value of *1* if the loan is used for the intended purpose and *0* otherwise.

6. Shortage of draught animals (discrete variable). Draught animals are one of the components of capital as a factor of production. The availability of this capital enhances the income generating capacity of farmers through increased crop production as well as oxen rental incomes. If the loan disbursed is used for productive purposes, availability of draught power would complement the loan to increase productivity. That means, despite loan acquisition, shortage of draught animals has negative effect on income generating capacity of the farmers. The shortage can be traced from the baseline information of households since the resources at hand are assumed to be available to complement the credit received to generate income. In the econometric model, the oxen variable assumed a value of *1* if the client had problem of draught oxen at the beginning of the loan period and *0* otherwise.

7. Extension service (discrete variable). Extension services provide technical skill to enable improved crop and livestock management and increase productivity. Coexistence of extension services along with micro finance services has direct influence on the improvement of income of the target groups. The variable is assigned a value of *1* if the client gets extension service and *0* otherwise.

8. Off-farm income (continuous variable). Off-farm activities are economic activities other than agricultural production. These include petty trade, handicrafts and other activities, directly reflecting the small-scale enterprises shown in Figure 1. These economic activities create employment opportunities by absorbing the disguised employment in rural areas through enhancement of diversification of economic activities and reduction of risks. Therefore, engagement in off-farm economic activities is expected to have a direct relationship with improved income of the clienteles.

9. Distance to market center (continuous variable). Access to market is crucial for business undertaking. This has critical importance for loan performance. Usually markets are situated at towns, even though there are small markets at village level. Farmers residing closer to markets have more access to information about the lending institutions and requirements for acquiring loan and business information, as compared to those away from the towns. On the other hand, experiences show that those residing near or in towns divert loan from the intended purposes or consume

the loan they have received. Moreover, mostly, farmers residing away from market centers /towns are believed to be more genuine and less extravagant. Therefore, the nature of relationship between distance to market and loan performance could depend on the prevailing situation.

10. Family size (continuous variable). Income from agricultural production is a function of labour. Family size, adjusted for dependency, is supposed to have direct relationship with the level of income. Children of less than 14 years and elders of more than 60 years were considered as dependent and do not as such contribute to income generation. Besides family size, gender differential is important in microfinance analysis. Unfortunately, the female households coverage of the microfinance services at the survey period was so limited to consider gender difference in the model.

11. Land holding (continuous variable). Land is also one of the major factors of production. Crop production is entirely dependent on land. Land is also crucial input for mixed farming through supply of grazing land, forages, and other feeds. Therefore, land holdings and improvement in income level are expected to have direct relationship.

5.2.2 Sensitivity Analysis

Significant explanatory variables discussed above would influence the change in income level. But the extent of the influence would not be the same for all the significant variables. The relative effect of a given quantitative explanatory variable on the changes in income level is measured by examining the elasticities, defined as the percentage change in probabilities that would result from a percentage change in the value of these variables. To calculate the elasticity, one needs to select a variable of interest, compute the associated P_i for 'Typical Clientele'. Then vary the X_j of interest by some small amount and re-compute the P_i, then measure the rate of change as $\partial P_i/\partial X_j$. Where ∂X_j and ∂P_i stand for percentage changes in the continuous explanatory variable (X_j) and in the associated probability (P_i), respectively: when dX_j is very small, this rate of change is simply the derivative of Pi with respect to X_j and is expressed as follows (Aldrich and Nelson, 1984; Maddala, 1992):

$$\frac{dP_i}{dX_j} = \frac{e^{zi}}{(1+e^{zi})^2}\hat{\beta}_j \quad \text{----------} \quad (4)$$

$$= P_i(1 - P_i)\hat{\beta}_j \quad (5)$$

The impact of each significant qualitative explanatory variable on the probability of improvement in income is calculated by keeping the continuous variables at their mean values and the dummy variables at their most frequent values (*0* or *1*).

6. RESULTS AND DISCUSSIONS

6.1 Socioeconomic Changes between Baseline and Survey Years

Descriptive statistics of some key indicators, which might be influenced by improvement in income due to micro-finance service, was analyzed. Apparently MFIs improve household income that can be used to stimulate savings and investment in livestock and oxen holdings, housing, and renting land resources. More savings imply the capacity of the farmer to avail more inputs, which enable him/her to produce more and generate more income. As discussed earlier, oxen provide draught power for cultivation and increased oxen holding contributes to improved wealth and household income.

Better housing condition results in healthy and productive life. Land rented-in contributes to incremental income due to its complementary use with other yield increasing inputs which would not have been used when land is scarce.

In addition to the above quantitative variables that measure impacts of micro finance services on the 'beneficiaries', there might also be other qualitative variables, such as children schooling, nutrition, clothing, etc. Employment generation and human capital formation can also be indicators of impacts of micro-finance services.

Assessment of the impacts of micro-finance services were made by asking the clienteles their perceptions of the impacts on variables listed in Table 1. The results indicate that living condition of 86% of the sample clienteles improved while that of 14% showed no improvement of which 3% of the clienteles had no changes in their living condition and that of 11% deteriorated. Disaggregated analysis shows that the

impact of the micro-finance service is highly associated with income generation (70%), asset creation (65%), improved nutrition for the family members (63%) and increased livestock holding (57%) (Table 1).

Table 1: Proportions of Clienteles with Improved Living Conditions

Indicator	Clienteles with Improved Conditions (%)
Children schooling	55.81
Better clothing	13.97
Improved nutrition	62.78
Improved housing condition	22.10
Increased livestock number	57.00
Increased asset	65.11
Improved income level	70.00

Source: Own Computation

In this paper, annual income of the clientele was considered as the most appropriate variable for the assessment of the influence of the micro-finance services. Hence, the improvement in income level was used to categorize the clientele in to those with improved income and those without improvement (Vasthoff, 1968; Tesfaye, 2001). Household incomes during the base year and survey year were compared. Those with increased household income were defined as *"Improved"* while those with no improvement, i.e. same level of income or worsened income level, were defined as *"Not Improved".*

Table 2 compares the mean level of the continuous economic variables of the clienteles with improved conditions and clienteles the economic conditions of whom were not improved. The comparisons were made at the base year and the survey year, i.e. five years after the commencement of the loan scheme. The economic improvement between the two reference years was statistically significant at 1% level. Income from agricultural production and off-farm income and the asset accumulation were significantly higher after the commencement of the micro-finance services. The difference between the clienteles with "Improved" and "Not Improved" groups in terms of the economic variables listed in Table 2 was insignificant at the initial stage and

became significant after the loan scheme was commenced. The factors underlining these differences are further analyzed under section 6.3.

Table 2: Mean Comparison of Some Economic Variables during the Base and Survey Years

	Base year			Survey year			Total		
	Improved	*Not Improved*	*t-values*	*Improved*	*Not Improved*	*t-values*	*Base year*	*Survey year*	*t-values*
Agricultural income (Birr)	1800	2119	-1.091	4270	2191	6.714***	1895	3647	-8.916***
Off-farm income (Birr)	114	42	1.656	728	299	2.850***	92	597	5.481***
Oxen owned	2.01	1.89	0.834	2.63	2.33	1.639	1.97	2.51	5.103***
al livestock holding (TLU)	6.48	5.74	1.003	8.38	6.29	2.348**	6.26	7.75	4.285***

* Significant at 10% level, **Significant at 5% level, ***Significant at 1% level.

6.2 Results of Multicollinearity Test

Existence of income differentials among the clienteles calls for identification of factors responsible for the variation in the household's incremental income. Accordingly, econometric analysis of factors affecting the probability of income improvement was made. Before estimating the model, it was necessary to check for the functional relationships between the explanatory variables. If multicollinearity is less than perfect, the regression coefficients, although determinate, possess large standard errors (in relation to the coefficients themselves), which means that the coefficients cannot be estimated with great precision or accuracy (Gujarati, 1995). In this paper, existence of serious multicollinearity was tested using Variance Inflation Factor (VIF) for continuous explanatory variables and contingency coefficient for discrete explanatory variables. Table 3 and 4 display the VIF and the contingency coefficients respectively.

Table 3: Tests for Existence of Multicollinearity among Continuous Variables

The Continuous Variables	Collinearity Statistics		
	Tolerance	VIF	R_i^2
Average loan size (Birr)	0.912	1.096	0.088
Total family size of the household (No.)	0.929	1.077	0.071
Total land holding (ha)	0.948	1.055	0.052
Distance to market (Kms)	0.872	1.147	0128
off-farm income during the base year (Birr)	0.976	1.024	0.023

Source: Own computation

R_i^2 is the coefficient of multiple determinations when the variable X_j is regressed on the other explanatory variables. A rise in the value of R_j that is an increase in the degree of multicollinearity, does indeed lead to an increase in the variances and the standard errors of the OLS estimators. The R_i^2 and the value of VIF are directly related while the value of VIF is inversely related to tolerance level. A VIF value greater than 10 is used as a signal

for the strong multicollinearity between the two considered continuous variables (Gujarati, 1995). The result of the test, therefore, indicates lack of serious multicollinearity problem among the continuous variables.

The values of contingency coefficient, which basically range between 0 and 1 are significantly small (Table 4). Low value of contingency coefficient indicates absence of serious multicollinearity problem between the considered discrete variables.

Table 4: Tests for Existence of Multicollinearity among Discrete Variables

	Loan disburse-ment time	Loan term	Problem of draught power	Extension service	Loan requested	Utilization of loan
Loan disbursement time	1.000					
Loan term	0.220	1.000				
Problem of draught power	0.1361	0.088	1.000			
Extension service	0.007	0.050	0.066	1.000		
Amount of loan requested	0.054	0.059	0.567	0.105	1.000	
Utilization of loan	0.238	0.247	0.043	0.120	0.059	1.000

Source: Own computation

6.3 Econometric Results

Using the explanatory variables defined above, a logit model was estimated using Maximum Likelihood Estimation procedure, of the SPSS computer software. Equation (3) was used to estimate the logit model. Table 5 shows the parameter estimates and statistical significance of the coefficients.

Table 5: Maximum Likelihood Estimates of Logit Function

Variables	Coefficients	Odds ratio	Wald statistics	Sig. level
	2.553	12.85	3.778	0.052*
Appropriateness of loan time	0.902	2.465	1.846	0.174
Appropriateness of loan term	0.004	1.004	5.051	0.025**
Average loan size	-0.466	0.627	0.603	0.437
Shortage of draught power, base year	0.064	1.067	0.013	0.911
Extension service	0.001	1.001	0.926	0.336
Off-farm income	0.279	1.321	0.736	0.391
Provision of loan demanded	0.116	1.123	2.721	0.099*
Distance to market	0.024	1.025	0.036	0.849
Family size	0.638	1.893	5.373	0.020**
Land holding	2.979	19.661	7.906	0.005***
Utilization of loan	-11.174	0	11.767	0.001
Constant				

-2 Log likelihood Ratio = 91.026
Likelihood Ratio Index (McFadden R^2) = 0.7450
Chi-square (χ^2) = 31.147
Correctly predicted (Count R^2) = 78.00%
*Significant at 10% level, **Significant at 5% level, ***Significant at 1% level

The econometric result shows that the probability of improved income level due to micro-finance intervention is positive and significant. The model predicts 78% of the cases correctly, which is considered as statistically significant. Among the microfinance service variables, appropriateness of time of loan disbursement, utilization of loan for the intended purposes, and loan size affected the probability of incremental income positively and significantly.

Moreover, the availability of land needed for crop production and distances to market center have positive influences on the probability of increased income, which implies positive loan performance in terms of impacting on the well being of the clienteles. These factors are essential for utilization of credit both for production and business undertaking since they serve as complementary factors.

6.4 Marginal Effect Analysis / Sensitivity Analysis

As discussed above, the improvement in income of the sample clienteles was attributed to different factors, the statistically significant ones being loan disbursement time, loan size, loan utilization for the intended purposes, proximity to markets and land availability. The contributions or relevance of these significant factors may not be equally important. Ranking of these variables in terms of their relative importance requires defining a 'typical clientele' in terms of the most frequent values of the explanatory variables, discrete variables and mean values of the continuous variables, included in the model (Gujarati,1995), .

After estimating the parameters β_i in Equation (3) and identifying significant variables, it is possible to know the effect of change in any of the significant explanatory variables on the probabilities of observations belonging to either of the two groups i.e. those with improved income and those without. The marginal contributions of the variables for the logit model are given by Equation (5). The relative importance of quantitative variables can be measured by examining elasticity of the variables that would result from a change in the value of the variables. Thus, elasticities were computed for a typical farmer using the significant quantitative explanatory variables.

Then by taking the mean values of continuous variables, and the most frequent values of discrete variables, values of Z_i and P_i, from equation 1, would be 3.893 and 0.98 respectively. Then the elasticities of P_i with respect to x_{ij} (Equation 5) can easily be computed to determine the relative importance of these variables.

For instance, if the average land holding of the farmers increased by 10%, which is equal to 0.268 ha, the probability of income improvement for a "typical clientele" will be about

0.32%. With a further 20% increase in land holding, which is equal to 0.536 ha, the probability of income improvement for a "typical clientele" will be about 0.58%. The procedure holds true for other significant continuous variables in the model. Therefore, a "typical clientele" of the MFI services would have higher probability of increased income provided that these explanatory variables are set in appropriate combinations. Table 6 summarizes changes in probability levels of the significant continuous variables, with their mean values increased by 10%.

Table 6: Relative Importance of Continuous Significant Variables

Variables	P_{i1}	P_{i2}	ΔP_i (%)	Relative Importance
Average loan size	0.980	0.9883	0.85	1st
Land holding	0.980	0.9831	0.32	2nd
Distance to markets	0.980	0.9826	0.27	3rd

Source: Own computation

In assessing the relative importance of proper utilization of the loan as per the agreement made between the two parties, we use the "with" and "without" approach. Considering the existence of all variables in the model, dummy variables will be given the most frequent value of a discrete variable i.e. 1, and the continuous significant variables will assume their mean values. Accordingly, the value of *Zi* will be 3.893 and that of P_i is 0.980. The importance of loan utilization for the intended purpose would be observed by assigning a 0 value for this variable while keeping other variables constant. The result shows that at a 0 value of loan utilization, the new P_i will be 0.714 where *Zi* equals 0.914. A considerable change in probability of improved income is observed due to change in the variable from 0 to 1. Changing the loan utilization variable from 1 to 0 would reduce the probability from 98 % to 71%. This shows that the relative importance of this variable is considerably high. Similarly, it would be possible to identify the relative importance of the remaining significant discrete variables. Table 7 summarizes changes in probability levels of the significant discrete variables using the "with" and "without" approach.

Table 7: Relative Importance of Discrete Significant Variables

Variables	P_{i1}	P_{i2}	ΔP_i (%)	Relative Importance
Utilization of the loan	0.980	0.7138	27.16	1st
Appropriateness of loan disbursement time	0.980	0.7925	19.13	2nd

Source: Own computation

7. CONCLUSIONS AND POLICY IMPLICATIONS

The study confirms the relevance of micro-finance service to improve the economic conditions of the poor by enabling access to rural finance. Among the 100 sample clients of the OCSSCO, Kuyu branch, 86 perceives improvement in their socioeconomic conditions during the five-year client-ship with the MFI. Actual comparison of income during the survey year with the baseline data indicates that improved income level is visible for 70% of the cases. The impact of the micro-finance service is highly observed in terms of increased asset creation, improved nutrition for the family members and household income.

Comparative analysis of the economic variables shows that the income from agriculture and off-farm activities increased over the loan period indicating the opportunities created to increase agricultural productivity and income diversification. The econometrics results indicate that the probability of improved income was affected by the appropriateness of loan disbursement time, loan size, utilization of loan for the intended purposes, proximity to markets and land availability. The policy implications of the results could be the following:

1. Due to seasonality of agricultural production, for which timely procurement of inputs and crop management are crucial, timely provision of rural credit is of paramount importance. Moreover, financial resources needed for small scale enterprises, particularly if needed for purchases of agricultural goods for trading would be affected by time of loan disbursement.

2. Level of capital used determines the economic scale of business transactions. Micro-finance institutions, however, provide small loan size. The econometric result revealed the importance of loan size on economic performance of the clienteles. Hence, considering the nature of the loan and other parameters, it would be of paramount importance to increase loan size and work out business plan.
3. The fact that utilization of loan for intended purposes implies improving business skill and innovativeness of the clienteles, identifying feasible income generation activities and proper business plan for clients would be essential.
4. Land availability is also one factor that contributed to increased income of the households. In case of use of improved agricultural technologies such as crop farming and dairy production, land plays complementary role to the loan disbursed. Assessment of such alternative complementary factors of production would encourage the farmers to seek credit and improve their socio-economic conditions. Provision of loan for agricultural production to farmers facing land shortage should consider possibilities of land transaction.

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INTENSIFICATION AND CROP COMMERCIALIZATION IN NORTHEASTERN ETHIOPIA[1]

Workineh Negatu[2]

Abstract

Due to low farm production and productivity the majority of subsistence farmers in Ethiopia are not self-sufficient in food, and deliver meager amounts of farm output to consumers and agro-processing industries. Agricultural growth, an important pathway to food security, is realized through increases in per capita farm endowments (physical and financial assets and resources) and adoption of appropriate and proven technology and requires a transformation out of the semi-subsistence, low-input and low-productivity agriculture into a high productivity commercial agriculture.

This article investigates farm commercialization from two perspectives - output-oriented and input-oriented farm commercialization. Logistic model was applied to examine factors of commercial participation and use of chemical fertilizer, while Cob Douglass production function was employed for the analysis of production determinants. The data used for the analysis was collected from farm households sampled from communities in Northeastern Ethiopia.

The regression analysis of commercialization asserts that lack of market access (measured by distance) and engagement in livestock and off-farm employment significantly and negatively impact food crop commercialization. Total food crop production has been found to impress a strong and significant effect on commercialization. The production analysis indicated that farm size operated and technology (chemical fertilizer) are the most important production factors under the context of the study areas. Results of estimation of fertilizer use show the important and positive role of access to oxen and credit, and size of operated farm.

The findings of the study generally imply the need for rationalization of policies and institutions in order to create incentives and rules that promote land transaction and markets for credit, product and input.

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[2]

1. INTRODUCTION

Ethiopia's economy is primarily based on agriculture, accounting for 50 % of GDP employing 85 % of its labor and 90 % of total foreign exchange earnings. According to CSA (2002) 10,738,000 small farm households cultivated 9,133,510 ha. in 1999/2000 comprised of 93 % annuals, the rest permanent crops, at average area of 0.79 ha./household. About 95 % of cultivated land is under smallholder agriculture, the rest under state and commercial farms. Ethiopia's food security and agricultural development are thus highly dependent on the performance and development of smallholder farming systems. Cereals occupy more than 70 % of cultivated land and are the main staple foods in Ethiopia.

At the level of developing countries, about 440 million farmers still practice mainly subsistence agriculture, and subsistence crops cover more than 50 percent of cultivated land in the majority of low-income countries (von Braun and Kennedy, 1994). Ethiopian small farm holders who produce more than 90 % of agricultural production of the country are by and large subsistence producers. It is estimated that only 20 % of smallholder production goes to markets, mostly by a small percentage of farmers with access and means. Smallholders in the highlands of central and northern Ethiopia in particular produce mainly food crops, and for the most part are not involved in conventional cash crops (coffee, cotton, sugar cane, groundnuts, and vegetables)[3].

Due to low farm production and productivity, majority of subsistence farmers are not even self-sufficient in food, and deliver meager amounts of farm output to consumers and agro-processing industries (markets).

Intensification, an important mechanism for transforming subsistence smallholder farms into economically viable and commercially oriented farming units (Hinderink and Sterkenburg, 1987; von Braun and Kennedy, 1994; Pender, Place and Ehui, 1999), is at low level in Ethiopia. For example, on average, cereals yield 12 qt[4]. per hectare and pulses about 9 qt per hectare, both very low by world standards[5].

[3] Farmers in southern, western and eastern low lands and mid-altitudes of the country are engaged considerably in the production of cash crops, particularly coffee, and in livestock and livestock products.
[4] 10 qt. = one metric ton
[5] For instance, the 2000 average per hectare yields of teff (*Teff eragrostis*), sorghum, maize, wheat and barley, the five major crops in the country in terms of area allocated to their production, are 7.96 qt, 11.54

The basic research question of this paper are thus what constrains small farm households from pursuing an outward-looking market orientation, producing surplus over and above their consumption requirements, or from devoting land and labor to cash crop cultivation.

This paper attempts to show: (i) determinants of food crop commercialization, and (ii) farm input intensification; and (iii) combined with the former, the contribution of resource access and technology to agricultural output, hence marketed surplus.

2. FARM COMMERCIALIZATION PERSPECTIVES

Food security is a key policy objective in Ethiopia's social and economic development strategy (FDRE, 2001). Agricultural growth, an important pathway to food security[6], is realized through increases in per capita farm endowments (physical and financial assets and resources) and adoption of appropriate and proven technology (Hayami, 2001) and requires a transformation out of the semi-subsistence, low-input and low-productivity agriculture into a high productivity commercial agriculture. Given population growth and limits of area expansion, yield growth and market oriented patterns of crop production (commercialization) are prerequisites to agricultural economic growth (Strasberg et. al.1999). Commercialization, along with specialization, intensification and development of markets and trade, are fundamental building blocks for achieving economic growth. (von Braun and Kennedy, 1994).

However, the sale of incidental surpluses does not transform farming units automatically into commercial farms (Hinderink and Sterkenburg, 1987). Commercial farming involves also profit and loss accounting in financial terms, and a wage earning labor system (Carpenter 1971 as cited in Hinderink and Sterkenburg, 1987). Practical achievement of marketed surplus and commercialization thus include indicators of effective market participation: gross value of sales; importance of purchased inputs; share of hired labor as a percentage of total labor; time spent on

qt., 18.25 qt., 13.79 qt. and 10.82 qt., respectively (CSA, 2002). The world average per hectare yields of wheat, maize, barley and sorghum in 2000 are 27.189qt, 42.880 qt., 24.419qt and 13.679qt.respectively, while the average yields of the same crops for Africa are 17.805 qt, 17.246qt., 5.096qt and 8.791qt. in that order (http://faostat.fao.org).

[6] Food importation at the national level through expanded growth in international trade, or food purchase at the household level through expanded income, are other important pathways.

growing cash crops versus crops for self consumption; and, acreage planted with crops for sale as a percentage of total cultivated area (Hinderink and Sterkenburg, 1987).

Hinderink and Sterkenburg (1987) distinguished between three perspectives of farm commercialization:
(i) Economic-technocratic perspective: emphasizes economic and technical measures of increasing productivity and production for the market, where commercialization is tightly associated with modernization, and technology and market development are key determinants of agricultural transformation. Development is seen as a uni-linear process in which agricultural development in developing countries must follow the path of developed economies. The role of green revolution technologies is emphasized and combined with integrated rural development to remove institutional and infrastructural bottlenecks for market penetration.

(ii) Psychological-cultural perspective: attitudes, motivation and other farmer behavior are emphasized. According to Rogers (1970, cited in Hinderink and Sterkenburg, 1987), subsistence farmers: are inclined toward mistrust which negatively affects cooperation and organization beyond the family circle; lack interest in innovations; are fatalistic, village centered, and not very individualistic; have low level of aspiration; limited attention for the future; and have little inclination to save and invest. Less commercialized communities are isolated vis a vis the outside world which negatively affects specialization of production, trade, technological innovation and social change. The hierarchical authority structure and the subordination of individuals to community interests prevail over personal contractual relationships and economic decisions. Social controls limit the already limited choice of subsistence farmers in land use, cropping patterns and production technology (Abercrombie 1961 cited in Hinderink and Sterkenburg, 1987).

(iii) *Political-economic perspective*: political context and the nature of power relations at various geographical scales motivates the choice of economic system and the degree of integration into the global economic system. Agricultural commercialization contributes to development, but only when accompanied or preceded by structural change at various geographical scales. The political-economic and institutional context is proposed as a major sphere explaining longitudinal and spatial differences

in socioeconomic development. Spatial differentiation is related to the intensity of market integration, interpreted as a process of structural change from subsistence to market economy. Four aspects of market integration are identified: increasing importance of wage labor, growing crops for sale, markets developed for consumer goods and production inputs, and purchase of consumer goods and services (Dietz and Van Haastrecht, 1982 in Hinderink and Sterkenburg, 1987)

Each perspective plays a partial role in explaining agricultural commercialization in Ethiopia. Agricultural commercialization cannot be understood without taking into account the socio-cultural, political-institutional and economic-technical contexts that condition the nature of capital formation, the organization of production, technological changes and crops grown. For purposes of this study, the definition of Hinderink and Sterkenburg (1987:19) is used: agricultural commercialization involves "deliberate action on the part of agricultural producers - of their own free will or by means of coercion - to use the land, labor, implements and annual inputs (owned, purchased, hired, borrowed, obtained on credit or through customary arrangements - reciprocal or not) in such a way that a greater or smaller part of crops produced and /or animals raised is for exchange or sale".

Von Braun and Kennedy (1994) argue that one of the main reasons for the choice of subsistence production over commercial production in Sub-Saharan Africa is that own-production of food is a response to high transaction costs and risks related to production, markets, and employment. Subsistence production can largely be viewed as an insurance policy of farm households in response to risky income and market environment. Because subsistence farmers devote their time and land resources largely to own farm production, mechanisms that increase farm output impact food security in two ways: (i) directly increasing food availability and (ii) promoting production for market that increases cash income to enable food purchase. This second path is made possible by enhancing cash crop production and marketable food crops and livestock products. In addition, off-farm income, if accessible, augments household income and purchasing power. The commercialization pathway is dependent off course on local comparative advantages in agricultural potential, population density (demand) and market access (Pender et al., 1999).

However poor, risk-averse farmers with little land and resources are usually reluctant to gamble on new and highly risky crops, regardless of their potential profitability, unless their food security is first assured (von Braun et. al., 1991). Holden and Hailu

(2002) in their empirical study in southern Ethiopia conclude that poverty and subsistence constraints undermine the ability to intensify production through the purchase of farm inputs or the planting of perennial cash trees. Adewumi and Omereshi (2002), based on their study of 291 sample farm households in Kwara state of Nigeria, conclude that meeting food requirement is the primary objective of farming households even prior to maximizing gross margin. Farming households there view agricultural activities as a personal non-monetary need first and an income need only second (ibid). Notwithstanding the importance of self-sufficiency in the psychic of poor farmers, Dembele et al (2003) in assessing the commercialization of cereals in Mali after the 1980 market reform observed that cereal commercialization was enhanced by use of productivity increasing inputs and technologies, and that commercialization varied by farm size, crop type and type of farming.

Recent studies (Von Braun and Kennedy, 1994; Strasberg et. al., 1999) show that the conclusion sometimes made in the literature that commercialization has a negative effect on food crop production and nutrition is flawed. Von Braun and Kennedy (1994) observe that improved technology helps subsistence farmers to commercialize in low-risk ways; commercialization of agriculture entails a substantial expansion of demand for hired labor; and, commercialization contributes to food security via increased income and food availability. Although commercialization of agriculture is generally a matter of stimulated private-sector activity, they also argue that public action in Sub-Saharan Africa is crucial to facilitate the power of its driving forces - macro economic and trade policy, market reform, rural infrastructure improvement, and the development of legal and contractual rules under which farmers, traders and processors operate.

3. DATA AND EMPIRICAL MODEL

Data for this study were collected from 420 randomly selected farm households in Bati, Jamma, Dessie-Zuria, and Legambo woredas (districts) in Ethiopia by BASIS-CRSP project in 2000 and 2001.

Regarding the analytical models, let production (Y) be determined by the relation Y = f{A, L, K, T} where A is land, L is labor, K is capital, and T is technology. Consumption (C) is determined by household size in adult-equivalent consuming units (CU) and

investment (I) made on non-consumption expenditures, i.e. C= f (CU, I). Fertilizer and improved seeds, depicted by technology, T, represent an input-oriented measure of farm commercialization. Marketed surplus (MS), defined as MS = Y-C, is an output-oriented measure of farm commercialization measured in this study via two constructs: percentage of farm households who participate in food crop marketing (Commercialization Participation, CP), and the ratio of total quantity of food (cereals, pulses and oil seeds crops) sold relative to total output produced (Commercialization index, CI).

As indicated in Table 1, except for Jamma farmers whose participation in marketing declined, the participation of farmers (CP) in other *woredas* increased in 2001/02 compared to 2000/01 (36.2 % to 51.1 %), due to better rainfall distribution. The commercialization index (CI), however, remained relatively static, and is generally low for all woredas. Jamma farmers who sold the highest proportion (CI-0.13) of food produced in 2000/01 sold a lower proportion (CI=0.07) in 2001/02 due to frost in the area, while CI in Dessie-Zuria and Legambo showed a slight increase. CP however showed considerable variability across woredas, hence was chosen as the output-oriented indicator of commercialization in the multivariate analysis that follows.

Table 1: Farmer Participation in Food Grain Marketing and Commercialization Index

Year	Item	Bati	Jamma	Dessie-zuria	Legambo	All *woredas*
2000/01	Commercial Participation (CP), %	34.9	60.4	24.7	20.5	36.2
	Commercialization Index (CI)	0.06 (0.14)	0.13 (0.16)	0.07 (0.17)	0.07 (0.17)	0.08 (0.16)
	N	106	106	97	83	392
20001/02	Commercial Participation (CP), %	35.8	48.5	58.8	62.1	51.1
	Commercialization index (CI)	0.05 (0.10)	0.05 (0.10)	0.10 (0.13)	0.10 (0.13)	0.08 (0.11)
	N	106	103	97	103	409

Source: BASIS-Ethiopia survey data. N= Number of respondents. Figures in parentheses are standard deviations.

Agricultural technology (T) - chemical fertilizer and improved seeds - plays an important role in commercialization, via their purchase from markets or government sales depots. Their adoption is generally influenced by size of farm holding, credit access, educational level of household members and agroecology. For the multivariate analysis of participation in input-oriented commercialization and adoption of agricultural technology, a logit model was employed based on the functional form in equation (1) (Maddala, 1992):

$$\log [\, p_{i\,/(1-p)}\,] \approx \beta_o + \sum_{j=1}^{k} \beta_j x_{ij} \qquad \textbf{(1)}$$

Where, log $[p_{i/(1-P)}]$ is log of odds ratio, β_o is constant term, β_j are coefficients, and x is independent variables. The dependent variable (log-odd ratio) is the natural logarithm of the ratio of the probability that the i-th farmer participates in food crop commercialization (or adopts technology) to the probability that the i-th farmer does not (1-p).

Neo-classic economic theory informs us that land, labor and capital are the basic factors of production. Recent theory (Ray, 1998) explains that in addition to these conventional factors, technology and human capital play crucial roles in transforming agricultural production by helping to accelerate partial and total factor productivity. The relationship of these factors to determination of agricultural output in the Ethiopian highlands is examined in this analysis by employing the Cobb-Douglas function in equation (2):

$$Q = aX_1^b X_2^c X_3^d --- X_n^m \qquad \textbf{(2)}$$

where, Q is food production, X_n refers to n-th factor of production, and b, c, d …… m are factor elasticities associated with the possible influencing variables. See Table 2 for variable names and definitions, and Appendix 1 for descriptive statistics. A priori expectation of the influence of explanatory variables on farm output follows.

*Market distance i*s used as a proxy for market access, as remote villages are exposed to poor road and telecommunication infrastructure and high transportation costs. Farmers nearer to market towns are expected to have higher participation in food crop marketing and technology adoption because transport and information costs increase with distance.

Table 2: Names, Definitions and Measures of Explanatory Variables

Variable name	Definition	Measure
Head's gender [SEX3]	Gender of household head	1=male, 0= female
Consuming units [AE_CU_4]	Household size in adult-equivalent consuming units	Number of consuming units
Labor units [AE_LU_4]	Household labor in adult-equivalent labor units	Number of labor units
Agro-ecology [jamadumy]	Agro-ecological zone of the village in which the household resides and farms	1=Jamma woreda, 0= other woredas
Livestock-TLU [LIV_TLU4]	Livestock size (excluding oxen)	Tropical livestock units (TLU)
Land operated [LA_OP45]	Total farm size operated during 2001/02 cropping year (*belg+meher* seasons)	Hectares
Oxen [OXENOWE3]	Number of oxen owned	Count
Head's education [EDULEVE2]	Educational status of household head	0=non-literate, 1=read and write, 2= primary school, 3=post-secondary school
Head's literacy [LITRAT2]	Literacy status of household head	1=literate 0=non-literate
Market distance [DISMARK]	Distance to main market place	Minutes to walk
Credit [CREDIT_2]	Value of credit received	Birr
Food crop output [C_OUTPU2]	Total food crop output	Kg.
Non-farm income [NFI_YR2A]	Non-farm income (business and wage employment income)	Birr
Head's age [AGE_RND3]	Age of household head	Years

Note: Numbers in variable names indicate year or survey round.

Agro-ecology affects commercialization of food crops and input procurements through locational factors, but also indirectly affects technology choice and application (chemical fertilizer and improved seeds) through biophysical interactions. Jamma woreda is agro-ecologically suited for crop farming because it is endowed with relatively better rainfall, soil, temperature, and topography (flat) that enable superior yield responsiveness of modern inputs compared with other study sites.

Food crop production, the total production of cereals, pulses and oilseeds, is taken as a measure of aggregate food output (Q). All else constant, an increase in food crop production either decreases the food gap between own-production and consumption within the household, or increases food grain surplus for sale to outside markets.

*Oxen***:** as the major source of traction power and an important capital asset, is expected to influence farm production positively by enabling farmers to accomplish seedbed preparation and seed covering on time and thoroughly, thus facilitating the use of other complementary technological inputs such as fertilizer and improved seeds.

Non-oxen livestock holding, measured in Tropical Livestock Units (TLU)[7] is taken to measures livestock wealth, the principal asset in the Ethiopia's highlands. Livestock activities compete with crop production for labor and other resources in ways that negatively affect food crop commercialization. Animal manure is also a substitute for fertilizer if widely and substantially applied on farmers' fields. But, income generated by livestock activities could also be used for the purchase of inputs that benefit crop-oriented and input-oriented commercialization positively.

Operated farm size[8]: is hypothesized to affect food production and technology adoption positively. As landholding size in the Ethiopian smallholder sector is very small, even a slight increase in farm size operated can be expected to substantially increase household food production and hence marketed surplus.

Household consumption, approximated by household family size in terms of standard adult-equivalent consuming units[9], is expected to negatively affect crop commercialization through three mechanisms: a) household labor time for crop production is decreased because of demands for household maintenance and reproduction; b) increased food demand derived from more mouths to feed; and c)

[7] Tropical livestock unit is calculated as 1.00 for a cow, 0.60 for heifer or young bull, 0.10 for calf, 1.43 for a camel, 0.80 for a horse, 0.70 for a mule, 0.50 for a donkey, 0.10 for a goat or sheep, and 0.01 for a chicken.

[8] Operated farm is land cultivated that includes own farmland held and land obtained in cash renting (rented-in) or in share cropping (shared-in) from other farm landholders. Leased-out farmland includes farm parcels rented-out on cash or shared-out in sharecropping arrangement to other farmers.

[9] Male (female) less than 1 year of age are assigned a weight of 0.3 (0.3), ages 1-6 a weight of 0.5 (0.5), ages 7-13 a weight of 0.7 (0.7), ages 14-19 a weight of 0.9 (0.9), ages 20—59 a weight of 1 (0.9), and ages greater than 59 a weight of 0.9 (0.7), respectively (source?)

decreased labor productivity in the event that low consumption for poor households erodes human nutrition.

Household labor refers to the number of adult-equivalent labor units[10] within the household. For a high land**/**labor ratio, a positive effect on total food production would be expected, but the effect would tend to converge toward a small, minimum subsistence wage (reflecting a flattening of marginal labor productivity) as the land/labor ratio grows tight under conditions of high land use pressure.

Age of household head is used as proxy for management experience. It is expected to influence production and technology adoption positively during the most productive working years, then decline as labor productivity falls toward retirement.

Literacy of household head measured by educational level is assumed to positively influence commercialization as literate or educated farmers tend to have better access to extension service and advice of local development agents, and make better use of internalizing that information.

Chemical fertilizer, the amount of chemical fertilizer (Di-Ammonium Phosphate (DAP) plus Urea) applied by a farm household for food crops is expected to increase food production, given certain preconditions (timely application, sufficient soil moisture, favorable climate).

Off-farm income, including business and wage employment, theoretically could affect commercialization and adoption of technology either positively by easing cash liquidity constraints that impede the purchase of modern inputs, or negatively by competing with crop production for a limited supply of labor within the household.[11]

Credit. Cash credit augments the household budget constraint enabling farmers to purchase (or expand their purchase of) farm inputs, in particular fertilizer and seeds that would enhance farm productivity.

[10] Coefficient for converting household labor into adult-equivalent standard labor units were as follows: for a male (female) less than 8 years of age 0.00 (0.00), 0.50 (0.50) for ages 8-14, 1.00 (0.70) for ages 15-65, 0.50 (0.35) for ages 66-75), and 0.00 (0.00) for ages above 75.

[11] The robustness of labor rental markets in rural areas is a critical conditioning factor, as hired labor if available could help augment a binding household labor constraint.

4. REGRESSION RESULTS

4.1 Food Crop Commercialization

The regression results in Table 3 seek to identify the main determinants of food crop-oriented commercialization. Results show that distance to main market is negatively and significantly related with participation in food crop commercialization as expected. An increase in market distance by 1 minute is predicted to decrease market participation by about 0.06 % (1- 0.994). Non-farm income is also negatively related to food crop commercialization. As non-farm income increases by 1 Birr, odds of market participation decline by 0.001 %, as non-farm income activities compete with crop farming for labor and other resources. It is also common observation that farmers who are not well endowed with farm resources and production capacity, resort to low-paying non-farm activities, in particular petty trading and selling of firewood.

Table 3: Logit Regression Estimates for Farmers' Participation in Food Crop Marketing in South Wollo, Ethiopia, 2001/02 Cropping Year

Variable	B	S.E.	Wald	Exp(B)
Market distance	-0.006	0.002	7.966***	.994
Head's gender	0.254	0.268	0.895	1.289
Head's age	0.007	0.008	0.930	1.007
Consuming units	-0.032	0.080	0.155	.969
Non-oxen-livestock	-0.168	0.057	8.712***	.845
Non-farm income	-0.001	0.000	10.634***	.999
Food crop output	0.001	0.000	13.506***	1.001
Head's literacy	0.409	0.250	2.679*	1.505
Constant	-0.108	0.683	0.025	.897

Dependent variable: Participation in food crop marketing (commercialization), 1=participant, and 0 = non-participant

Note: Exp(B) shows the predicted change in odds for a unit increase in the predictor.

Omnibus tests of model coefficients: Chi-square= 51.083; df. = 8; sig. level = 1 %

Cox and Snell R^2 = 11.9 %; Nagelekerke R^2 = 15.9; percentage of correct prediction: 66.2 %; N included: 402 (95.7 %); *** = sig. at 1%; * = sig. at 10 %

Livestock holding (excluding oxen) is also negatively related with crop-oriented commercialization. An increase in one TLU results in a decline in the odds of market

participation by 15.5 %, due to competition between livestock activities and crop farming for labor and other resources. Crop output, however has a significant and positive impact on food crop commercialization. As crop output increases by one unit, the odds of market participation increases by 100 %.

The regression analysis also shows the positive and significant (at about 10 % level) relation of literacy and participation in commercialization of food crops. Farm households with better education level seem to be keen to participate in food crop marketing. The education effect could be direct (market-orientation) or indirect via better production skill and knowledge. Household size measured in adult-equivalent consuming units, which reflects household subsistence needs, is negatively related with participation in food crop commercialization. The negative sign suggests that households with large family size are forced to consume much or all of their production, supplying an insignificant amount or none for market, but the finding is not statistically significant. Neither gender nor age shows any significant impact on market participation.

In short, the regression analysis confirms that lack of market access (measured by distance) and engagement in livestock and off-farm employment significantly and negatively impact food crop commercialization. Literacy and total food crop production play a positive role, but only the latter has a strong significant effect. The logical question is therefore what determines food crop production in ways that stimulate marketed surplus, the focus of the next section.

4.2 Determinants Food Crop Production

Results of the Cobb-Douglass production function estimation are shown in Table 4. The empirical model (F-value=3.865, sig. level=1 %) estimated coefficients of farm size operated, household labor, age of household head (proxy for knowledge, skill and experience), oxen owned, fertilizer used, and cash credit received. Beta coefficients in the model are elasticities reflecting the percentage change in output resulting from a percentage change in input use.

As Table 4 shows, land size operated is highly significant with an elasticity of 0.518. A doubling of the present size of land operated (mean size=1.46 ha.) would result in an increase of food production by 51.8 %, other factors remaining the same. The

coefficient for chemical fertilizer[12] is also significant and implies that doubling of the current level of fertilizer application would result in an increase in food production by 35.5 %. As the average amount of fertilizer used in the study areas is small (20.87 kg. per household, as shown in appendix 1), there are sizable output gains to be made from expanded fertilizer application. The result for oxen however is not statistically significant, suggesting the social capital is enabling oxen-less households to borrow or rent oxen in ways that prevent yield-deterioration.

Table 4: Cobb-Douglass Estimation of Food Crop Production in South Wollo

Variable	B	Std. Error	Beta	t-value
(Constant)	8.504	1.259		6.757
log of household labor	-0.0558	0.228	-0.038	0.245
log of oxen owned	0.233	0.219	0.149	1.062
log of land operated	0.518	0.215	0.377	2.406**
log of credit received	-0.124	0.098	-0.199	1.262
log of head's age	-0.755	0.276	-0.378	2.738**
log of fertilizer (DAP+Urea)	0.355	0.148	0.387	2.391**

Dependent Variable: log of food crop production; ** = sig. at 5 % level

Age of household head is negatively related to food production. This could be due to the better educational level of younger farmers; a bivariate statistical association test has shown that more of younger household heads are literate, while most of older farmers are non-literate. The credit coefficient in the regression is insignificant and negative, which is consistent with Damite and Negatu (2004) findings that the small cash credit obtained by farmers is used for smoothing consumption of food-short households. Household labor is negative but highly insignificant. This negative relation, though statistically insignificant, could be probably due to larger size of family labor in relation to other factors of production.

In sum, farm size operated and technology (chemical fertilizer) are found to be the most important factors of production under the context of the South Wollo in the 2001/02 cropping year. Policies and institutions that facilitate access to farmland (in particular via land rentals and sharecropping) require attention, particularly in

[12] In the production function improved seeds and fertilizer were tested and found to show a high level of co-linearity problem, and thus excluded.

situation where land underutilization is evident. Similarly, one has to focus on policy and institutions that promote technological change in smallholder agriculture. The next section deals with the adoption patterns and constraints of agricultural technology, particularly chemical fertilizer in the study area.

4.3 Farm Input Intensification

Smallholder farming households in the study *woredas* use limited chemical fertilizer, improved seeds, herbicides, insecticides, and farm implements. Chemical fertilizers are applied mainly to cereals, but its application to pulses and other crops is not common (Demeke et al., 1997). Improved seeds and chemical fertilizer are the dominant improved technologies used by farmers in the study areas (see Appendix 2 for the percentage of users of improved seeds and fertilizers). Maize and wheat are the main crops for which improved seeds are extensively promoted, the rest benefiting less from improved seed technology. Both a greater proportion of farmers and the average amount of seeds and chemical fertilizer applied in Jamma woreda are greater than in the other study woredas in 2000/01 and 2001/02. Bati farmers use the least improved seeds and chemical fertilizer both in terms of average amount of inputs used and percentage of users. However, a higher proportion of Bati farmers apply manure, and rates of manure application are the highest in Bati, compared with other study woredas.

The results of the regression estimation of fertilizer use are shown in Table 5. Regression estimation was also carried out for Jamma, a study woreda in which the highest proportion of farmers use chemical fertilizer (Appendix Table 1), for more insights.

The regression results show that operated farm size has a positive and statistically significant impact on fertilizer use in both South Wollo and Jamma woreda. A unit change in size of farm operated entails more than two and half times and eight times higher chance to use chemical fertilizer in South Wollo and Jamma, respectively. This could be due to economies of scale, for fertilizer transaction cost per unit of operated land is lower for larger farms. Also larger farms often have greater influence (social capital) on personnel involved in fertilizer distribution.

Table 5: Logit Regression Estimation of Use of Chemical Fertilizer in South Wollo

Variable	South Wollo (All Study woreda)				Jamma woreda			
	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)
Market distance	.007	.007	.944	1.007	-.016	.011	2.026	.985
Head's age	.003	.015	.037	1.003	-.008	.020	.149	.992
Labor units	.071	.222	.103	1.074	.124	.369	.112	1.131
Farm size operated	.974	.351	7.686***	2.648	2.147	.750	8.202***	8.557
Soil quality	.860	.502	2.934*	2.363	1.499	.746	4.033**	4.477
Oxen	1.482	.448	10.942***	4.400	1.649	.677	5.931**	5.203
Non-oxen livestock, TLU	-.344	.140	6.070**	.709	-.512	.220	5.432**	.599
Non-farm income	-.001	.001	1.333	.999	-.002	.002	.852	.998
Credit	.003	.001	9.668***	1.003	.003	.002	2.375	1.003
Head's literacy	.877	.542	2.615	2.403	1.221	.745	2.684	3.390
Jamma-dummy	5.995	.981	37.361***	401.426	-	-	-	-
Constant	-10.665	2.072	26.492	.000	-3.355	2.344	2.050	.035

Dependent variable: use of chemical fertilizer (DAP and/or urea), 1=user, 0 = non-user

Note: Exp(B) shows the predicted change in odds for a unit increase in the predictor.

Omnibus tests of model coefficients for all woreda (South Wollo): Chi-square= 229.679; df. = 11; sig. level= 1 %

Cox and Snell R^2 = 43.6 %; Nagelkerke R^2 =74.6 %; Percentage of correct prediction: 95.5 %; N included: 401 (95.5%).

Omnibus tests of model coefficients for all Jamma woreda: Chi-square= 70.465; df. = 10; sig. level= 1 %

Cox and Snell R^2 = 51.3 %; Nagelkerke R^2 =69.0 %; Percentage of correct prediction: 86.7 %; N included: 98 (94.2 %).

*** =sig. at 1 % level; ** = sig. at 5% level; * = sig. at 10 %

Fertility status of soil, traditionally measured as low fertility (*tuff*), medium fertility (*lem-tuff*) and high fertility (*lem*), also has a role in the decision of whether and how much fertilizer to use. Findings of the regression analysis show that farm households with better soil quality tend to use chemical fertilizer. Soil quality is positively induced by the application of organic manure, rotation and residual fertilizer carry-over. Landscape may also affect soil fertility via its effect on erosion. A change in soil quality towards better level in South Wollo and Jamma woreda results in the increase of odds of applying fertilizer by 2 times and four and half times respectively, other factors remaining constant. These results are consistent with the findings for

agroecology, as proxied by the Jamma dummy variable, which also shows a positive and significant effect on fertilizer use. This could be probably better quality soils respond to chemical fertilizer better than poor quality soils, for good quality soils have better organic matter that enhances the productivity impact of chemical fertilizer.

Increasing oxen holdings by one unit increases the odds of using fertilizer in South Wollo and Jamma by more than four times and five times, respectively, other factors remaining unchanged. Oxen power is a critical production factor for small farm holders (Negatu, 2004). The relationship between livestock holding (excluding oxen) and fertilizer use is found to be negative and significant in both South Wollo and Jamma. An increase in one TLU in South Wollo and Jamma, other factors remaining constant, reduces the odds of applying chemical fertilizer by 29.1 % and 40.1 %, respectively, reflecting both competition for household labor, and substitution effects between manure and fertilizer need.

An increase in the credit received in one unit would increase the chance of applying fertilizer in South Wollo by 100 %. In Jamma, credit coefficient is positive but not significant at 10 %. The results indicate in general the importance of credit in improving farmers' access to chemical fertilizer.

The fertilizer adoption estimation results in general imply the need and importance of policies and institutions that promote farmers' access to oxen, that increase size of operated farm, and access to credit. The results imply also the need of agricultural diversification through promoting food crops production in agro-ecologically suitable areas like Jamma and non-staple food crops and off-farm activities in agriculturally less suitable agro-ecological areas like Bati (Kola agroecology) and Legambo (Wurch agroecology) areas.[13]

6. SIZE OF OPERATED FARMS AND SMALLHOLDER FARMING SYSTEMS

As observed in the above analyses, size of operated household farm is a key factor of production, technology adoption and commercialization under Ethiopian rural context. Households in the study areas can be categorized into three farm size groups: (i)

[13] *Kola*, is an agroecology characterized with high temperature, lowland and semi-arid conditions, while W*urch* is an agroecology with low temperature, highland and sub-moist conditions.

small size farm size, 0.50 ha and less; (ii) medium size farm, 0.51 ha - 2.0 ha., and; (iii) large size farm, above 2.0 ha. The role of size of operated farms can also be demonstrated in terms of its association with technology use, soil quality, manure use, and commercialization (Table 6). As shown in the table, large size farm holders are significant users of fertilizer, improved seeds and manure, and they commercialize the largest proportion of food crop produced compared to medium and small size farm holders. Thus, size of operated farm is a crucial factor in the intensification and commercialization of smallholder farming systems in Ethiopia. For a farm household to be sustainably food secure and user of modern improved productive technologies, consolidation of small and fragmented holdings into larger and viable size is therefore essential. This has a clear implication on policies and institutions required to ensure a long-term and secure marketing of land-lease holdings.

Table 6: Distribution of improved seeds, chemical fertilizer, manure, soil quality and commercialization by operated farm size groups

Item	Small farm	Medium farm	Large farm	F-value
Fertilizer, kg.	1.41 (11.868)	23.69 (59.472	27.83 (62.898	5.530***
Improved seeds, kg.	.00 (0.000)	.42 (3.772	2.67 (13.690)	3.940**
Manure use, kg.	16.972 (80.194	74.66 (151.583)	140.92 (278.429)	9.985***
Soil quality index	2.19 (0.595)	2.15 (0.478	2.17 (0.475)	0.247
Commercialization index (CI)	.06 (0.095)	.08 (0.112	.10 (0.129	3.428**

Note: *** =sig. at 1 %; ** = sig. at 5 %

7. SUMMARY AND CONCLUDING REMARKS

Commercialization of farm production is considered as an important strategy of transforming low productivity subsistence production of small farm holders into surplus - and market-oriented production systems. Data from the study areas of South Wollo in Northeastern Amhara region reveals that the amount of marketed food crops is substantially low (8 % of the total produced food crops). In terms of

participation in food crop marketing, commercialization ranges from 36 % in poor cropping year (2000) to 51 % in relatively better cropping year (2001).

Access to marketplace (physical proximity) has been found to significantly affect farmers' commercial participation. Farm households nearer to market participate in food marketing than those far from market place. In the absence of means of transportation, farmers walk to market, in which case long distances to market play a disincentive to marketing. The importance of local and federal governments' efforts to improve roads and transportation services and market infrastructure is clear in stimulating participation of smallholders in marketing. Institutions and policies that encourage private investment in transportation service are also of a paramount importance. Marketing cooperatives would also have important role in facilitating input and output marketing.

Above all, the study asserts the major importance of surplus production or increased production in stimulating participation in food marketing. Enhanced food production is a very critical factor in promoting farm commercialization as also repeatedly indicated in various studies (see section 2). This warrants the need of investigating factors that determine food production. The Cobb-Douglas model estimation of food production clearly showed that size of farm cultivated with food crops and fertilizer are the most important and significant factors that determine food production. Since improved seed and fertilizer are highly co-linear in application, the findings underscore the importance of markets and service delivery in multiple inputs. This result implies the need for forging appropriate policies that promote land mobility (marketing) in order to create conditions for increasing farm land operated by efficient farmers, by rationalizing the existing leasehold marketing and improving tenure security through efficient land institutions. This accompanied with aggressive technological change in smallholder farming through availability and accessibility of appropriate technologies like chemical fertilizer complemented with improved seeds and water irrigation (wherever necessary and feasible) is necessary to enhance the production side of farm commercialization. Technological change accompanied by change in human capital is a fundamental force to bring the anticipated production increase and farm commercialization.

In connection with this finding, the study attempted also to examine the pattern and constraints of fertilizer use in smallholder farming systems in South Wollo. According to this study, oxen holding, farm size and credit are the most important positive

factors. Associated with larger farm size are benefits from economies of scale. As fertilizer is an expensive input for smallholders, the positive role of credit and the importance of strengthening credit service are clear. On the other hand, the study shows that applying fertilizer is feasible for farming located in suitable agro-ecology like Jamma compared to other case areas (e.g. Bati, Legambo). In agro-ecologies that are not suitable for agriculture, other options like non-farm income activities and animal farming are worth considering (Little et al, 2006).

Overall, rationalizing the existing land tenure policies and institutions in such a way to enhance production, technological change and commercialization is an important step that needs consideration by regional and federal governments. In connection with this, agricultural planning that prioritizes agro-ecologies for different agricultural and non-agricultural activities would be helpful.

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Appendix 1: Descriptive Statistics of Major Variables, 2001/02 cropping year

	N	Minimum	Maximum	Mean	Std. Deviation
Distance to Main Market, minutes	420	4.00	300.00	99.7512	50.60825
Age of household head	420	10.00	91.00	47.7024	15.45119
HH Labor (Adult Equivalent)	420	.00	8.40	2.8363	1.26923
HH Size (Adult-equivalent consuming units)	420	.70	10.70	4.1317	1.62785
Total operational holding (ha.)	420	.00	4.63	1.4644	.98205
Livestock ownership other than oxen (TLU)	420	.00	24.35	2.0411	2.52907
No. of Oxen Owned	420	.00	5.00	.7429	.86600
Improved seed used, kg.	420	.00	95.00	.9114	7.48626
Non-farm Income (revenue from own business plus wage labor employment), Birr	420	.00	4729.00	381.8412	710.82177
Total Farm cash income, Birr	414	.00	5440.00	595.6344	656.13704
Cash credit received, Birr	420	.00	2422.00	98.2307	230.87015
Total food crop production, kg.	411	.00	89508.00	967.1607	4418.89306
Fertilizer (Dap+urea) applied	420	.00	400.00	20.8667	55.75091

Appendix 2: Amount and user percentage technological inputs in 2000/01 and 2001/02 cropping years

Technological input	Woreda	N	2001/02 cropping year		2000/01 cropping year	
			Mean	Number of users (%)	Mean	Number of users
Fertilizer, kg.	Bati	110	0.00 (0.000)	0 (0.00)	0.51 (3.397)	3(2.73)
	Jamma	104	80.90 (87.271)	62 (59.62)	87.60 (76.837)	73(70.19)
	Dessie zuria	100	3.50 (13.771)	8 (8.00)	8.83 (20.199)	24 (24.00)
	Legambo	106	0.00 (0.000)	0 (0.00)	2.90 (12.214)	6(5.68)
	Total	420	20.87 (55.751)	70 (16.67)	24.66 (53.888)	106(25.24)
Improved Seed, kg.	Bati	110	0.00 (0.00)	(0.00)	0.71 (4.532)	6(5.45)
	Jamma	104	3.20 (14.454)	7 (6.73)	8.97 (18.117)	24(23.08)
	Dessie zuria	100	0.50 (3.518)	2(2.00)	3.32 (8.804)	15(15.00)
	Legambo	106	0.003 (0.029)	1(0.94)	1.58 (6.695)	7(6.60)
	Total	420	0.91 (7.486)	10(2.38)	3.60 (11.224)	52(12.38)

Note: Herbicides were not used in all *woreda*, while insecticides were provided to a considerable number of farmers freely by the local government to control the insect epidemics in Bati woreda in 20001/01. In 2001/02 neither herbicides nor insecticides were used in all the *woreda*. Figures in parentheses are standard deviations.