Enhancing Market Orientation of Smallholders: Lessons From Market Orientation of households in Selected Grains In Ethiopia

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Abstract:

In spite of the policy decision of the GoE to commercialize subsistence agriculture, there is a dearth of information on the commercialization process and marketing behavior of small holders in Ethiopia. This paper attempts to contribute to redressing this gap of knowledge for the cereal crops of teff, wheat and rice; the pulse crops of haricot beans and chickpea and an oil crop (niger seed). Data for the study was collected from districts where these crops are important market oriented commodities. Analysis of the variation in market participation of households in these crops in areas where the crops are already important market oriented commodities offers a unique opportunity to gain insight into the determinants of the commercialization behavior of households. About 65 - 77% of households produce these market oriented commodities, on about 27 – 44% of the total cultivated area. About 47 – 60% of the produce of these market oriented commodities is sold. The important market places for producers of these commodities are the district town markets and markets located at the peasant associations (PA). Markets in other district towns or regional markets are rarely used by producers. Wholesalers and retailers are the most important buyers from producers. Econometric analyses show that market orientation of households is affected by factors related to household demographic characteristics, human and physical capital endowment, distance to markets, institutional support services, and village level factors of population density, agricultural labor wage and rainfall. Our results imply that market interventions to improve the gains to producers need to target district level markets. Special attention is required to female headed households in the process of commercial transformation of subsistence agriculture. The comparative advantage of female headed households may not be in grain production. Population control measures may contribute to commercial transformation of subsistence agriculture through their effect of reducing household subsistence requirements. Improving the operations of factor markets of land, traction and farm labor could contribute to enhancing market orientation of farm households. Alternatively, institutional arrangements to improve household access to land and traction power could contribute to market orientation of households. Market access remains an important factor for market orientation of households, implying the need for interventions to develop market infrastructure. The extension and credit services that were designed to achieve food security objectives need to be re-examined to adopt them to the policy of commercial transformation of subsistence agriculture Ethiopia is following. In particular, the institutionalization and development of marketing extension services warrants emphasis.

1. Introduction:

Sustainable food security and welfare cannot be achieved through subsistence agriculture (Pingali, 1997). In line with this, the Government of Ethiopia (GoE) has adopted commercial transformation of subsistence agriculture as the basis of the Agricultural Development-led Industrialization (ADLI) development strategy of the country. As a result of the economic reform that took place in Ethiopia in 1991, grain markets have also been liberalized and restriction on grain trade lifted, and official pricing have been eliminated (Gabre-Madhin, 2001).

Commercial transformation of subsistence agriculture is a process and commercializing subsistence farmers may not instantly move on to high value crops. Often times, increased market orientation of staple crop production offers a more pertinent option to small holders, at least in the short and medium terms until infrastructural facilities are developed to accompany the production, processing, transportation and marketing of high value crops.

Commercial transformation of subsistence agriculture can not be expected to be a frictionless process, as it is likely to involve substantial equity issues (Pingali and Rosegrant, 1995). Small holders can be left out from benefiting from the commercialization process due to inadequate services and infrastructure, and new set of transactions costs that emerge from new market institutions and actors. Moreover, economic development, coupled with rising per capita incomes, technological change, and urbanization is causing significant changes in food markets in developing countries (Reardon and Timmer, 2007). Ethiopia is not an exception. Hence, governments and development agencies are confronted with the challenge of ensuring that small holders and the rural poor benefit from commercialization either by participation in the market or providing exit options for employment in other sectors.

An understanding of the marketing behavior, market channels used and the determinants of market participation of small holders is required to aid in designing appropriate technological, policy, organizational and institutional strategies to ensure small holders and the rural poor benefit from the process of commercialization. In spite of the policy decision of the GoE to commercialize subsistence agriculture, there is a dearth of information on the commercialization process and marketing behavior of small holders in Ethiopia. This paper attempts to contribute to redressing this gap of knowledge for the cereal crops of teff (a grass-like fine seeded staple food crop), wheat and rice; the pulse crops of haricot beans and chickpea, and an oil crop (niger

seed). Data for the study was collected from districts where these crops are important market oriented commodities. Analysis of the variation in market participation of households in these crops in areas where the crops are important market oriented commodities offers a unique opportunity to gain insight into the determinants of the commercialization behavior of households during the process of commercial transformation of subsistence agriculture.

2. Overview of grain production and marketing in Ethiopia

Grain Production

In Ethiopia, cereals, pulses, and oil seeds covered about 78%, 14% and 8% of the total grain cultivated area of about 11 million ha in 2004/05 production season (CSA, 2006). In the same production season, cereals, pulses and oil seeds contributed about 85%, 11% and 4% of total grain production of 12.5 million metric tons, respectively.

Measured in terms of contributions to total cereal production, maize, wheat, teff, sorghum and barley are the most important cereal crops in that order. However, the relative importance of the crops changes slightly when compared in terms of their contribution to total cereal area covered, due to differences in productivity (Table 1). Maize has the highest yield.

Table 1: Contribution of cereal crops in total cereal area and total cereal production in 2004/05

Crop	Proportion of total cereal production (%)	Proportion of total cereal area (%)
Maize	27	20
Wheat	21	22
Teff	19	25
Sorghum	16	15
Barley	13	14
Other	5	4

Source: Computed from CSA (2006) data

Among pulses, faba beans, haricot beans, field peas, chickpea, grass pea and lentils are the most important crops grown in that order both in terms of area covered and contribution to total production (Table 2). Faba beans contributed about 40% of total pulse production and covered about 31% of pulse area in the 2004/05 production season.

Table 2: Contributions of pulses to total pulse area and total pulse production in 2004/05

Crop	Proportion of total pulse production (%)	Proportion of total pulse area (%)
Faba beans	40	31
Haricot beans	18	25
Field peas	17	17
Chickpea	12	12
Grass pea	na	7
Lentils	na	6
Other	na	2

na: data not available

Source: Computed from CSA (2006) data

Among oil crops, niger seed, lin seed, and sesame are the most important crops which together accounted for about 87% of total oil crop production in 2004/05. Lin seed and sesame are important export crops. While sesame is grown mostly in the lowland parts of the country, niger seed and linseed are grown in higher altitudes. Among these oil crops, niger seed is most important, followed by linseed both in terms of contribution to total oil crop production and area coverage (Table 3).

Table 3: Contributions of oil crops to total oil crop production and oil crop area in 2004/05

Crop	Proportion of total oil crop production (%)	Proportion of total oil crop area (%)
Niger seed	36	43
Lin seed	29	31
Sesame	22	16
Other	13	10

Source: Computed from CSA (2006) data

Grain production in Ethiopia can be classified into two cropping seasons: the main rain season and the short rain season. The main rain production season takes place during June – December, while the small rain production season takes place during March – June. The small rain season accounts for about 10% of total annual grain production in the country. Wheat, maize, barley and teff are the cereal crops grown during the small rain season, while haricot beans, lentils and chickpea are the pulse crops grown during the season. The proportion of production accounted for by the small rain season is much lower than the proportion of area covered by the grain crops, perhaps because of the erratic and unreliable nature of the small rains that affects productivity.

Grain Marketing

Cereals are the major sources of food intake in Ethiopia, accounting for about 70% of calorie intake, out of which two-third is accounted for by teff, wheat and maize alone (Lirenso, 1993). Among cereals, maize, wheat and teff are most traded commodities in Ethiopia (Jayne, Negassa and Myers, 1998). Based on a survey conducted in 1997, Negassa and Jayne reported that nationally the proportion of maize, wheat and teff sold by smallholders was about 30%, 31% and 28% of production, respectively, and the proportion of total cereal sales (maize, teff, wheat, barley, sorghum, and millet) from the 1995/96 main season was about 26% of total cereal production. The same data source indicated that about 78% of oil seeds was marketed, indicating that oil seeds are produced mostly for the market.

Grain marketing was heavily controlled by the socialist military government that ruled the country during 1974-1990. The socialist military government was directly involved in wholesale and retail grain trade, essentially suppressing private grain marketing. Farmers were forced to sell a certain quota of their grain produce (usually 10-50%) to the then government grain trade parastatal known as the Agricultural Marketing Corporation (AMC), at fixed prices which were 2-3 times below the prevailing market prices. Interregional private trade was also severely restricted. The heavy government involvement and restrictions in grain trade during 1974 - 1991 had adversely affected producer incentives, farm technology uptake and productivity.

In 1991 grain trade was liberalized, official pricing was abandoned, trade restrictions were lifted and private grain trade expanded. Upon grain trade liberalization, the reform resulted in reduced marketing margins, better market integration and entry by private traders (Negassa and Jayne, 1997; Gabre-Madhin et al, 2003). After liberalization, about 95% of cereal marketed by smallholders in Ethiopia was handled by private traders.

However, margins and transactions costs remained high, and weak private sector capacity, inadequate market institutions and poor infrastructure remained fundamental problems in the marketing system. As a result spatial and temporal arbitrage opportunities remained underutilized and many markets remained segmented (Gabre-Madhin, et al., 2003). Despite the increased entry of private traders in grain trade, limited access to finance and storage facilities, lack of processing linkages and limited market information remain fundamental problems confronted by traders. Cereal marketing costs accounted for about 40% to 60% of consumer prices of cereal commodities in 1995/96 (Negassa and Jayne, 1997). Imperfections in the grain marketing system result in several consequent outcomes.

Surplus grain producing areas in Ethiopia are localized, implying the critical role of transportation to different and distant deficit areas. The size and topography of the country, limited transportation possibilities (road transport is the only available means for grain transportation), and the radial configuration of transport networks with Addis Ababa at the center has hampered inter-regional grain flows. As a result, localized shortage of food supply exists due to poor marketing and distribution networks, high transport cost, and related infrastructural problems that isolate surplus production areas from outside sources of effective demand even during good harvest seasons. Sometimes, surplus production results in sharp drop in prices. For example, in 1999/2000 a 19% increase in production resulted in 40% drop in grain prices (Hailegabriel, 2003), due to lack of processing, limited storage capacity, poor post-harvest grain management, weak domestic demand, and poor international or regional market outlets. Similarly, the significant surplus of grain in 2002 resulted in 60-80% drop in producer grain prices (Gabre-Madhin et al., 2003)

Post-harvest losses in Ethiopia could be as much as 5-19% for maize, 6-26% for millet, 6-23% for wheat, and 5-20% for teff (Ashagari, 2000), forcing traders not to store grain for more than the minimum turnover period. The problem of post-harvest loss is particularly important due to the fact that about 80% of farmer sales

occur during January – March, the first quarter after harvest, and that about 50% of trader purchases also take place during this period (Hailegabriel, 2003).

3. Conceptual framework, data and analytical approach

Conceptual framework

In this study, market orientation of households is conceptualized as incorporating both production and marketing decisions, because commercial transformation of subsistence agriculture is basically a shift from "sell surplus of what you produce" to "produce what you intend to sell". There is a fundamental difference in the two approaches. In the first approach the prime objective of subsistence producers is to fulfill subsistence requirements and production decisions are made based on agro-ecological feasibility and subsistence needs. In this case, producers attempt to sell what ever surplus they might have upon fulfillment of subsistence needs. In the second approach, the prime objective of producers is profit maximization and production decisions are made based on comparative advantages and market signals. Hence, in this study, proportion of households producing the market oriented commodity and the proportion of area under the commodity are used as indicators of market orientation at the community level, while whether household produces the commodity and proportion of produce sold are used as indicators at the household level.

Several factors affect market orientation of households by affecting the conditions of commodity supply and demand, factor and output prices, and marketing costs and risks faced by producers, traders and other market actors (Pender, 2006). Hence, in this study, market orientation is modeled as a function of household demographic factors (age and sex of head, household size, child dependents), human capital (education and labor supply); physical capital (land, oxen ownership, ownership of other livestock), institutional support services (access to extension, credit, and market information), market access (distance to nearest market, distance to district town market) and village level factors (population density, rainfall and agricultural labor wage).

Data

Results are based on analysis of data collected from community and household surveys conducted in the five districts of Alaba (about 310 km south of Addis Ababa, in the Southern region), Dale (about 330 km south of Addis Ababa, in the southern region), Ada'a (about 45 km east of Addis Ababa, in the Oromia region), Fogera (about 610 km north west of Addis Ababa, in the Amhara region), and Atsbi (about 860 km North of Addis Ababa, in the Tigray region) in 2005 (Figure 1). The study districts are areas where these crops are important market oriented commodities for smallholders[1].

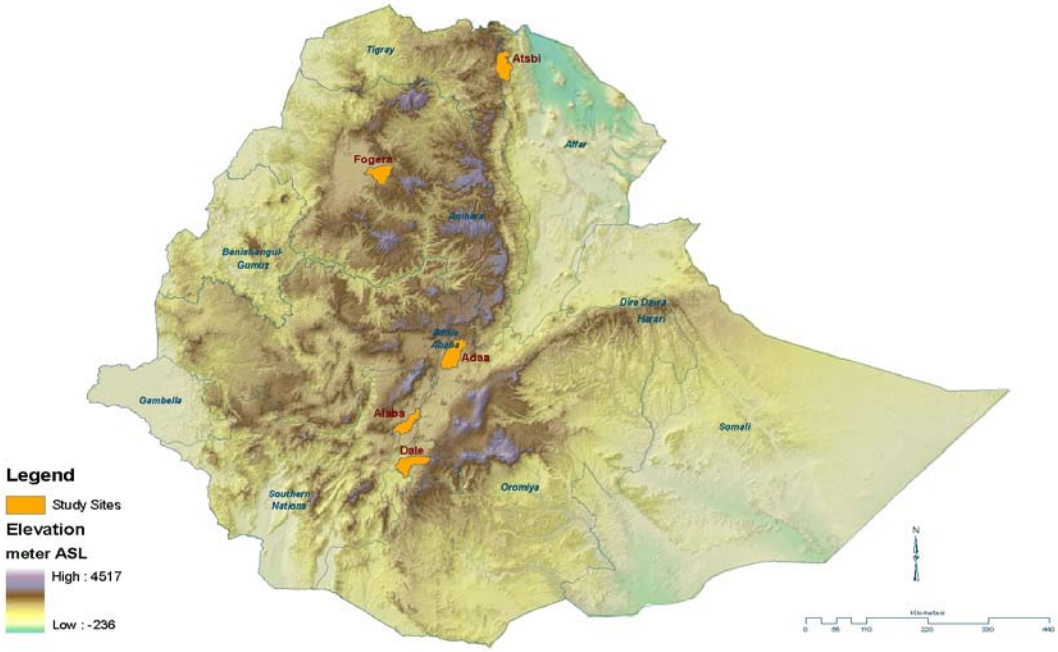

Figure 1: Study sites

Since the focus of the study is on market oriented commodities that are important for smallholders, data were collected only from the farming systems in each district where the commodities are important marketable commodities. For this purpose, each district was classified into two farming systems based on cropping

[1] The districts are pilot learning woredas (PLWs) of the Improving Productivity and Market Success (IPMS) of Ethiopian Farmers project, implemented by the International Livestock Research Institute (ILRI) on behalf of the Ethiopian Ministry of Agriculture and Rural Development (IPMS, 2005). For more information on the IPMS project, visit www.imps-ethiopia.org.

pattern. Analysis of the variation in the degree of market orientation of households in these market oriented commodities provides a good opportunity to explore the determinants of variations in market orientation of households that can inform policy making to facilitate commercial transformation of subsistence agriculture.

The commodities included in the study are teff, wheat, rice, haricot beans, chickpea and Niger seed. Data on wheat and teff were collected from the two farming systems in Ada'a and one farming system in Alaba, and data on Niger seed were collected from both farming systems in Fogera, while data on rice was collected from one farming system in Fogera. Data on haricot beans were collected from one farming system each in the districts of Dale and Alaba. Data on chickpea were collected from the two farming systems in Ada'a, and one farming system each in Fogera and Atsbi. The data pertain to the 2004/05 production season.

Analytical approach

Analysis of descriptive information is used to determine the level of market orientation, average household income from the sale of the commodities, and markets and market channels used by producers. Econometric analyses are used at both the community and household levels. At community level, econometric analyses are used to analyze the determinants of the proportion of households who produce the market oriented commodities and the proportion of area covered by these commodities. Interval regression (with robust standard errors) and OLS are used to estimate the regression models as appropriate. Distance to markets, rainfall, agricultural labor wage, proportion of female headed households in community, population density, average cultivated land per household, average number of bullocks per household, average other livestock holding per household, average altitude, availability of credit and market information services in community are used as explanatory variables in the community level regression models.

At the household level, econometric analyses are also used to analyze the determinants of household decision to produce these market oriented commodities (Probit models) and the proportion of produce sold (interval regression), a measure of the extent of market orientation. Since the proportion of households who do not sell the produce was small, regressions for the determinants of household decision whether to sell or not were not estimable. At the household level, population density, access to markets, household characteristics (age and sex of head, literacy of head,

household size, number of children dependents, and household labor supply), wealth factors (land ownership, and ownership of livestock), involvement in extension program and access to credit during the previous year, and rainfall are used as explanatory variables in the regression models.

A sample selection problem arises in the regression for the proportion sold by the household, since proportion sold is observed only for households who produce the crop. Hence, Heckman's two-step estimation procedure is used. The probability of growing the grain crop was predicted in the first stage, a predicted value of the inverse Mills ratio (IMR) is obtained and the ratio included as an explanatory variable in a second stage regression (Maddala, 1983). However, since the second stage regressions are censored regression (censored at both ends) the predicted IMR introduces hetroskedasticity because its errors depend on the values of the explanatory variables. Unlike in the linear model, hetroskedasticity results in inconsistent estimators (Maddala, 1983). Hence, in the second stage, interval regressions with robust to hetroskedasticity standard errors are used. Interval regression is a generalization of the Tobit model, and is estimable with robust standard errors **(**StataCorp**,** 2001**).** The regressions for rice and haricot beans are not significant and not reported.

Identification of the second regression is an important issue. The problem of identification is resolved by finding variables that are correlated with the decision to grow a cereal crop, but not correlated with the decision of how much to sell. Altitude and walking time to nearest milling service are used as instruments in the Probit models. Intuitively, these variables explain the decision to grow a cereal but not to market it. Altitude determines the suitability of the agro-ecology for the crop, while distance to milling service affects cost of consumption. Descriptive statistics of explanatory variables are given in Annexes 1 & 2.

4. Results and discussion

Degree of market Orientation

Indicators of the level of household market orientation in the commodities are given in Table 1. The indicators are calculated at the community and household levels.

Teff

Teff has become an important market oriented crop in Ethiopia. In the study area, about 77% of households produce the crop, on an average of about 31% of the total cultivated area (Table 4). On average, among the households that produce teff, a household produces teff on about 1.2 ha.

Table 4: Indicators of level of market orientation and average income

	Teff	Wheat	Rice	Haricot beans	Chick pea	Niger seed
Proportion of households producing crop (%)/PA[2] (STD)	77 (22.84)	64 (26.37)	72 (32.17)	62 (32.75)	20 (23.04)	28 (23.70)
Proportion of area covered by crop (%)/PA (STD)	31 (19.12)	27 (11.05)	44 (26.00)	13 (15.20)	3 (3.67)	9 (6.19)
Area allocated (ha/household) (STD)	1.2 (0.96)	1.4 (0.87)	0.62 (0.22)	0.29 (0.24)	0.53 (0.45)	0.42 (0.67)
Proportion of produce sold (%)/household (SE)	60 (2.38)	47 (2.81)	50 (4.35)	46 (4.91)	46 (4.84)	92 (1.46)
Amount sold (kg) (SE)	540 (50)	601 (96)	886 (149)	90 (20)	456 (68)	201 (29)
Average revenue/household (Birr) (SE)	1417 (126.36)	978 (145.92)	1567 (292.65)	108 (24.91)	801 (117.70)	565 (84.11)

About 60% of teff produce is sold, although there were significant variations across the study area. On average about 540 kg of teff per household was sold, with a monetary value of about Birr 1417 (USD 170.00). Analysis of the household market participation level shows that about 32% of households sold 46-60% of their teff produce, and about 25% of them sold more than 90% of their teff produce (Figure 2). It is interesting to note that the mode in the proportion of teff produce sold is 46-60%, followed by 91-100%. In general, the proportion of households selling teff increases with the increase in the proportion of teff sold from 0-15% to 46-60%, then drops when the proportion sold increases to 61-75% and 76-90%, after which it rises again.

[2] PA stands for peasant association which is the lowest administrative unit in Ethiopia comprising of about 4-5 villages.

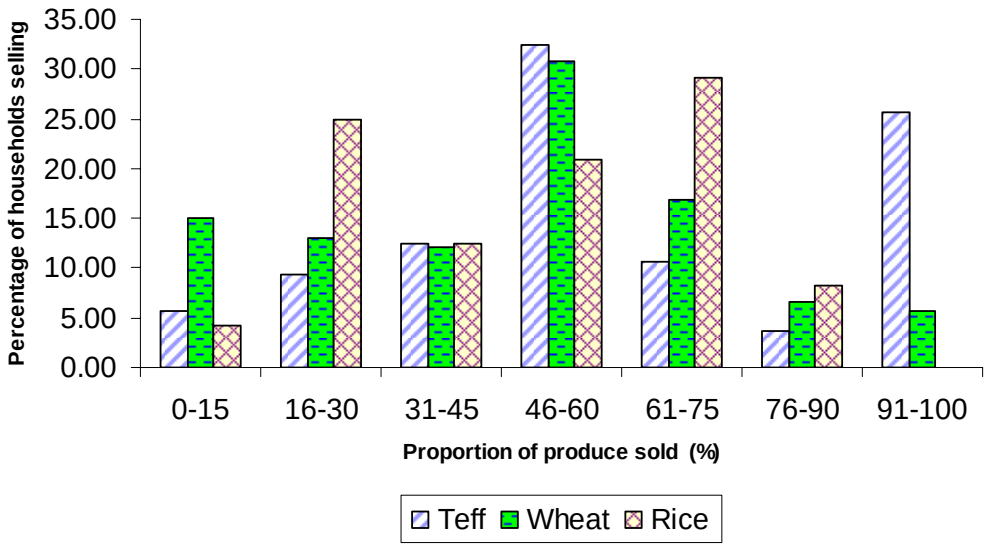

Figure 2: Percentage of produce sold by percentage of households selling for teff, wheat, and rice

Wheat:

Like teff, wheat is also an important market oriented commodity in the study area. On average, wheat is produced by about 64% of the households on about 27% of total cultivated area. On average about 1.4 ha of land is allocated for wheat by a household. About 47% of wheat produce is sold. A household sold about 600 kg of wheat for a sales value of about Birr 978. About 31% of households sold 46-60% of their wheat produce, while about 17% sold 61-75% (Figure 2). Like teff, the mode in the proportion of wheat produce sold is 46-60%, followed by 61-75%. The pattern of the variation in the proportion of wheat sold is similar to that of teff.

Rice

Rice, which has relatively recently been introduced to Ethiopia, is also fast becoming an important market oriented crop in one of the farming systems of the Fogera district[3]. About 72% of households produce rice in the farming system, on about 44% of the total cultivated area. Among the households who produce the crop in the district, an average household produces rice on about 0.62 ha of land. About 50% of rice produced was sold. A household sold an average of 880 kg of rice, with a

[3] Upland rice is being introduced in the higher altitude farming system.

sales value of about Birr 1566. About 28% of households sold 61-75% of their rice produce, while about 26% sold more than 90% of their rice produce, and 22% sold 46-60% (Figure 2).

Haricot bean

Haricot bean is an important market oriented commodity in the districts of Alaba ad Dale. About 62% of households produce haricot beans in the study area, on about 13% of total cultivated land. A household allocates about a third of a hectare of land for haricot bean production. About 46% of haricot bean production is sold, suggesting that haricot bean is also an important component of the household food basket. On average a household sold about 94 kg of haricot bean for a sales value of about Birr 108. The proportion of haricot been sold is more evenly distributed by the proportion of households selling. About 25% of households sell only 0-15 of their produce, while about 20% sold 91-100% of their produce (Figure 3).

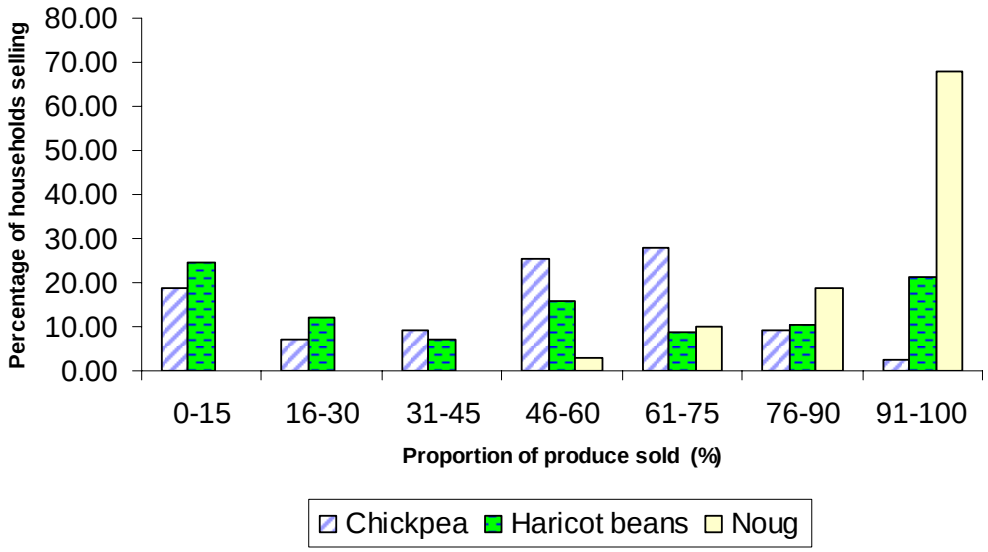

Figure 3: Percentage of produce sold by percentage of household selling for chickpea, haricot beans and Niger seed

Chickpea

In the study area, chickpea is produced by about 20% of the households, on about 3% of the total cultivated area. On average a household allocates about 0.53 ha of land for chickpea. A household also sold about 456 kg of chickpea, about 46% of total chickpea produce, for a total revenue of Birr 800. The mode in the proportion of chickpea produce sold is 61-70% (about 28% of households selling), followed by 46-60%. About half of the households sold 46-75% of their chickpea produce (Figure 3).

Niger seed

Niger seed is an important market oriented oil crop in the two farming systems of the Fogera district. About 28% of households in the district produce niger seed on about 9% of the total cultivated land. A household allocates an average of 0.42 ha of land to niger seed production. During the study period, a household sold about 92% of its niger seed produce, or about 200 kg, for a revenue of Birr 565. No household sold less than 46% of its Niger seed produce, and about 65% of households sold 91-100% of their Niger seed produce (Figure 3).

Market Places[4]:

Teff

The most important market places for teff producers are the nearest market outside the PA (where about 45% of households sold their teff produce) and the district town markets (where about 38% of producers sold teff) (Figure 2). Markets outside woreda and regional markets are not important for teff producers in the study area. The average distance to teff market in the study area is 2 walking hours.

[4] Market places were classified into five: markets that exit in the PA where the household lives (Market in PA), markets in nearby PAs within the same district (Nearest market outside PA), markets located at district capital towns (district town markets), markets located at other districts (markets outside district), and markets located at regional capital towns (Regional markets).

Table 2: Producer market places (proportion of households selling) and average distance (SE))

	Teff	Wheat	Rice	Haricot beans	Chick pea	Niger seed
Market in PA	16 (0.03)	20 (0.04)	4 (0.04)	22 (0.07)	17 (0.06)	19 (0.05)
Nearest market outside PA	45 (0.04)	66 (0.05)	19 (0.09)	38 (0.08)	46 (0.09)	24 (0.05)
District town markets	38 (0.04)	13 (0.04)	74 (0.09)	38 (0.08)	37 (0.08)	51 (0.06)
Markets outside district	1 (0.01)	1 (0.01)	0	2 (0.03)	0	4 (0.03)
Average distance (walking hours)	2.1 (0.31)	1.5 (0.14)	1.9 (0.19)	1.4 (0.17)	1.5 (0.14)	2.5 (0.41)
Regional markets	0	0	0	0	0	0

Wheat

As in teff, the most important market place for wheat producers in the study area are the nearest market outside PA, where about 66% of producers sold their wheat. However, district town markets were not as important for wheat as they are for teff. Hence, the second most important market for producers is markets in PA (where about 20% of producers sold wheat), followed by district town markets (where about 11% of producers sold wheat) (Table 2). Markets outside district and regional markets are not important for wheat producers, as is the case with teff. The average distance to market for wheat is 1.5 walking hours.

Rice

Unlike in the case of teff and wheat, the most important market place for rice are the district town markets (where about 74% of the households sell the commodity), followed by the nearest market outside PA (where 19% of households sell rice) (Table 2). A small proportion of households use markets in PA to sell their rice. The average distance to market place for rice is about 2 walking hours.

Haricot bean

Nearest market outside PA and district town markets are equally important for haricot bean producers. About 38% of households sell in each of these markets. Markets in PA are the next important market places, where about 22% of haricot bean

producers sell their haricot bean produce. As in teff, wheat, and rice, markets outside district and regional markets are not important for haricot bean producers. The average distance to the market place for haricot bean is about 1.5 walking hour.

Chickpea

The most important market place for chickpea producers are nearest market outside PA (where about 46% of producers sell their produce), followed by district town markets (where about 38% of producers sell their chickpea produce). Markets in PA are used by about 17% of households. The average distance to chickpea market place is 1.5 walking hour.

Niger seed

In the study area, district town markets are the most important market places used by niger seed producers (about 51% of producers use this market place). Nearest markets outside PA and markets in PA account for about 24% and 19% of producers, respectively. The average distance to Niger seed market is 2.5 walking hours.

Market outlets

Teff

On average across the farming systems, about 65% of producers of teff sold to wholesalers, followed by retailers (31%), and only about 2% of teff producers sold directly to consumers (Table 3). The role of rural assemblers and processors in the teff market chain is quite insignificant. Hence, the most important market channels for teff producers appear to be producer → wholesaler, and producer → retailer. All teff is sold in cash.

Table 3: Producer market channels (proportion of households selling (%) (SE))

	Teff	Wheat	Rice	Haricot beans	Chick pea	Niger seed
Rural assembler	2 (0.01)	0	13 (0.07)	11 (0.05)	4 (0.04)	4 (0.03)
Wholesaler	65 (0.04)	51 (0.06)	35 (0.10)	51 (0.08)	54 (0.10)	49 (0.06)
Retailer	31 (0.04)	43 (0.06)	22 (0.09)	22 (0.07)	42 (0.10)	32 (0.06)

Processor	0	0	22 (0.09)	0	0	15 (0.04)
Consumer	2 (0.01)	6 (0.03)	8 (0.06)	16 (0.06)	0	0

Wheat

Wholesalers and retailers are the most important buyers for wheat producers. On average, about 51% of producers sold to wholesalers, 43% sold to retailers, and 6% sold directly to consumers (Table 3). It is interesting to note that no producer sold to rural assemblers or processors. Hence, as in teff, the important market channels for wheat producers were producer → wholesaler, and producer → retailer. As with teff, wheat sale is effected only in cash.

Rice

The market channel for rice seems to be broader than other crops, except niger seed. About 35% of households sold to wholesalers, and 22% of households sold to retailers and processors each (Table 3). While about 13 % sold to rural assemblers, the remaining 8% sold directly to consumers. Hence, the important market channels for rice producers appear to be producer → wholesaler , producer → processor, producer →retailer, producer → rural assembler, and producer → consumer. As with teff and wheat, rice sale is effected only in cash.

Haricot bean

About 51% and 22% of haricot bean producers sell their haricot bean produce to wholesalers and retailers, respectively (Table 3). Direct sale to consumers is more important for haricot bean than for other crops. About 16% of haricot bean producers sell directly to consumers. About 11% sell to rural assemblers. No sales was made to processors. Hence, the important market channels for haricot bean producers are producer → wholesaler, producer → retailer, producer → consumer and producer → rural assembler. Almost all haricot bean sales are effected in cash.

Chickpea

As in wheat, there are only three buyers of chickpea from producers in the study area. Wholesalers are the most important buyers (accounting for about 51% of

producers), followed by retailers (accounting for about 42% of sellers) (Table 3). Only about 4% of producers sell to rural assemblers, and no producer made sales to processors or consumers. Hence, the important market channels for chickpea producers are producer →wholesaler, producer → retailer, and producer → rural assembler. All chickpea sales were effected in cash.

Niger seed

As with rice, the niger seed market channel is broader than the other crops. Although wholesalers and retailers remain to be the most important buyers of niger seed from producers, processors are also of some significance because of the processing requirements of the commodity (Table 3). About 49% and 32% of producers sell to wholesalers and retailers, respectively, while about 15% sell to processors. Only about 4% sell directly to rural assemblers. No sales is effected directly to consumers. Hence, the important market channels for Niger seed producers are producer→ wholesaler, producer → retailer, and producer →processor.

Determinants of market participation

Teff

At the community level, proportion of households who produce teff is explained positively by the size of cultivated land per household, but negatively by proportion of female headed households (Table 4). The explanation for the negative association between the proportion of female household heads and proportion of households producing teff can not be explained by resource endowment or household labor supply since we are controlling for these factors. Perhaps, women headed households do not have comparative advantage in commercializing in the laborious teff crop production Availability of cultivated land is associated with higher proportion of households producing the market oriented commodity, due to the land scarcity and also the land market imperfection that exist in the study areas.

The proportion of area covered by teff is explained positively by daily wage of agricultural labor, and availability of credit service, but negatively by the amount of rainfall. Higher opportunity cost of labor as reflected in higher wage rates appears to induce communities to shift to market oriented commodities, consistent with the findings reported in Pingali and Rosegrant (1995) and von Braun and Kennedy

(1994). Availability of credit service, by easing liquidity constraints of households, also contributes to market orientation in teff. The negative association between rainfall and proportion of area covered with teff may be due to the water logging problem that results from high rainfall and heavy vertisols in the study area. Interestingly, non of the market access factors have significant impact on either the proportion of households who produce teff or the proportion of cultivated land covered by teff.

Table 4: Community level regression results for proportion of households producing Teff (interval regression) and proportion of area covered by Teff (OLS)

Variable	Proportion of households producing (interval regression)	Proportion of area covered by teff (OLS)
Nearest market place (km)	-0.00356 (0.00421)	-0.00118 (0.00217)
Nearest market town (km)	0.00342 (0.00249)	-0.00052 (0.00119)
Rainfall (mm)	-0.00059 (0.00043)	-0.00104 (0.00028)***
Average adult male daily local wage during peak season (birr)	0.00675 (0.00442)	0.00917 (0.00330)***
Proportion of female household head (%)	-1.05803 (0.30424)***	-0.22079 (0.18567)
Population density (persons/ha)	-0.01337 (0.03192)	0.00145 (0.02055)
Cultivated land per household	0.04366 (0.02330)*	0.00475 (0.01690)
Number of bullocks per household	-0.00922 (0.01556)	0.01382 (0.00869)
Number of other livestock per household	-0.00102 (0.00474)	-0.00169 (0.00292)
Average altitude (meter)	-0.00017 (0.00015)	0.00004 (0.00013)
Credit service availability in the PA	0.10398 (0.02921)	0.11408 (0.03138)***
Market info service available in the PA	-0.05831 (0.04952)	0.00250 (0.02395)
Constant	1.74229 (0.39852)***	1.09244 (0.28506)***
Chi^2/F	80.43	26.17
Prob > Chi^2/F	0.0000	0.0000
R^2	-	0.7087
Number of observation	85	84

Household level regression analysis also shows that household decision to produce teff, and the proportion of teff produce sold given the decision to produce, are explained by a host of community level factors, household characteristics, and access to services (Table 5). The Probit model shows that household decisions to produce teff is explained positively by the number of dependent children, household labor supply, number of bullocks owned, involvement in extension, and amount of rainfall. The decision is explained negatively by population density, household size, and cows owned. All significant variables in the Probit model have the expected signs.

Table 5: Household level regression results for decision to produce Teff (Probit) and proportion of produce sold (Interval regression)

	Household decision to produce teff (Probit marginal effects)	Proportion of teff produce sold (interval regression)
Population density (persons/ha)	-0.00016 (0.00044)***	0.06758 (0.02107)***
Nearest market place (km)	-0.00002 (0.00005)	0.00234 (0.00327)
Nearest market town (km)	0.00001 (0.00002)	0.00005 (0.00181)
Age of household head	-0.00005 (0.00013)*	-0.01499 (0.00570)***
Age squared	0.000006 (0.00000)**	0.00012 (0.00006)**
If household head is male	0.00330 (0.00694)	-0.01173 (0.04394)
If household head is literate	-0.00025 (0.00060)	0.02092 (0.03018)
Household size (no)	-0.00023 (0.00065)***	0.01139 (0.02663)
Children (<14 years old) (no)	0.00026 (0.00073)***	-0.01672 (0.02969)
Number of labor supply	0.00021 (0.00060)**	-0.01156 (0.02752)
Land owned (1/4 ha.)	0.00001 (0.00002)	0.00735 (0.00367)**
Bullocks owned (no)	0.00011 (0.00029)**	0.02696 (0.01296) **
Sheep & goats owned (no)	-0.00001 (0.00003)	-0.00727 (0.00425)*
Other cattle owned (no)	-0.00003 (0.00008)**	0.00161 (0.00585)
Equine owned (no)	0.00005 (0.00016)*	0.02374 (0.01741)
Chicken owned (no)	0.00000 (0.00001)	0.00088 (0.00365)
Involvement in extension (2003/04) (0/1)	0.00188 (0.00409)**	-0.07250 (0.03889)*
Access to credit (2003/04) (0/1)	-0.00006 (0.00019)	-0.25135 (0.04766)***

Rainfall (mm)	0.000003 (0.00001)***	0.00096 (0.00034)**
Average altitude (meter)	-0.000001 (0.00000)***	---
Nearest milling service (km)	0.00001 (0.00003)	---
Inverse mills ratio (IMR)	---	-0.00651 (0.05847)
Constant	4.86453 (8.26494)	0.05736 (0.37421)
F	1.58	16.36
Prob > F	0.0609	0.0000
Number of observation	164	156

Higher number of children dependents implies higher need for cash to cover household expenditures related with children such as school fees and other expenses, inducing households to grow market oriented commodities. Teff is a labor demanding crop and requires multiple rounds of land preparation. Hence, households with higher family labor supply and more traction power are more likely to grow it, given the labor and traction power market imperfection in the study area. Involvement in extensions increases likelihood of growing teff, since teff is one of the crops for which a few improved varieties are available from the national research system and has received attention from the extension service. Higher amount of rainfall encourages households to grow teff for obvious reasons.

Population density is associated negatively with growing teff. Perhaps, more densely populated areas in the highlands of Ethiopia suffer from higher land degradation resulting in low soil fertility and thus reducing the probability of growing teff since it requires relatively good and fertile soils. Larger households have higher household consumption needs and perhaps are more likely to produce cheaper but more productive staple food crops relative to teff. Higher ownership of cows appears to detract from teff production, perhaps by offering an alternative income source to households.

We find U-shaped relationship between age and probability of growing teff. The turning point on this relationship is 38 years, well within the age range of household heads in the sample. The U-shaped relationship between age and probability of growing teff may indicate variations in consumption preferences of households. However, this is a tentative explanation for an unexpected results and requires further testing.

Interval regression results show that the determinants of the proportion of teff produce sold are generally consistent with the determinants of household decision to grow the crop (Table 5). The proportion of teff produce sold is explained positively by ownership of land and traction power, population density, and amount of rainfall, while it is negatively explained by ownership of shoats, involvement in extension and availability of credit.

That population density is negatively associated with household decision to grow teff while it is positively associated with proportion of teff produce sold indicates that given the decision to grow teff, households in high population density areas offer higher amount of their teff produce to market, perhaps to cover for variable expenses such as fertilizer required to make up for the low soil fertility due to higher land degradation. Given the imperfections in the land market and land scarcity that prevails in the area, households with higher land ownership offer higher proportion of their teff produce for sale, as is also the case with traction power. In the presence of factor market imperfections, ownership of the resource increases efficiency. Households who live in areas of higher rainfall sell higher proportion of their teff produce, perhaps due to the effect of rainfall on teff productivity and thus production. None of the market access factors have significant impact on either the probability of household growing teff or the proportion of teff produce sold.

Contrary to expectation, we find an inverse relationship between involvement in extension and access to credit and proportion of teff sold, although involvement in extension is associated with higher probability of producing teff. Investigation of the nature of the extension and credit services are required to explain these unexpected results. Consistent with the result for the probability of growing teff, we also find U-shaped relationship between age and the proportion of teff produce sold. The turning point in this relationship is 65 years, within the age distribution of sample households. About 11% of household heads are 65 or more years old. The IMR is insignificant indicating little sample selection problem.

Wheat

At the community level, proportion of households producing teff is positively explained by agricultural labor wage rate, cultivated land per household, and availability of credit, while it is negatively explained by proportion of female headed households in community, and availability of market information service (Table 6).

Similarly, proportion of area covered by wheat is explained positively by agricultural labor wage, ownership of traction power, and availability of credit, and negatively by the proportion of female headed households in community. All variables except availability of market information service have the expected signs. As in teff, none of the market access factors have significant effect.

Table 6 : Community level regression results for proportion of households producing Wheat (interval regression) and proportion of area covered under Wheat (OLS)

	proportion of households producing (Interval regression)	OLS (proportion of area covered)
Distance to nearest market place (km)	0.0001 (0.0057)	0.0006 (0.0019)
Distance to nearest market town (km)	0.0027 (0.0024)	-0.0003 (0.0009)
Rainfall (mm)	0.0007 (0.0007)	-0.0003 (0.0003)
Average adult male daily local wage (Birr)	0.0115* (0.0059)	0.0053** (0.0023)
Proportion of female headed households	-0.7242** (0.3188)	-0.1890* (0.1083)
Population density (persons/ha)	-0.0255 (0.0479)	-0.0057 (0.0123)
Cultivated land per household (0.25ha/household)	0.0851** (0.0262)	0.0071 (0.0101)
Number of bullocks per household	0.0099 (0.0267)	0.0207** (0.0102)
Number of other livestock per household	-0.0060 (0.0100)	-0.0051 (0.0035)
Average altitude (meter)	-0.0001 (0.0002)	0.0002** (0.0001)
If credit service is availability in the PA	0.1427** (0.0644)	0.0883*** (0.0246)
If market information service is available in the PA	-0.1040** (0.0474)	0.0002 (0.0181)
Constant	-0.1271 (0.4695)	0.0446 (0.1934)
Chi^2/F	99.56	9.95
Prob > Chi^2/F	0.0000	0.0000
R^2	----	0.61
Number of observation	73	73

Increased opportunity cost of labor induces households to be profit oriented and commercialize. Given the imperfections in the land and traction power markets in the study area, households with higher cultivated land and more traction power tend to be more market oriented in wheat. Availability of credit services appears to play role

in enhancing market orientation by easing credit constraint of liquidity constrained households. Wheat is also laborious crop and female headed households may not have comparative advantage in producing it. A deeper analysis of the market information service provided at community level is required to explain the unexpected effect of the variable, including possibilities of measurement error.

Household level regressions of the determinants of probability household decision to produce wheat show that male headed households and households involved in extension program are more likely to produce wheat (Table 7). On the other hand, literacy of household heads detracts from household decision to produce wheat, perhaps because literate households have higher opportunity cost of their labor in other farm enterprises or off-farm employment.

Household level regression of the determinants of the proportion of wheat produce sold, given decision to produce, shows that the decision is positively explained by number of dependent children, labor supply, land ownership, ownership of equines, and rainfall, while it is negatively explained by household size and access to credit. All variables except credit access have the expected signs (Table 7).

Table 7: Household level regression results for decision to produce Wheat (Probit) and proportion of wheat produce sold (Interval regression)

	Household decision to produce wheat (Probit marginal effects)	Proportion of produce sold (interval regression)
Population density (persons/ha)	0.03931 (0.04825)	-0.01529 (0.02483)
Nearest market place (km)	0.01477 (0.00975)	-0.00874 (0.00534)
Nearest market town (km)	-0.00107 (0.00370)	-0.00249 (0.00246)
Age of household head	-0.00646 (0.01604)	-0.00971 (0.00806)
Age squared	0.00000 (0.00015)	0.00013 (0.00007)
If household head is male	0.27912 (0.16376)*	0.00430 (0.10003)
If household head is literate	-0.30222 (0.09930)***	0.04658 (0.06805)
Household size (no)	0.03637 (0.06429)	-0.09402 (0.03767)**
Children (<14 years old) (no)	0.00094 (0.06758)	0.07675 (0.03726)**
Number of labor supply	-0.01067 (0.06265)	0.07917 (0.03906)**
Land owned (1/4 ha.)	0.00969 (0.00928)	0.01161 (0.00465)**
Bullocks owned (no)	0.03570 (0.02620)	0.02382 (0.01818)
Sheep & goats owned (no)	-0.01650 (0.01129)	-0.00219 (0.00928)
Other cattle owned (no)	-0.00497 (0.01215)	-0.00244 (0.00692)
Equine owned (no)	0.00548 (0.03534)	0.06578 (0.03033)**
Chicken owned (no)	-0.00078 (0.00814)	0.00768 (0.00440)*
Involvement in extension (2003/04) (0/1)	0.31097 (0.14180)**	0.03165 (0.09419)
Access to credit (2003/04) (0/1)	-0.10719 (0.07912)	-0.45278 (0.08123)***
Rainfall (mm)	0.00098 (0.00123)	0.00102 (0.00044)**
Average altitude (meter)	0.00034 (0.00032)	---
Nearest milling service (km)	-0.01779 (0.00835)**	---
Inverse mills ratio (IMR)	---	0.07824 (0.15766)
Constant	-6.38198 (4.23557)	-0.09254 (0.59325)
F	2.14	9.22
Prob > F	0.0058	0.0000
Number of observation	138	106

Number of dependents increases the need for cash to cover expenses related to services associated with children. Availability of labor supply and cultivated land increase market orientation in wheat due to their effect on production efficiency as a result of imperfections in these factor markets. Equines are used for transportation of produce to market, thus reducing marketing costs to households who own them. Rainfall also increases proportion sold due to its effect on production. The negative association between household size and proportion of wheat produce sold is perhaps due to the higher domestic consumption needs of larger households. The negative association of credit service with proportion of wheat sold was not expected, especially since credit service is associated with higher proportion of households producing the market oriented crop and the proportion of area covered by the commodity. A closer investigation of the credit service is required to explain this unexpected result. The IMR is insignificant indicating little sample selection problem.

Chickpea

Community level regression shows that the proportion of households producing chickpea is positively explained by amount of rainfall, adult labor wage, and cultivated land per capita (Table 8). There was no variable that explains proportion of households producing chickpea negatively. Similarly, the proportion of area covered by chickpea is explained positively by cultivated land per household, and negatively by distance to nearest market town.

Similar to the effect on teff and wheat, higher opportunity cost of labor appears to induce market orientation in chickpea production. Availability of land is also clearly an important constraint in market oriented chickpea production. Distance to market appears to be important for market oriented chickpea production because of its impact on marketing costs.

Table 8: Community level regression results for proportion of households producing chickpea and proportion of area covered by chickpea (interval regressions)

Variable	Interval (proportion of households producing)	Interval (proportion of area covered)
Nearest market place (km)	-0.00185 (0.00687)	-0.00053 (0.00094)
Nearest market town (km)	-0.00409 (0.00299)	-0.00096 (0.00050)*
Rainfall (mm)	0.00051 (0.00023)**	0.00006 (0.00005)
Average adult male daily local wage during peak season (birr)	0.01320 (0.00711)*	0.00163 (0.00132)
Proportion of female household head (%)	-0.40688 (0.32012)	-0.03422 (0.05957)
Population density (persons/ha)	0.03053 (0.03878)	0.00768 (0.00829)
Cultivated land per household	0.11091 (0.01896)***	0.00901 (0.00365)**
Number of bullocks per household	-0.01067 (0.02784)	0.00236 (0.00320)
Number of other livestock per household	-0.00115 (0.00954)	-0.00162 (0.00113)
Average altitude (meter)	0.00026 (0.00013)**	-0.00001 (0.00003)
Credit service availability in the PA	0.01385 (0.06764)	0.00830 (0.01450)
Market info service available in the PA	0.05032 (0.06545)	0.00778 (0.01360)
Constant	-1.22348 (0.40575)***	-0.05609 (0.08821)
Chi^2/F	72.64	30.59
Prob > Chi^2/F	0.0000	0.0023
Number of observation	60	60

Household level regression shows that household decision to produce chickpea is positively explained by ownership of traction power, ownership of equines, and involvement in extension, while it is negatively explained by land ownership, ownership of shoats and cows (Table 9). Ownership of traction power increases efficiency in chickpea production, as is also true with teff and wheat, while ownership of equines reduces marketing costs. The extension service appears to be effective in inducing market oriented chickpea production in the study area. The negative association between land

ownership and household decision to produce chickpea was not expected. Further investigation is required to explain this unexpected result. Ownership of shoats and cows may be offering alternative sources of cash to the household.

Household regression also shows that the proportion of chickpea produce sold, given decision to produce, is positively explained by population density, dependent children, household labor supply, land ownership, and ownership of cows and poultry (Table 9). The proportion of chickpea produce sold is negatively explained by distance to market and household size, as expected, and ownership of traction power, contrary to expectation. Households in high population density areas sell higher proportion of their chickpea produce perhaps to cover variable costs associated with soil fertility amendment to make up for land degradation. The cash requirement associated with dependent children, and the efficiency effect of household labor supply and land ownership induce market orientation in chickpea production. Distance to market reduces proportion of chickpea produce sold by raising marketing costs. Larger households sell less proportion of their chickpea produce due to their higher domestic consumption requirements. The negative association between ownership of traction power and proportion of chickpea produce sold was not expected. Perhaps, households with higher traction power tend to grow crops that require multiple preparation of land such as teff and wheat.

Table 9: Household level regression results of household decision to produce chickpea (Probit) and proportion of chickpea produce sold (interval regression)

	Household decision to produce chickpea (Probit marginal effects)	Proportion of chickpea produce sold (Interval regression)
Population density (persons/ha)	-0.05619 (0.03173)	0.27767 (0.12080)**
Nearest market place (km)	0.00543 (0.00452)	-0.04369 (0.01085)***
Nearest market town (km)	-0.00009 (0.00222)	-0.00080 (0.00835)
Age of household head	0.02140 (0.01162)*	-0.19035 (0.04576)***
Age squared	-0.00018 (0.00012)	0.00178 (0.00041)***

If household head is male	0.01920 (0.05937)	-0.06498 (0.15416)
If household head is literate	-0.01120 (0.04347)	-0.05980 (0.08915)
Household size (no)	0.00131 (0.03985)	-0.32354 (0.12355)**
Children (<14 years old) (no)	0.02268 (0.04192)	0.27353 (0.13847)*
Number of labor supply	0.01711 (0.04015)	0.25468 (0.13266)*
Land owned (1/4 ha.)	-0.02441 (0.00595)***	0.08743 (0.03406)**
Bullocks owned (no)	0.03339 (0.01541)**	-0.14313 (0.06436)**
Sheep & goats owned (no)	-0.01279 (0.00755)	0.00891 (0.02840)
Other cattle owned (no)	-0.01908 (0.00937)**	0.09071 (0.04127)**
Equine owned (no)	0.06675 (0.02128)***	-0.10438 (0.08621)
Chicken owned (no)	0.00023 (0.00390)	0.02029 (0.00755)***
Involvement in extension (2003/04) (0/1)	0.09315 (0.04705)**	-0.15818 (0.25928)
Rainfall (mm)	0.00027 (0.00018)	-0.00066 (0.00085)
Average altitude (meter)	-0.00019 (0.00009)**	---
Nearest milling service (km)	0.00001 (0.00457)	---
Inverse mills ratio (IMR)	---	-1.01738 (0.40308)**
Constant	-4.45431 (2.59574)*	7.05996 (2.20475)***
F	3.19	12.28
Prob > F	0.0000	0.0000
Number of observation	213	43

Niger seed

Community level regression shows that proportion of household producing niger seed and proportion of area covered by niger seed are explained positively by non-traction power livestock holding per household and altitude, while the proportion of household producing niger seed is explained negatively by distance to nearest market place (Table 10). No variable explained the proportion of area covered by niger seed negatively.

Table 10: Community level regression results of the proportion of household producing Niger seed and the proportion of area covered by Niger seed (OLS regressions).

Variable	OLS (proportion of households producing)	OLS (proportion of area covered)
Nearest market place (km)	-0.01793 (0.00772)**	-0.00392 (0.00242)
Nearest market town (km)	0.00127 (0.00809)	0.00208 (0.00146)
Rainfall (mm)	-0.00040 (0.00151)	-0.00018 (0.00026)
Average adult male daily local wage during peak season (birr)	-0.01256 (0.02080)	0.00150 (0.00538)
Proportion of female household head (%)	-0.27533 (0.64413)	-0.30239 (0.30152)
Population density (persons/ha)	-0.03560 (0.03955)	0.01327 (0.01642)
Cultivated land per household	0.11233 (0.13939)	0.07395 (0.04575)
Number of bullocks per household	-0.21314 (0.28063)	-0.18715 (0.07433)**
Number of other livestock per household	0.16343 (0.07273)**	0.05955 (0.01843)***
Average altitude (meter)	0.00115 (0.00046)**	0.00018 (0.00014)
Credit service availability in the PA	-0.11543 (0.09980)	-0.04972 (0.04647)
Market info service available in the PA	0.14962 (0.08935)	0.01603 (0.03143)
Constant	-1.40377 (1.75439)	-0.09570 (0.41733)
Chi^2/F	12.64	10.18
Prob > Chi^2/F	0.0001	0.0003
R^2	0.7587	0.6658
Number of observation	25	24

Household level Probit regression show that household decision to grow niger seed in the study area is explained positively by ownership of equines and involvement in extension service, but negatively by number of dependent children, ownership of land, and amount of rainfall (Table 11). The negative association between household decision to grow niger seed and number of dependent children and land ownership is unexpected.

Household level regression of the proportion of niger seed produce sold, given the decision to produce, is explained positively by population density, number of dependent children, household labor supply, all with expected signs (Table 11). The high cash requirements associated with dependent children, the efficiency effect of household labor supply, and the factor scarcity due to population density increases market orientation of households in niger seed. The proportion of Niger seed produce sold is also negatively explained by distance to market and household size as expected, and by equine ownership contrary to expectation. Marketing costs associated with distance are clearly important for household decision on the proportion of niger seed produce sold, and household size reduces proportion sold due to the domestic consumption requirements.

Table 11: Household level regressions of household decision to produce Niger seed (Probit) and the proportion of Niger seed produce sold (interval regression)

	Household decision to produce Niger seed (Probit marginal effects)	Proportion of Niger seed produce sold (interval regression)
Population density (persons/ha)	0.02199 (0.06425)	0.03771 (0.01983)*
Nearest market place (km)	0.00043 (0.01030)	-0.00513 (0.00253)**
Nearest market town (km)	0.01660 (0.00930)	-0.00105 (0.00503)
Age of household head	0.00047 (0.03005)	0.01564 (0.01244)
Age squared	-0.00011 (0.00030)	-0.00018 (0.00012)
If household head is male	-0.01640 (0.16438)	0.02794 (0.06017)
If household head is literate	-0.08069 (0.11139)	-0.03840 (0.04255)
Household size (no)	0.12339 (0.08847)	-0.10083 (0.03235)***
Children (<14 years old) (no)	-0.20818 (0.09535)**	0.07858 (0.03556)**
Number of labor supply	-0.11504 (0.10159)	0.08007 (0.03926)**
Land owned (1/4 ha.)	-0.05926 (0.02902)**	-0.01287 (0.01578)
Bullocks owned (no)	-0.00495 (0.07681)	0.03435 (0.02572)
Sheep & goats owned (no)	0.04025 (0.02485)	0.01207 (0.00799)
Other cattle owned (no)	0.03440 (0.02659)	0.00956 (0.00804)

Equine owned (no)	0.21104 (0.09720)**	-0.05110 (0.02527)**
Chicken owned (no)	0.01354 (0.01010)	-0.00577 (0.00339)*
Involvement in extension (2003/04) (0/1)	0.31765 (0.12786)**	0.07017 (0.04357)
Access to credit (2003/04) (0/1)	-0.17035 (0.10609)	0.00259 (0.07279)
Rainfall (mm)	-0.00494 (0.00175)***	-0.00079 (0.00054)
Average altitude (meter)	0.00180 (0.00064)***	---
Nearest milling service (km)	-0.00670 (0.01482)	---
Inverse mills ratio (IMR)	---	0.07624 (0.08563)
Constant	8.43688 (6.46638)	1.62036 (0.70568)**
F	1.64	3.03
Prob > F	0.0580	0.0009
Number of observation	108	67

Conclusions and Implications

Teff, wheat, rice, haricot beans, chickpea, and niger seed are important market oriented crops in the respective study areas. About 60%, 47%, 50%, 46%, 46%, and 92% of produce of teff, wheat, rice, haricot beans, chickpea and niger seed are sold by producers of the commodities, respectively. Except niger seed, these commodities are important both as sources of cash to the household and as food crops. Being an oil crop, niger seed is almost entirely produced for the market, with some amount consumed at home. About 77%, 64%, 72%, 62%, 20% and 28% of households in the respective study areas produce teff, wheat, rice, haricot beans, chickpea and niger seed, respectively.

Wholesalers are the most important buyers of these commodities from producers, followed by retailers, and rural assemblers. Wholesalers and retailers together account for 96%, 94%, 57%, 77%, 96% and 81% of producer sales of teff, wheat, rice, haricot beans, chickpea and niger seed, respectively. Processors are important buyers of rice and niger seed from producers, and consumers are important buyers of haricot beans.

The important market places for buyers to sell these commodities are either those located at the district towns or in the peasant associations (PAs) within the districts.

District town markets are especially important for rice, haricot beans and niger seed. Markets outside of the districts and regional markets are rarely used by producers. The average distance to markets where producers sell their produce is about 2 walking hours. These results imply that market interventions to improve the gains to producers need to target district level markets. Almost all sales are effected in cash.

Community and household level econometric results show that market orientation of smallholders is affected by household demographic factors, human capital, physical capital, institutional support services, distance to market, and the village level factors of population density, agricultural labor wage and rainfall. Female headed households are less likely to grow the market oriented cereal crops of teff and wheat, perhaps due to low comparative advantage in such laborious crops. Moreover, female headed households have no positive association with any of the market orientation indicators used in this study. These results imply that special attention is required to female headed households in the process of commercial transformation of subsistence agriculture. The comparative advantage of female headed households may not be in grain production.

Household size is associated negatively with many of the market orientation indicators, with no positive association with any indicator. This suggests that larger households have higher household consumption needs, and so are more likely to grow cheaper but more productive subsistence crops, and sell less proportion of their produce. Hence, population control measures may contribute to commercial transformation of subsistence agriculture through its effect of reducing household subsistence requirements.

Number of child dependents, through its effect on cash need to cover expenses related with children, appears to induce market orientation. We find evidence of an U-shaped relationship between age of household head and market orientation of households in teff and chickpea, indicating the increasing preference for self sufficiency during the initial years and a shift to market orientation as the household gets older.

Given the scarcity of land and the imperfections in the factor markets of land, labor and traction power, endowment of these resources explained market orientation significantly positively. Hence, improving the operations of factor markets of land, traction and farm labor could contribute to enhancing market orientation of farm

households. Alternatively, institutional arrangements to improve household access to land and traction power could contribute to market orientation of households.

Access to markets as measured by distance to market places does not effect market orientation of households in teff and wheat, but detract from market orientation in chickpea and niger seed. The study areas for teff and wheat are relatively plain lands and infrastructure is relatively better developed compared with the study areas for chickpea and Niger seed. Hence, market access remains an important factor for market orientation of households, implying the need for interventions to develop market infrastructure.

Among the village level factors, we find population growth to have mixed effects on market orientation. While population density detracts from the probability to produce teff and chickpea, it is associated positively with proportion of teff and chickpea produce sold. These results indicate that land degradation due to population pressure reduces the probability of producing teff and chickpea, but once decision to produce is made, proportion of produce sold is higher in order to cover variable costs associated with land preparation and soil fertility management. Wage of farm labor, by increasing the opportunity cost of labor, appears to induce market orientation.

The effect of extension and credit services in household market orientation is mixed. Involvement in extension service is positively associated with household probability of growing the market oriented commodities, but has negative impact on the proportion of teff produce sold. While availability of credit at the community level is positively associated with proportion of households who produce the market oriented commodities and the proportion of area covered by the commodities, household use of the credit service has negative impact on the proportion of teff and wheat produce sold. Deeper investigation into the nature of the credit service is required to offer explanations. The extension and credit services that were designed to achieve food security objectives need to be re-examined to adopt them to the policy of commercial transformation of subsistence agriculture Ethiopia is following. In particular, the institutionalization and development of marketing extension services warrants emphasis.

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Annex 1: Descriptive statistics of explanatory variables used in community level regressions

1.1 Teff and wheat

Variables	Teff					Wheat				
	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
Nearest market place (km)	86	6.52	5.15	0.00	25.00	74	6.42	4.71	0.00	21.00
Nearest market town (km)	86	11.86	7.92	0.50	37.00	74	13.78	9.96	0.50	47.00
Rainfall (mm)	87	980.79	72.13	858.00	1108.00	73	931.86	48.33	858.00	1080.00
Average adult male daily local wage during peak season (birr)	87	11.88	4.34	5.50	23.00	74	12.64	4.64	5.00	23.00
Proportion of female household head	86	0.17	0.08	0.04	0.37	74	0.13	0.07	0.03	0.40
Population density	87	2.13	1.13	0.19	6.76	73	1.82	1.07	0.19	5.81
Cultivated land per household	87	2.67	1.54	0.68	6.81	74	2.97	1.48	0.93	6.81
Number of bullocks per household	87	1.26	1.57	0.00	12.90	74	1.54	1.62	0.00	12.90
Number of other livestock per household	87	4.38	4.82	0.00	35.54	74	5.37	5.22	0.00	35.54
Average altitude (meter)	87	1859.87	125.20	1603.00	2264.00	73	1866.06	148.59	1603.00	2264.00
Credit service availability in the PA	87	0.66	0.48	0.00	1.00	74	0.64	0.48	0.00	1.00
Market info service available in the PA	87	0.60	0.49	0.00	1.00	74	0.61	0.49	0.00	1.00

1.2 Chickpea and haricot beans

Variables	Chick pea					Haricot beans				
	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
Nearest market place (km)	60	6.52	5.19	0.00	21.00	73	5.22	4.70	0.00	25.00
Nearest market town (km)	60	13.13	8.72	0.50	37.00	73	9.66	6.30	0.50	27.00
Rainfall (mm)	60	886.20	180.88	493.00	1244.00	74	1050.24	153.90	623.00	1216.00
Average adult male daily local wage during peak season (birr)	60	13.13	4.34	6.50	23.00	74	9.23	3.62	2.00	22.50
Proportion of female household head (%)	60	0.18	0.11	0.04	0.48	71	0.21	0.10	0.02	0.46
Population density (persons/ha)	60	1.49	0.87	0.19	5.54	74	3.19	1.24	0.91	6.76
Cultivated land per household	60	2.73	1.79	0.00	6.81	74	1.27	0.53	0.29	3.76
Number of bullocks per household	60	1.53	1.78	0.00	12.90	74	0.43	0.45	0.00	2.46
Number of other livestock per household	60	4.74	5.52	0.00	35.34	74	2.59	1.67	0.00	8.88
Average altitude (meter)	60	1999.03	308.90	1603.00	2786.00	74	1762.45	129.64	1393.00	1973.00
Credit service availability in the PA	60	0.83	0.38	0.00	1.00	74	0.31	0.47	0.00	1.00
Market info service available in the PA	60	0.67	0.48	0.00	1.00	74	0.39	0.49	0.00	1.00

Table: Descriptive statistics of explanatory variables used in community level regression

1.3 Niger seed

Variables	Noug			
	N	Mean	Std. Dev.	Min	Max
Nearest market place (km)	25	6.22	5.93	0.00	24.00
Nearest market town (km)	25	13.29	6.25	0.25	24.00
Rainfall (mm)	25	1,215.52	41.32	1,133.00	1,286.00
Average adult male daily local wage during peak season (birr)	25	10.20	1.98	6.50	13.00
Proportion of female household head (%)	25	0.16	0.06	0.02	0.33
Population density (persons/ha)	25	2.78	0.90	1.51	5.41
Cultivated land per household	25	1.16	0.44	0.00	2.08
Number of bullocks per household	25	0.78	0.31	0.09	1.81
Number of other livestock per household	25	2.21	0.96	0.59	5.60
Average altitude (meter)	25	1,900.08	100.57	1,789.00	2,139.00
Credit service availability in the PA	25	0.80	0.41	0.00	1.00
Market info service available in the PA	25	0.84	0.37	0.00	1.00

Annex 2: Descriptive statistics of explanatory variables used in household level regressions

2.1 Teff and wheat

Variables	Teff					Wheat				
	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
Population density	170	2.08	1.10	0.19	6.76	140	1.82	1.09	0.19	5.81
Nearest market place (km)	167	6.29	5.22	0.00	25.00	141	6.35	5.07	0.00	21.00
Nearest market town (km)	167	11.96	7.96	0.50	37.00	141	14.27	9.69	0.50	45.00
Age of household head	170	43.35	14.41	16.00	89.00	141	45.16	14.21	16.00	89.00
Age^2	170	2085.45	1403.84	256.00	7921.00	141	2239.61	1445.97	256.00	7921.00
Sex of household head	170	0.84	0.37	0.00	1.00	141	0.89	0.31	0.00	1.00
Proportion of household heads literate	170	0.43	0.50	0.00	1.00	141	0.38	0.49	0.00	1.00
Number of household size	170	6.99	2.94	1.00	22.00	141	6.94	2.99	1.00	22.00
Number of dependents	170	3.15	1.97	0.00	9.00	141	2.96	1.89	0.00	8.00
Number of labor supply	170	3.56	2.08	0.00	16.00	141	3.65	2.26	0.00	16.00
Land owned (1/4 ha.)	170	7.75	4.20	0.00	25.00	141	8.67	4.67	1.00	25.00
Number of bullocks	170	2.04	1.82	0.00	10.00	141	2.46	1.90	0.00	10.00
Number of sheep & goats	170	2.18	3.34	0.00	23.00	141	2.80	4.60	0.00	28.00
Number of other cattle	170	3.19	3.05	0.00	21.00	141	3.82	4.70	0.00	40.00
Number of equine	170	1.34	1.23	0.00	6.00	141	1.64	1.38	0.00	6.00
Number of local poultry	170	4.17	4.67	0.00	24.00	141	4.40	4.95	0.00	24.00
Involvement in extension (2003/04)	169	0.61	0.49	0.00	1.00	140	0.71	0.46	0.00	1.00
Access to credit (2003/04)	170	0.75	0.43	0.00	1.00	141	0.79	0.41	0.00	1.00
Rainfall (mm)	170	972.82	73.54	858.00	1108.00	140	928.26	42.45	858.00	1080.00
Average altitude (meter)	170	1864.87	124.42	1603.00	2264.00	140	1880.61	142.13	1603.00	2264.00
Nearest milling service (km)	165	3.87	4.72	0.00	21.00	140	4.62	5.28	0.00	21.00

2.2 Chickpea and haricot beans

Variables	Chick pea					Haricot beans				
	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
Population density (persons/ha)	43	1.52	0.57	0.40	3.02	57	3.58	1.51	0.91	6.76
Nearest market place (km)	43	6.37	4.76	0.00	20.00	56	4.47	4.25	0.00	18.00
Nearest market town (km)	43	12.41	5.79	0.50	28.00	56	10.15	6.79	0.50	27.00
Age of household head	43	47.05	11.47	30.00	80.00	57	38.00	13.01	19.00	70.00
Age squared	43	2341.88	1237.34	900.00	6400.00	57	1610.35	1115.29	361.00	4900.00
If household head is male	43	0.88	0.32	0.00	1.00	57	0.88	0.33	0.00	1.00
If household head is literate	43	0.51	0.51	0.00	1.00	57	0.54	0.50	0.00	1.00
Household size (no)	43	8.14	2.21	4.00	14.00	57	6.47	3.08	2.00	15.00
Children (<14 years old)	43	3.70	1.71	0.00	8.00	57	2.98	1.97	0.00	7.00
Labor supply (no)	43	4.16	1.95	2.00	10.00	57	3.30	1.91	0.00	10.00
Land owned (1/4 ha.)	43	7.13	2.82	1.00	16.00	57	5.08	3.96	0.00	18.25
Bullocks owned (no)	43	3.09	2.04	0.00	10.00	57	0.88	1.04	0.00	4.00
Sheep & goats owned (no)	43	1.79	2.23	0.00	8.00	57	2.58	3.68	0.00	22.00

Other cattle owned (no)	43	3.26	2.50	0.00	10.00	57	4.14	4.59	0.00	28.00
Equine owned (no)	43	1.95	1.53	0.00	6.00	57	0.51	0.76	0.00	3.00
Chicken owned (no)	43	4.51	5.03	0.00	24.00	57	2.19	2.18	0.00	9.00
Involvement in extension (2003/04) (0/1)	43	0.93	0.26	0.00	1.00	56	0.34	0.48	0.00	1.00
Access to credit (2003/04) (0/1)	43	1.00	0.00	1.00	1.00	57	0.40	0.49	0.00	1.00
Rainfall (mm)	43	954.60	104.28	877.00	1234.00	57	1076.23	144.62	667.00	1216.00
Average altitude (meter)	43	1934.44	124.31	1713.00	2264.00	57	1765.46	119.63	1393.00	1927.00
Nearest milling service (km)	43	4.54	5.21	0.00	20.00	55	4.22	4.61	0.00	20.00

2.3 Niger seed

Variables	Noug				
	N	Mean	Std. Dev.	Min	Max
Population density (persons/ha)	69	2.79	0.88	1.51	5.41
Nearest market place (km)	69	7.37	7.42	0.00	24.00
Nearest market town (km)	69	14.13	6.75	0.25	24.00
Age of household head	69	40.74	10.00	18.00	72.00
Age squared	69	1758.16	893.94	324.00	5184.00
If household head is male	69	0.90	0.30	0.00	1.00
If household head is literate	69	0.57	0.50	0.00	1.00
Household size (no)	69	6.58	2.22	1.00	13.00
Children (<14 years old)	69	2.75	1.46	0.00	6.00
Labor supply (no)	69	3.68	1.80	1.00	12.00
Land owned (1/4 ha.)	69	5.44	2.85	1.00	12.50
Bullocks owned (no)	69	1.81	1.15	0.00	5.00
Sheep & goats owned (no)	69	2.51	2.97	0.00	10.00
Other cattle owned (no)	69	4.64	3.82	0.00	23.00
Equine owned (no)	69	0.70	1.05	0.00	5.00
Chicken owned (no)	69	4.00	5.09	0.00	22.00
Involvement in extension (2003/04) (0/1)	67	0.73	0.45	0.00	1.00
Access to credit (2003/04) (0/1)	69	0.81	0.39	0.00	1.00
Rainfall (mm)	69	1215.38	43.28	1133.00	1286.00
Average altitude (meter)	69	1924.97	93.91	1789.00	2139.00
Nearest milling service (km)	69	5.01	5.28	0.00	15.00