STABLE FOOD CROPS TURNING INTO COMMERCIAL CROPS: CASE STUDIES OF TEFF, WHEAT AND RICE IN ETHIOPIA[1]

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Abstract

Teff, wheat and rice are becoming important market oriented crops in Ethiopia. This study aims at measuring the level of market orientation of households in these crops, identifying the important market places and market outlets used by producers, and analyzing the determinants of market orientation in these crops. Results are based on analysis of data collected from community (peasant association) and household surveys in three districts in three regional states of the country in 2005. Analysis of descriptive information and econometric analysis are used. About 65 - 77% of households produce these market oriented commodities in the study areas, on about 27 – 44% of the total cultivated land. 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 within the district. Wholesalers and retailers are the most important buyers from producers. Average distance to market places for these commodities is about two walking hours. Econometric analyses show that market orientation of households is affected by a host of factors related to household demographics, household endowments of human and physical capital, access to institutional services, and village level factors. Size of cultivable land and traction power, and household labor supply are important factors that induce households to be market oriented. While household size tends to favor food security objectives, number of dependents is associated with market orientation. Population control measures could contribute to market orientation through their effect of reducing household subsistence requirements. Our results also imply that interventions to improvements markets operations in order to benefit producers need to consider the operation of district level markets. Improving the operations of factor markets of land, traction and farm labor could contribute to enhancing market orientation of farm households. Special attention is needed to female headed households in the process of commercial transformation of subsistence agriculture. The development and institutionalization of marketing extension warrants due consideration.

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1. Introduction

Sustainable food security and welfare cannot be achieved through subsistence agriculture (Pingali, 1997). Cognizant of 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). The rural poor 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 places and outlets 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 using

case study analyses for the cereal crops of teff[3], wheat and rice. Specifically, the paper is aimed at (1) measuring the degree of market orientation of households, (2) identifying the important market places and outlets used by producers, and (3) analyzing the determinants of market orientation of households.

Data for the study was collected from districts where these crops are considered important market oriented commodities (Ada'a and Alaba Kulito for teff and wheat, and Fogera for Rice). 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 during the process of commercial transformation of subsistence agriculture.

2. 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 "selling surplus of what is produced" to "producing for sale". 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 commodities and the proportion of area under the commodities are used as indicators of market orientation at the community (Peasant Association (PA[4])) level, while whether a household produces the commodities and the 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,

[3] Teff is a grass-like fine seeded staple food crop grown in Ethiopia.
[4] APA is the lowest administrative unit in Ethiopia and consists of 4 - 6 villages.

market orientation is modeled as a function of household demographic factors (age and sex of head, household size, children dependents), human capital (education and labor supply); physical capital (land, oxen ownership, ownership of other livestock), institutional 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 (PA) and household surveys conducted in the three districts of Alaba Kulito (about 310 km south of Addis Ababa, in the Southern region), Ada'a (about 45 km east of Addis Ababa, in the Oromia region), and Fogera (about 610 km north west of Addis Ababa, in the Amhara region). Data on teff and wheat are collected from Alaba Kulito and Ada'a.districts, and those on rice are collected from Fogera district. The study districts are areas where these crops are considered important market oriented commodities for smallholders[5].

For sampling purposes, each district was classified into two farming systems based on agro-ecology, cropping pattern and livestock production. Important market oriented commodities were then identified in each farming system. Community level data were collected from all PAs in the farming systems where the commodities are identified as market oriented commodities. Household level data was collected from a random sample of households in each farming system. Analysis of the determinants of variations in the degree of market orientation of households in these market oriented commodities provides a good opportunity to inform policy making to facilitate commercial transformation of subsistence agriculture. 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 market places and outlets used by producers. Econometric analyses are used at both the community (PA) and household levels. At community (PA) level, econometric analyses are used to analyze the determinants of the proportion of households who produce the market

[5] 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.

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). 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 are not estimated. Household demographic characteristics(age and sex of head, household size, number of children dependents), household human capital endowments (literacy of head, household labor supply), household physical capital endowments (land ownership, ownership of livestock), access to institutional services (involvement in extension program and access to credit during the previous year), and village level factors (rainfall, population density, distance to markets) are used as explanatory variables in the household 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 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 **(**Stata Corp. 2001**).** The regression for rice is 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.

3. Results and discussion

3.1 Degree of marketing 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 land (Table 1). On average, among the households that produce teff, a household produces teff on about 1.2 ha.

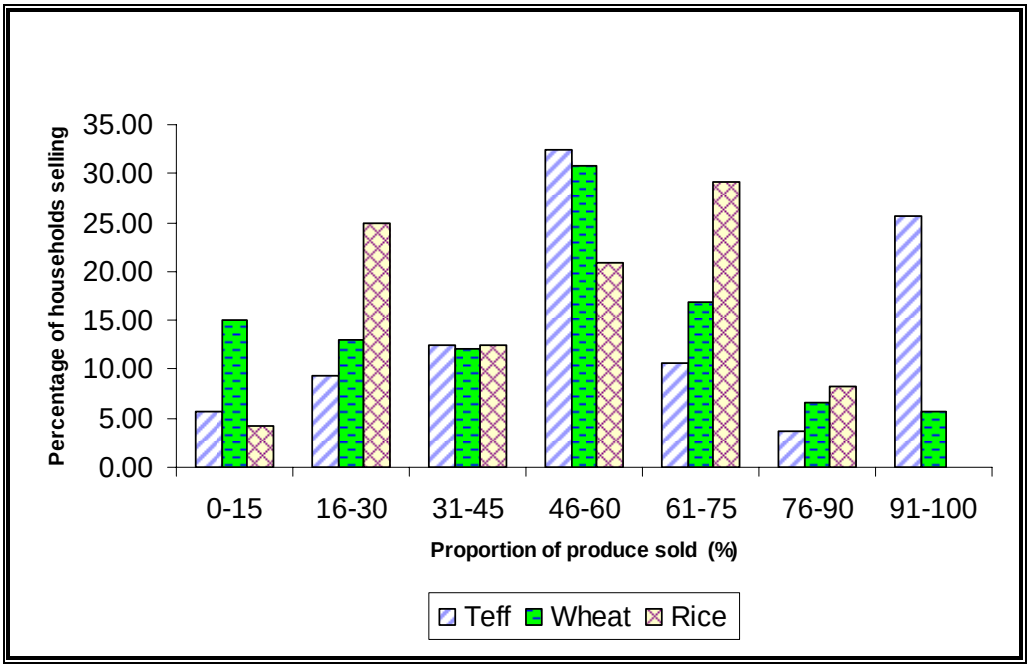
Table 1: Indicators of level of market orientation and average income

Indicator	Teff	Wheat	Rice
Percentage of households producing crop/PA (Std)	77 (22.84)	64 (26.37)	72 (32.17)
Percentage of area covered by crop / PA (Std)	31 (19.12)	27 (11.05)	44 (26.00)
Area allocated (ha/household) (Std)	1.2 (0.96)	1.4 (0.87)	0.62 (0.22)
Percentage of produce sold /household (Se)	60 (2.38)	47 (2.81)	50 (4.35)
Amount sold (kg) (Se)	540 (50)	601 (96)	886 (149)
Average revenue/household (Birr) (Se)	1417 (126.36)	978 (145.92)	1567 (292.65)

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 1). It is interesting to note that the mode in the percentage 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.

Figure 1: Percentage of produce sold by percentage of households selling



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 (Table 1). 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 1). 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 the swampy part of the Fogera district[6]. About 72% of households produce rice in this 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 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 1).

3.2 Market Places[7]

Teff

The most important market places for teff producers are the nearest markets outside the PA where about 45% of households sold their teff produce, and the district town markets where about 38% of producers sold teff (Table 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.

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

	Teff	Wheat	Rice
Market in PA	16	20	4
	(0.03)	(0.04)	(0.04)
Nearest market outside PA	45	66	19
	(0.04)	(0.05)	(0.09)
District town markets	38	13	74
	(0.04)	(0.04)	(0.09)
Markets outside district	1	1	0
	(0.01)	(0.01)	
Regional markets	0	0	0
Average distance to markets of sale (walking hours)	2.1	1.5	1.9
	(0.31)	(0.14)	(0.19)

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

[7] 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).

Wheat

As in teff, the most important market places for wheat producers in the study area are the nearest markets outside PA, where about 66% of producers sold their wheat (Table 2). However, district town markets are not as important for wheat as they are for teff. Hence, the second most important markets for producers are markets in PA where about 20% of producers sold wheat, followed by district town markets where about 11% of producers sold wheat. 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 their 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.

3.3 Market outlets

Teff

On average across the study area, About 65 of teff producers sell their teff produce to wholesalers, and about 31% sell to retailers, while only about 2% of teff producers sell 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 outlets (percentage of households selling (Se))

	Teff	Wheat	Rice
Rural assembler	2	0	13
	(0.01)		(0.07)
Wholesaler	65	51	35
	(0.04)	(0.06)	(0.10)
Retailer	31	43	22
	(0.04)	(0.06)	(0.09)
Processor	0	0	22
			(0.09)
Consumer	2	6	8
	(0.01)	(0.03)	(0.06)

Wheat

As in teff, wholesalers and retailers are the most important buyers from wheat producers. On average, about 51% of producers sell to wholesalers, 43% sell to retailers, and 6% sell directly to consumers (Table 3). It is interesting to note that no producer sells to rural assemblers or processors. Hence, as in teff, the important market channels for wheat producers are 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 those of teff and wheat. About 35% of households sell to wholesalers, and 22% of households sell to retailers and processors each (Table 3). While about 13 % sell to rural assemblers, the remaining 8% sell 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.

3.4 Determinants of market participation

Teff

At the community level, proportion of households who produce teff is explained positively by the average size of cultivated land per household, but negatively by proportion of female headed households (Table 4). 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. This result indicates that land is an important constraint in households' efforts to be market oriented. The explanation for the negative association between the proportion of female household heads and proportion of households producing teff can not be made in reference to variations in household 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

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)[a]	Proportion of area covered by teff (OLS)[a]
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 (0.25ha/household)	0.04366 (0.02330)*	0.00475 (0.01690)
Number of bullocks per household (No.)	-0.00922 (0.01556)	0.01382 (0.00869)
Number of other livestock per household (No.)	-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 (0/1)	0.10398 (0.02921)	0.11408 (0.03138)***
Market info service available in the PA (0/1)	-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

, **, ** significant at 10, 5 and 1%, respectively.

[a] Proportion of area covered is not a censored variable in the data, while proportion of households producing *teff* is.

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 demographic characteristics, household

endowment of human and physical capital, and access to institutional 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.

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 extension service increases likelihood of growing *teff*, since *teff* is one of the crops for which 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 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.

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 (years)	-0.00005 (0.00013)*	-0.01499 (0.00570)***
Age squared	0.000006 (0.00000)**	0.00012 (0.00006)**
If household head is male (0/1)	0.00330 (0.00694)	-0.01173 (0.04394)
If household head is literate (0/1)	-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)
Household labor supply (No.)	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

*, **, *** significant at 10%, 5%, and 1%, respectively

That population density is negatively associated with household decision to grow teff while it is positively associated with proportion of teff produce sold is interesting. Perhaps, it 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, but are also indicative of the need to institutionalize marketing extension. 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 wheat is positively explained by agricultural labor wage rate, average size of 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 rate, average number of bullocks per household (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 has significant effect.

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.

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)[a]	proportion of area covered (OLS)[a]
Distance to nearest market place (km)	0.0001	0.0006
	(0.0057)	(0.0019)
Distance to nearest market town (km)	0.0027	-0.0003
	(0.0024)	(0.0009)
Rainfall (mm)	0.0007	-0.0003
	(0.0007)	(0.0003)
Average adult male daily local wage (Birr)	0.0115*	0.0053**
	(0.0059)	(0.0023)
Proportion of female headed households (%)	-0.7242**	-0.1890*
	(0.3188)	(0.1083)
Population density (persons/ha)	-0.0255	-0.0057
	(0.0479)	(0.0123)
Cultivated land per household (0.25ha/household)	0.0851**	0.0071
	(0.0262)	(0.0101)
Number of bullocks per household (No.)	0.0099	0.0207**
	(0.0267)	(0.0102)
Number of other livestock per household (No.)	-0.0060	-0.0051
	(0.0100)	(0.0035)
Average altitude (meter)	-0.0001	0.0002**
	(0.0002)	(0.0001)
If credit service is availability in the PA (0/1)	0.1427**	0.0883***
	(0.0644)	(0.0246)
If market information service is available in the PA (0/1)	-0.1040**	0.0002
	(0.0474)	(0.0181)
Constant	-0.1271	0.0446
	(0.4695)	(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

*, **, *** significant at 10%, 5%, and 1%, respectively

Proportion of area covered is not a censored variable in the data, while proportion of households producing *teff* is.

Household level regressions of the determinants of probability of 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 non-farm employment.

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 (years)	-0.00646 (0.01604)	-0.00971 (0.00806)
Age squared	0.00000 (0.00015)	0.00013 (0.00007)
If household head is male (0/1)	0.27912 (0.16376)*	0.00430 (0.10003)
If household head is literate (0/1)	-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)**
Household labor supply (No.)	-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

*, **, *** significant at 10%, 5%, and 1%, respectively

Household level regression of the determinants of the proportion of wheat produce sold, given decision to produce, shows that the proportion of wheat produce sold 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).

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.

4. Conclusions and Implications

Teff and wheat are important market oriented commodities in the Ad'a and Alaba Kulito districts, while rice is in the Fogera district. In these areas, about 60%, 47% and 50% of teff, wheat and rice produce are sold, respectively. The average distance to markets where producers sell their produce is about 2 walking hours. The important market places for producers are either those located at the district town or in the peasant associations (PAs) within the district. District town markets are especially important for rice. Markets outside the districts (markets at other district towns or regional markets) are not important for producers. Wholesalers and retailers are the most important buyers of these markets oriented commodities from producers. All sales are effected in cash. These results imply that interventions to improve the gains to producers from the operation of the cereal markets must take into consideration the operation of the district level markets.

Community and household level econometric results show that market orientation of smallholders is affected by household demographic factors, household human and

physical capital endowment, access to institutional services, and the village level factors of population density, agricultural labor wage rate and rainfall. Female headed households are less likely to grow the market oriented cereal crops of teff and wheat, perhaps due to their 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 a U-shaped relationship between age of household head and market orientation of households in teff, 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. The study areas for teff and wheat are relatively plain lands and infrastructure is relatively better developed. 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, it is associated positively with proportion of teff produce sold. These results indicate that land degradation due to population pressure reduces the probability of producing teff, but once the hurdle of decision to produce is overcome, 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 on household market orientation is mixed. Involvement in extension service is positively associated with household probability of growing teff, 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 of 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 development and institutionalization of marketing extension services warrants emphasis.

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

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 heads (%)	86	0.17	0.08	0.04	0.37	74	0.13	0.07	0.03	0.40
Population density (Persons/ha)	87	2.13	1.13	0.19	6.76	73	1.82	1.07	0.19	5.81
Cultivated land per household (1/4 ha)	87	2.67	1.54	0.68	6.81	74	2.97	1.48	0.93	6.81
Number of bullocks per household (No.)	87	1.26	1.57	0.00	12.90	74	1.54	1.62	0.00	12.90
Number of other livestock per household (No.)	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 (0/1)	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 (0/1)	87	0.60	0.49	0.00	1.00	74	0.61	0.49	0.00	1.00

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

Variables	Teff					Wheat				
	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
Population density (persons/ha)	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 (Years)	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
If household head is male (0/1)	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
Household size (No.)	170	6.99	2.94	1.00	22.00	141	6.94	2.99	1.00	22.00
Number of dependents (No.)	170	3.15	1.97	0.00	9.00	141	2.96	1.89	0.00	8.00
Household labor supply (No.)	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 (No.)	170	2.04	1.82	0.00	10.00	141	2.46	1.90	0.00	10.00
Number of sheep & goats (No.)	170	2.18	3.34	0.00	23.00	141	2.80	4.60	0.00	28.00
Number of other cattle (No.)	170	3.19	3.05	0.00	21.00	141	3.82	4.70	0.00	40.00
Number of equine (No.)	170	1.34	1.23	0.00	6.00	141	1.64	1.38	0.00	6.00
Number of local poultry (No.)	170	4.17	4.67	0.00	24.00	141	4.40	4.95	0.00	24.00
Involvement in extension (2003/04) (0/1)	169	0.61	0.49	0.00	1.00	140	0.71	0.46	0.00	1.00
Access to credit (2003/04) (0/1)	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