IMPACT OF CASH CROPPING AND PERENNIAL CROPS ON FOOD CROP PRODUCTION AND PRODUCTIVITY

Adane Tuffa Debela[1]

Abstract

The argument for promoting cash crops in developing countries has generally been based on their contribution to agricultural productivity, small farmer incomes and their impact on other household activities such as household crop production through interlinked markets. These have neglected the effects that cash cropping can have on these household activities through its impact on household liquidity for purchasing productive inputs and through maintaining soil fertility and moisture and the fact that they save inputs such as labor and draft power, which can be used for food crop production. In this study we build on previous studies by developing key hypotheses by which perennial cash crops affect food crop production and the implication for household food security. In addition, we look at the link between the two types of food crops, enset and other food crops. We empirically measure these effects using survey data on 150 rural households in 1999 in Ethiopia. Our results indicate that-after controlling for conventional inputs, household wealth variables, education and other variables-higher chat production is associated with reduced value of food crop yields and total food crop production. On the other hand, higher sugarcane production is correlated with higher value of total food grain production and higher value of grain yields. Moreover, more intensive coffee production is associated with more intensive enset production. However, production of coffee and enset do not have significant effects on food crop production and productivity. These results suggest that while farmers can gain from sugarcane production through cash income and its impact on food crops, coffee and enset can be produced to bring additional income to the household at no cost to food crops. However, the real impact of chat on the welfare of households should be viewed in terms of its opportunity cost and the functioning of markets.

Keywords: Ethiopia, Cash crops, Food crops, Productivity, Enset.
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[1] Department of Economics and Resource management, Norwegian University of Life Sciences, Norway
E-mail:adantu@umb.no

1. Introduction

Reducing rural poverty is one of the main challenges facing farmers and rural development workers in Ethiopia. Agricultural intensification is required to transform the subsistence, low-input, low-productivity farming systems that characterize the Ethiopian agriculture. The state-led food crop intensification program consisting of provision of mainly fertilizers and seeds on credit basis has not achieved the desired results. There have been frequent delays in input distribution and problems with loan repayment. Studies by Afrint (2003) and Demeke et al. (1997) indicate that the program did not generally fit to the specific needs of farmers. Sustainable agricultural intensification requires alternative means of financing highly productive inputs and diversification of crops to compensate for the increasing degradation and population pressure on existing cultivated land.

Perennial cash crops with high value provide one opportunity for agricultural intensification. Cash crops provide readily available cash income to households, enabling farmers to meet the expenditure, needed at the time of planting and before farmers earn income from their food crops harvests. Producer prices of cash crops are also more stable than food crop prices (Goetz, 1993; Kelly et al., 1996; Strasberg et al., 1999)). This helps farmers relax the liquidity constraints to purchase inputs during planting periods.

Past studies of the contribution of cash cropping have focused on the opportunities cash crops bring through interlinked markets for accessing cash crop inputs on credit basis and the possibility of using these inputs for food crops as well to increase productivity and the associated training opportunities farmers receive through input suppliers (Govereh and Jayne, 2003; Goetz, 1993). While these opportunities may exist in some cases, these studies have neglected the benefits cash crops offer apart from the case of market interlinkages in terms of their impact on food crop production and productivity. Although cash crops can compete with food crops for resources, the claim that cash crops can exacerbate household food insecurity problem may not be a concern in mixed cash crop-food crop smallholder farming system. In this semi-subsistence agriculture households continue to store at least some of their own food instead of specializing in cash crops and depending on markets for food crops since there may not be reliable or regular markets for local food crops and there are no insurance markets (Binswanger and McIntyre, 1987, quoted in Goetz, 1993).

The net impact of cash crops and other perennial crops on household welfare depends on the magnitude of the opportunity cost of these crops in terms of land and other resources and the impact of cash cropping on cash income and food crop productivity (Coelli and Fleming, 2004). Nevertheless, the fact that households plant cash crops implies that they derive a higher utility from doing so than not given, their specific opportunities and constraints. Unlike annual cash crops, perennial cash crops put less pressure on resources in terms of input expenditures such as draft power, labour, and fertilizers. In addition, they reduce soil erosion. Perennial cash crops also

reduce soil erosion (Future Harvest, 2000; Lewis, 1985; Clay et al., 1998; Hailseslassie et al, 2005). Moreover, perennial cash crops conserve soil moisture (Kasperon et al., 1995).The possibility of intercropping perennial cash crops with food crops is another benefit of the crops, enabling farmers to produce food crops on the same plots (Byiringiro and Reardon, 1996; Pender et al, 2004; Gladwin et al, 2001).

In this paper we study the impact of cash cropping on food crop production, productivity and enset intensification in southern Ethiopia using household level data collected in 1998/99. The study is intended to contribute to the cash crop-food crop productivity debate, and to assist in developing policy to help smallholder farmers cope with land degradation and population pressure.

In section two, we present the conceptual framework of the study; section three presents data and description of the study area; in section four methods of data analysis are presented; results and discussions are provided in section five; and section six concludes the paper.

2. Conceptual Framework

2.1. Synergies between Cash Crops, Enset and Food Crops

The argument for promoting cash crops in African countries has been based on the principles of comparative advantage and the benefits related to interlinked markets. Those who base their argument on comparative advantage perceive that households, which can produce cash crops at more efficiency than other crops, can specialize in producing cash crops and increase their overall income. The perceptions of interlinked markets are that cash crops attract input supply agents, which provide agricultural inputs on credit basis to enhance the productivity of both food and cash crops in return for the purchase of the cash crops (Timmer, 1997). However, market failures, which are common in developing countries, may stand in the way of commercialization based on comparative principle by giving rise to the non-separability of production and consumption (Singh et al, 1986). This has raised a concern that specialization and commercialization lead to increased market vulnerability and food insecurity (Eicher and Baker, 1982).

The concept of interlinked market, while supported by empirical evidences (e.g., Govereh and Jayne, 2003), neglects the contribution of perennial cash crops to relaxing financial constraints during peak farm operations. Although perennial cash crops compete with food crops for resources, they make cash income available, which can be used to buy inputs to increase food crop productivity in situations where farmers are credit constrained (Strasberg, et al., 1999; Kelly et al., 1996). Unlike food crops, cash crops face a relatively stable price because some of them are exported and some are needed elsewhere domestically (Goetz, 1993). In addition to its impact on cash income, cash crops may increase the credit worthiness of farmers from moneylenders through interlocked markets since lenders think default due to risk is less probable. Reducing soil erosion and nutrient depletion is another contribution of perennial cash crops: for example, Haileslassie et al. (2005) show that in Ethiopia soil

nutrient stocks did not decrease in areas under perennial cash crops. This can enhance sustainable productivity of crops intercropped with perennials. The ability of perennial cash crops to conserve soil moisture is another important contribution of perennial cash crops, especially in water stress areas of Ethiopia.

Moreover, perennial cash crops save inputs such as labour, draft power and seeds. These inputs can be used to intensify food crop production. They can also allow intercropping with other crops easing the problems of population pressure.

In this study we consider the impacts of the following three types of cash crops (coffee, chat and sugar) on food crop production and productivity. Since it is difficult to calculate the value enset for one year, we divide the food crops into enset and non-enset food crops. We also look at how the two types of food crops affect each other.

Coffee:

Coffee is one of the main perennial cash crops in Ethiopia and also in the study area. It is produced mainly for export although some of the production is consumed at home. This crop provides cash income to households; protects soil from erosion; and can support other intercrops by way of retaining moisture.

Chat:

Chat (Catha Edulis) is a large perennial shrub, which can grow to tree size (e.g., Klingele, 1998). It is mainly grown in Ethiopia and Kenya and the main markets are in Ethiopia, Kenya, Somalia, Yemen, etc. Chat is an important cash crop in the area. Chat is also used as a stimulant to dispel feelings of hunger and fatigue (e.g., Parker, 1995). This crop has been the most important cash crop in most parts of Ethiopia because of its stable prices and the fact that it is harvested year-round. In addition to being a source cash income, it is consumed by family members to abate hunger. Chat can be intercropped with coffee. However, farmers prefer to grow chat as a monocrop.

Sugarcane:

Sugarcane typically is a 12 to 18 month crop although it can be left in the ground for a further growing period if favourable conditions exist. In this case it becomes a 'ratoon' crop (when new shoots grow from the sugarcane root after cropping) (Mushtag and Dawson, 2002). Sugarcane has been an increasingly important cash crop in the area. Traders come from as far as the capital city to buy sugarcane. The cane from these smallholders is chewed for its juice, unlike cane from the big plantations, which is converted to white sugar. Sugarcane can be intercropped with food crops such as potato. Imam et al (1990) indicated that intercropping potato with sugarcane exploits the temporal complementarity between crops.

Enset:

In addition to cash crops, we analyse the impact of another perennial food crop well known in the area as enset. Enset (Ensete venttricosum) is related to and resembles the banana plant and is produced primarily for the large quantity of carbohydrate-rich food found in a false stem (pseudostem) and an underground bulb.

More than 20 percent of Ethiopia's population concentrated in the highlands of southern Ethiopia depend up on enset for food, fibre, animal forage, construction materials and medicine (Brandit et al, 1997). Enset resists water stress, is less prone to other risks and yields more per unit area than other food crops in the area. Enset can also be intercropped with other food and cash crops. Possible synergies or trade-offs can indicate the future of these crops in the face of current socio-economic and ecological conditions prevailing in the region.

While the above discussions indicate possible synergies, the actual impact can run either way. If there is little interlinkage of markets, the impact of cash crops on food crop production and productivity should go only through its impact on household liquidity, intercropping, through the impact of the crops in restoring soil fertility and soil moisture conservation. In turn, the impact through liquidity depends on the nature of food crop markets and the actual cash income farmers earn from cash crops. If food markets operate well and cash income is high, farmers may resort to specializing in cash crop production and buy food since this increases household utility. This paves the way for specialization. On the other hand, if food market is not reliable as it is in most regions of developing countries, there might be synergies between food and cash crops.

2.2. Theoretical model

In this section we develop a theoretical model for food crop production and productivity and the production indices for cash crops and enset. Theoretically the model for food crop production and productivity, cash crops and enset production indices can be derived from the farm household model. Farmers in developing countries operate under many forms of market failures, including markets for labor, credit and land (Sadoulet and de Janvry, 1995; Singh et al, 1986; Heltberg, 1998; Taylor and Adelman, 2003; de Janvry et al, 1991). Market failures introduce binding constraints in production where households cannot make separate decisions on consumption and production rendering the household model nonseparable. We start with a household model, which draws on the model developed in Singh et al (1986).

Assume the household consumes a home produced non-enset food crop commodity, x_o, enset, x_e, a purchased commodity, x_m, a cash crop commodity, x_c, and leisure time, x_l; and let z^h represent a vector of household characteristics which parameterizes the utility function. Then the problem of the household is to maximize the household's utility function

(1) $\max u\left(x_o, x_e, x_c, x_m, x_l, z^h\right)$

$(x_0, x_e, x_c, x_m, x_l, L_0, L_e, L_c, y_i)$

Subject to:

(2) Budget constraint: $p_0 x_0 + p_e x_e + p_c x_c + p_l x_l + p_m x_m \leq p_0 Q_0 +$

$$p_c Q_c + E + p_l T - p_l L - \sum_{j=0}^{e} w\, Y_j$$

Where p_o, p_e, p_c and p_m are prices of produced food crops, enset, cash crops and purchased commodities, respectively; p_l is wage rate and w is a vector of prices of other variable inputs; L is total labor demand by the household, both family and hired; y is a vector of variable agricultural inputs other than labor (j=o,c,e); E is exogenous income; Q_o is home produced non-enset food production, used both for consumption and market; T is the total stock of household time; Q_e is household enset production used both for consumption and market; Q_c is home produced cash crop used both for consumption and market.

In addition, farmers face credit constraint to purchase agricultural inputs at the time of planting. There is no formal credit facility in the area except for fertilizer credit given in kind. Therefore, farmers have to cover the costs of other purchased inputs and fertilizer beyond those provided by the government agencies. Framers have to use their own savings, income from sale of cash crops and income from hired out labor. Farmers also may get informal credit from village money lenders based on their credit worthiness which again depends on their stock of cash crops. This informal borrowing, B, is a function of cash crop production given by B(Q_c) $(\frac{\partial B}{\partial Q_c} > 0)$. The cash from the sale of cash crops is predetermined at the time of planting food crops (produced during the previous years).

(3) Credit constraint: $\sum_{i=1}^{N} w_i y_i + p_l(L^{hi} - L^{ho}) \leq p_c Q_c + B(Q_c) + K + A + S$

Where L^{hi} and L^{ho} are labor days hired in and out, respectively; L^{hi} =L-F where F is family labor and L= $L_0 + L_c + L_e$; K is the amount of fertilizer credit. We assume that labor market exists at the same wage rate for hiring in and out.

(4) Food crop production function constraint: $Q_o = f_o(A_o, L_o, Y_o, Z^q)$

(5) Enset production constraint: $Q_e = f_e(A_e, L_e, Y_e, Z^q)$

(6) Cash crop production constraint: $Q_c = f_c(A_c, L_c, Y_c, Z^q)$

where $A_c + A_o + A_e = \overline{A}$; $\overline{A}$ is total operated land holding; A_c, A_e and A_o are sizes (shares) of total operated holding planted to cash crops, enset and other food crops, respectively. z^q is a vector of farm characteristics; and $f(.)$ is a strictly

concave production function. We assume that land is fixed due to imperfections in land rental markets.

Furthermore, the household utility function, u (equation (1)), is assumed to be strictly concave and twice continuously differentiable.

The Lagrangian function for the above maximization problem can be written as

(7) L = U $(x_o, x_e, x_c, x_m, x_l, z^h) + \lambda(p_o Q_o + p_e Q_e + p_c Q_c + p_l T + E - \sum_{j=o}^{e} w\, Y_j - p_l L$

$$- p_o x_o - p_e x_e - p_c x_c - p_m x_m - p_l x_l) + \mu(p_c Q_c + B(Q_c) + A + K + S - \sum_{j=o}^{e} w\, Y_j - p_l(L^{ho} - L^{hi})$$

Denoting the consumer goods by c_i (i=o, e, c, l, m) the interior first order conditions of interest are:

(8) $\frac{\partial L}{\partial c_i} = \frac{\partial U}{\partial c_i} - \lambda p_l = 0$

(9) $\frac{\partial L}{\partial L_0} = \lambda p_o \frac{\partial Q_o}{\partial L_o} - p_l \mu - \lambda p_l = 0$

(10) $\frac{\partial L}{\partial L_e} = \lambda p_c \frac{\partial Q_c}{\partial L_c} - p_l \mu - \lambda p_l = 0$

(11) $\frac{\partial L}{\partial L_c} = \lambda p_c \frac{\partial Q_c}{\partial L_c} + p_c \mu \frac{\partial Q_c}{\partial L_c} - p_l \mu + \mu \frac{\partial B}{\partial Q_c} . \frac{\partial Q_c}{\partial L_c} - \lambda p_l = 0$

(12) $\frac{\partial L}{\partial Y_o} = \lambda p_o \frac{\partial Q_o}{\partial Y_o} - \lambda w - \mu w = 0$

(13) $\frac{\partial L}{\partial Y_e} = \lambda p_e \frac{\partial Q_e}{\partial Y_e} - \lambda w - \mu w = 0$

(14) $\frac{\partial L}{\partial Y_c} = \lambda p_c \frac{\partial Q_c}{\partial Y_c} - \lambda w - \mu w = 0$

The following reduced form of optimal food crops and enset production can be derived from the first order conditions:

(15) $Q_{oi}^* = Q_{oi}^*\left(z^q, A_{oi}^*, A_{ei}, A_{ci}^*, L_i^*, y_i^*, z^h\right)$, and

(16) $Q_{ei}^* = Q_{ei}^*(z^q, A_{oi}^*, A_{ei}^*, A_{ci}^*, y_i^*, z_i^*)$

where Q_{oi}^* is total aggregate value of food crops or value of food crops per unit of land (productivity) for household i; Q_{ei}^* is production of enset; and L_i^* and y_i^* are optimal labor and other inputs, respectively; and A_{oi}^*, A_{ei}^* and A_{ci}^* are sizes (shares)

of operated land holding planted to food, enset and cash crops, respectively. A similar procedure can be used to derive the theoretical model of cash crop production indices.

Equations (9) and (12) indicate that if the credit constraint is binding, i.e., μ >0, farmers cannot use the optimal level of inputs that they would use in the absence of credit constraint. On the other hand, production of cash crops relaxes credit constraints in addition to their contribution to income enabling farmers to purchase optimal level of productive inputs, which raise productivity. Equation (11) has two additional terms, $p_c \mu \frac{\partial Q_c}{\partial L_c}$ and $\mu \frac{\partial B}{\partial Q_c} . \frac{\partial Q_c}{\partial L_c}$. These are contributions of cash crops to the household utility through relaxing credit constraint in addition to their contribution to utility through direct income, given the constraint is binding. Therefore, the optimal level of resource allocation should be determined based on the contribution of cash crops to income and relaxing credit constraints and the income from the sale of food crops and enset.

3. Data and the Study Area

The data used for this study was collected in the 1998/1999-production year from Wondo Genet area located in the Southern Nations and Nationalities Regional State, 270 KM south of the capital, Addis Ababa. It lies within the southern rift valley of Ethiopia. Awassa serves as the administrative capital of the region, with Shashemene town being the nearest local market.

Households were randomly selected from two peasant associations, Wesha and Chuko. The area is characterized by a mixed crop-livestock production system. It is well known for its cash crops such as coffee, sugarcane and chat (khat), making it appropriate for cash crop research. Other main crops are enset, maize, bean, kale, banana, avocado and papaya. Maize is the main staple food crop, while enset is a well-known perennial food crop in the area. Chat trading is common in Chuko, while sugarcane trade is common in Wesha. The area has been a centre of rural business because of its cash crops and proximity to Awassa and Shashemene markets (Adya, 2000).

Farmers in the area produce sugarcane, coffee, and chat, mainly for markets. Although there is no statistics on how much of the total of cash crops is sold, the number of farmers who sold the crops is presented in Table 1.

Although there are other crops grown by farmers in the area, they have little significance in terms of their area and contribution to household income. Production is mainly based on rainfall, which is bimodally distributed throughout the year. The area is among the highest annual rainfall areas in the country, making it suitable for coffee, sugarcane, and especially chat production, the yield of which is highly dependent on the amount of soil moisture throughout the year.

Table 1: Overview of main crops, production intensity and market orientation

Crops	Percent of sample households producing	Percent of growers who sold crops
Enset	77	9.7
Wheat	0.68	0
Coffee	71	17.1
Barley	1.4	0
Maize	69	8.8
Sugarcane	54	84.4
Chat	29	46.5
Soya bean	15	4.5
Sweet potato	8	75
Teff	6	11

Interlinkages of input supply and output markets are not common in the area. Thus, most of the products are sold in the market and inputs are purchased both from the markets and from government agencies on credit basis. The inputs purchased from government agricultural development offices are mainly fertilizer and improved seeds. Farmers are expected by government offices to pay a certain portion of the input prices at the time of purchase with the remaining balance due at the end of the harvest period. Farmers cannot get these inputs on credit basis for the next season unless the previous year's credit is completely repaid. There is no control on the part of the government on the outputs (prices) and it is up to the farmers where to get the money for repayment of credits.

Seventy-five households were randomly selected from each of the two peasant associations. Households were interviewed about demographics, farm and non-farm activities, agricultural practices, asset holdings and attitudes and perceptions about different farm and non-farm activities. The data were collected using trained enumerators from the area with strict follow up by researchers for good quality data. Out of 150 households selected we use 127 households for econometric analysis because of incomplete information and outlier observations on some variables. However, data in Table 1 is for 147 households for which most of the data were recorded.

4. Methods of Analysis and Hypotheses

In our conceptual framework, we argued that cash cropping could influence food crop production and productivity in different ways. This section develops an empirical model, which enables us to measure the impact of the intensity of these crops on food crop production and productivity. Since it is difficult to measure the value of enset produced in one year to aggregate it with other food crops, we divide the food crops into enset and non-enset food crops (hereafter referred to as food crops).

4.1. Impact of Cash Crops and Enset on Food Crops Production and Productivity.

In addition to cash crops, we examine if there exists significant relationship between enset and other food crops. Since it is difficult to measure the production of these cash crops and enset (Q_c and Q_e) as they are perennials harvested over time, we define a measure of the level of involvement (intensities) of households in the production of these crops. Based on the hypothesis that the intensity of cash crop production can affect food crop production and productivity, we develop indices of intensity of cash and enset crop cultivation.

We define household i's cash crop and enset cultivation indices as C_{ij} where j indexes the type of crop (j=coffee, chat, sugarcane, enset). For coffee this index (C_{icof}) is defined as the number of coffee trees divided by total operated land holding; for chat the index (C_{ichat}) is defined as the size of land planted to chat over total operated holding multiplied by 100. The sugarcane production index (C_{isugar}) is defined as the area planted to sugarcane divided by total operated holding and multiplied by 100; and the index for enset production (C_{ienset}) is defined as the number of enset trees divided by total operated holding. We use the total operated holding because food crops and cash crops are sometimes intercropped and it is difficult to know the share of each separately.

These indices simply measure the household's level of involvement in these crops' production relative to its available land for operation and do not show a production function relationship. The indices assume values of zero for some households. To study the impact of these indices on food crop production and productivity, we specify models for y_i, the aggregate gross value of food crops output, and $\frac{y_i}{fland_i}$, the aggregate gross value of food crops output over the total land planted to food crops. Thus, the empirical specification of equation (15) can be written as

(17) $y_i = f(C_{ij}, x_i, fland_i, z_i^h, z_i^q,)$.

(18) $\frac{y_i}{fland_i} = f(\ C_{ij}, z_i^h, z_i^q, fland_i, \frac{x_i}{fland_i})$ -

Where x_i is a vector of variable inputs; z_i^h and z_i^q are vectors of household characteristics and farm characteristics, respectively, which include non-conventional production variables that affect production and productivity). Equation (17) specifies the empirical model of the aggregate value of total food crop production (y_i) while equation (18) specifies the aggregate value of total food crop production divided by total land planted to food crop ($\frac{y_i}{fland_i}$). In addition to conventional inputs (x_i), some elements of z_i^h and z_i^q are also normalized by the size of land planted to food crops ($fland_i$). Descriptions and overview of variables used in the analysis are presented in Table 2.

We use Cobb-Douglas (C-D) type as the basic functional form of production functions given by (17) and (18) since this is the commonly used form of production in agricultural economics research (Hayami, 1970). The C-D form is also easy to interpret and holds the promise of more statistically significant parameter estimates (Liu and Zuang, 2000). Debertin (1986), Chambers (1988) and Brown (1970) present properties of the C-D production function.

The aggregate value of food crops produced by a household, y_i, include maize, teff, wheat, barley, sweet potato, potato, yam, taro, soybean, horse bean, and chickpea.

To get the total value of gross output, the outputs of individual crops are weighted by average market prices, which do not vary across households. The aggregate value is used because it solves the problem associated with mixed cropping (Rao and Chotigeat, 1981; Byiringiro and Reardon, 1996). There are no high-value crops in the aggregate value of food crops, and it is assumed that differences in aggregate productivity between small and large farms are attributed to size or returns to scale (Byiringiro and Reardon, 1996). Although enset is a food crop itself, we can not include its values in the aggregate value of food crops (y_i) because it is difficult to calculate the values of enset crop for inclusion in one year production data as it is perennial and is harvested over period. Farmers usually harvest some enset trees from a single plot and leave others standing.

The dependent variables and all continuous explanatory variables, including the crop indices are transformed into logarithmic form. For censored right-hand side variables (with zero observations), we add one to all observations before transforming them into logarithmic form. Transforming the data into logarithmic form helps reduce heteroskedasticity in error variance (Maddala, 1998; Mukherjee et al, 1998). These transformations reduce problems associated with non-linearity and outliers, improving the robustness of the regression results (Mukherjee et al, 1998; Godfrey et al, 1988).

Consistent estimation of the above model depends on two conditions. First, y_i and

$\frac{y_i}{land_i}$ are not all positive observations.

A significant number of farmers reported zero values for these variables. Since there could be systematic differences between the farmers with positive and zero values of these variables, taking only observations with positive values and estimating (17) and (18) can introduce selectivity bias (Heckman, 1979; Greene, 2000; Wooldridge, 2002). To correct for this selectivity bias, we use the Heckman's selection model ((Heckman, 1979) which involves running a separate probit model using all observations, generating the inverse Mill's ratio (IMR) and including this in the regressions for, y_i , $\frac{y_i}{fland_i}$ >0 observations.

Table 2: Overview and description of variables

Variable	Description	Expected sign: Probit for food crop production	Expected sign: Food crop production	Expected sign: Food crop productivity	Mean	Std. error
A. endogenous variables						
Fcropvalue (y_i)	Aggregate Value of food crop production				480.82	1789.48
Fcropdum	Dummy variable: 1=if fcropvalue>0, 0=other wise				0.74	0.44
Fcroppdvty ($\frac{y_i}{fland_i}$)	Aggregate value of food crop output (Fcropvalue) divided by total food crop area (fland)				1068.84	2222.06
Chathold (C_{ichat})	Land planted to chat divided by total operated holding (tophold) times 100	-	-	+	0.059	0.16
Cofhold (C_{icof})	Number of coffee trees over total operated holding (tophold)	-	-	+	17.49	27.88
Sughold (C_{isugar})	Area of sugarcane over tophold times 100	-	-	+	0.276	0.33
Ensethold (C_{ienset})	Number of enset trees over tophold	-	-	-	171.69	328.30
B. Exogenous variables						
Age	Age of household head in years	?	?	?	44.22	14.27
Sex	Household head sex dummy: 1=male, 0=female	?	?	?	0.9	0.30
Mwf	Size of male workforce in standardized unit	+	+	+	2.22	1.44
Fwf	Size of female workforce in standardized unit	+	+	+	1.52	0.99
Cwr	Ratio of consumer unit to worker unit	+	-	-	1.72	0.34
Edu	Educational level of household head in years	?	?	+	2.19	2.90
Rrl	Ratio of rented in land to tophold	+	+	-	0.09	0.25
Tlu	Size of livestock holding in tropical livestock unit	?	+	+	1.68	1.67
Cu	number of consumers in standardized unit	+	+	-	6.14	2.80
Oxen	Number of oxen owned by household	+	+	+	0.25	0.64
Tophold	Total operated holding (in timad)	+			1.64	1.03
Fland	Size of land planted to food crops (in timad)*		+	?	0.58	1.01
Fertland	Cost of fertilizer used in food crop production in Birr over fland		+	+	37.63	153.50
Labland	Amount of labour in man days used in food crop production over fland		+	+	36.44	51.52
Oxland	Number of oxen days used in food crop production over fland		+	+	2.44	9.83
Seedland	Value in Birr of seed used in food crop production over fland		?	?	101.82	241.93
Mktdist	Average distance of households from markets in hours	+	+	-	1.99	3.48
Padum	Dummy variable for location of household: 1=Wesha, 0=Chuko	?	?	?	0.7	0.46
Lnvarname	Logarithmic transformed variable where varname is the name of one of the above variables					

*Timad is a local measure of land, equivalent to what an adult male can plough in a day using a pair of oxen: on average it is approximately equal to 0.25 hectare of land.

However, since the standard errors of the second stage estimates become incorrect because the IMR is estimated, we have to bootstrap the standard errors from the second stage to get the correct standard errors (Deaton, 1997). Second, the cash crop and enset production indices are basically the result of choices made by the households. If these indices are endogenous in equations (17) and (18), we get inconsistent parameter estimates (Shively, 1997). However, as we will show below,

although they are endogenous to the household, they are predetermined variables and exogenous at the time of making food crop planting decisions as the later are annual and the former perennial (cash crops and enset) having been planted before the annual food crops.

To make sure that they are predetermined only perennial crops older than one year are included in the indices, as they are not harvested before this age. As a precaution we use both the predicted and unpredicted values of the indices for comparison purposes and test the unpredicted indices for endogeneity. We use Tobit models to predict the indices, as many observations of the dependent variables assume zero values. We also use the log-log specification for these equations adding one before transforming the dependent variables and the right-hand side variables with zero observations. Thus, the impact of the cash crops and enset production on food crop production and productivity are determined by the coefficients of the indices in (17) and (18). We use market distance, location of the households (dummy variable for the two peasant associations) as instruments in the first stage probit equation to identify equations (17) and (18).

In addition to cash crops and enset indices and the conventional inputs, we include other explanatory variables including sex, education, and age of the household head, wealth variables such as total livestock unit, size of operated land holding, dependency ratio (consumer-worker ratio), size of male and female work forces, number of consumer units, the ratio of rented in land to total operated holding, the number of oxen owned by households, distance from markets and a dummy variable for location of the households (see Table 2)

While the conventional inputs are physical controls for production and productivity, inclusion of sex, education and age of household head assume that household head is the primary decision maker and thus provide additional controls for management input. Total land planted to food crops, on the other hand, measures the controversial relationship between the size of land and productivity on (18) and we expect positive and negative signs in (17) and (18), respectively. In areas where markets are imperfect, labour, wealth (tlu and ophold) and the number of oxen can put a given household at the advantage of early operation and credit worthiness and hence we expect positive signs both in (17) and (18). On the other hand, dependency ratio and the ratio of rented in land to total operated holding may reduce productivity and production.

4.2. Impact of Cash and Food Crops on Enset Intensification

Since enset is one of the main food crops in the area, we also look at the impacts of cash crops and food crops on enset intensification. We use the indices defined in the previous section in a model for enset intensification with a slight modification as:

(19) $$c_{aenset} = f(c_{iacof}, c_{ichat}, c_{isugar}, y_i, z_i^h, z_i^q, tophold)$$

where $c_{iaenset}$ now indexes total number of enset trees at all ages divided by total operated holding (tophold); c_{iacof} is the number of all-age coffee trees divided by total operated holding; c_{ichat} and c_{isugar} are the same as defined in the previous section since no chat and sugar cane of less than two years were recorded, unlike coffee and enset, which include trees of less than two years of age; y_i is aggregate value of food crop production (equation (8)); z_i^h, z_i^q are vectors of household and farm characteristics as defined previously; and tophold is total operated holding.

The dependent variable in (19) involves zero values for households who do not plant enset. However, the number of households with zero enset production is only 5% of the total households used for econometric analysis. Therefore, we use only observations with positive values of enset production. On the other hand, if all the three cash crops and food crop production are endogenous in (19), the model will form a system of simultaneous equations system and the OLS will be biased and inconsistent. Nevertheless, tests of simultaneity show that the cash and food crops production are not endogenous in (19). We have also tested for heteroskedasticity and could not reject the null hypothesis of constant variance.

5. Results and Discussion

5.1. Characteristics of Cash Cropping and Enset Farmers

Before we start discussing the results of the econometric analysis, we provide some descriptive insights on three categories of sample farmers based on their involvements in the production of cash crops and enset. Accordingly, we divide them into non-growers, average or below average growers and above average growers. We discuss only the main variables, which are used in (17) and (18), the dependent variables and some important characteristics in relation to the categories (see Table 3). As the table shows, the average aggregate value of food crops is highest for non-chat producing farmers while it is lowest for farmers with more than average involvement in chat production. On the other hand, average total production is higher for farmers with more than average involvement in sugarcane production than it is for farmers with average and less than average involvement. Generally, aggregate value of food crop production per household is higher for non-producers of the cash crops (except sugarcane) and enset suggesting that these crops tend to be produced at the expenses of food crops although the decrease may not be significant.

Total operated holding and livestock holdings are generally lower for non-cash and non-enset farmers. This is in line with the argument by Timmer (1997) that farmers with larger land holdings engage in cash crop production more than their counterparts. Both total operated holding and food crop areas increase for above average enset producers indicating that larger farms have more advantage of both diversifying into enset and ensuring the family with food crops. This is in contrast with the belief that farmers with smaller holdings plant enset to intensify enset production, which is believed to give higher yields.

Growers of chat, sugarcane and enset also have higher number of male work force. However, the number decreases with the intensity of production. The value of fertilizer applied per unit of land of food crop is higher for non-producers of chat, sugarcane and enset but it increase with chat production intensity while it reduces with the intensities of sugarcane and enset production. On the other hand, it is higher for producers of coffee than non-producers but it decreases with the intensity of coffee production. Per unit of land uses of labour, oxen and seed are higher for sugarcane and coffee producers than non-producers while it is lower for chat producers. However, there is no indication that cash crops enable farmers to apply more fertilizer per unit of food cropland from these statistics. One reason for this might be that fertilizer is obtained on credit basis from government and non-cash (and poorer) farmers compensate for other inputs, which require immediate cash outlays. Nevertheless, sugarcane and coffee producers produce more food crops per unit of land than non-producers of these crops in line with our hypothesis while chat producers are less productive.

However, these descriptive statistics may not provide clear insights into the impacts of cash crops and enset on household crop production and productivity. These will be addressed in the next sections.

5.2 Econometric Results

5.1.1. Determinants of the probability of food crop production

First we look at factors influencing the probability of growing food crops. Results of probit models of determinants of the probability of growing food crops are presented in Table 4 (Model I). Column (a) of Table 4 provides the two-stage limited dependent variable (2SLDV) estimation results while column (b) presents the probit estimation without predicting the four crop indices.

The results of the tests of the null hypothesis that the cash crops and enset indices are endogenous are reported at the lower part of Table 4. As we can see from the tests for the endogeneity of the crop indices, we cannot reject the hypothesis that the indices are exogenous in the model. As a result, model 1 (b) can consistently estimate the parameters of the probit model and our discussions are based on column (b)

The results show that the intensity of coffee production is associated with lower probability that the household produces food crops. This could be because of the fact that coffee is intercropped with food crops and other crops less often, which means that once land is occupied with coffee, the probability of growing food crops is low.

Other cash crops and enset are not related with the probability of growing food crops significantly.

Both male and female workforces are positively correlated with the probability of growing food crops. This is an indication that food crops are demanding in terms of labour. The ratio of consumers to workers or dependency ratio (cwr) is also associated with the probability of growing food crops positively. On the other hand, total consumer unit (cu) is correlated with food crop planting probability negatively suggesting that households may use cash crops and enset as a means of intensification given scarcity of land.

Table 3. Characteristics of households based on their cash crop and enset production indices in Southern Ethiopia, 1998/99[1]

Characteristics	Cash crops and enset production Indices												Total
	Chathold			sughold			Cofhold*			Ensethold*			
	Nongrowers	≤average	>average	Nongrowers	≤average	>average	Nongrowers	≤average	>average	Nongrowers	≤average	>average	
Sample size*	111	15	12	62	49	27	45	66	27	42	65	31	138
Dummy variable: 1=produces food crops, 0=no food crops	0.721	0.866	0.75	0.79	0.714	0.666	0.8	0.742	0.629	0.666	0.707	0.903	0.739
Total value of food crops (Et Birr)	564.63	139.83	131.88	572.89	221.23	740.51	828.33	368.28	176.75	531.94	305.1	202.86	352.51
Age of household head in years	44.25	43.14	45.25	46.33	43.5	40.7	42.1	44.5	46.96	44.87	42.84	45.32	44.22
Sex of household head: 1=male, 0=female	0.88	0.93	1	0.9	0.89	0.88	0.88	0.92	0.85	0.83	0.89	1	0.89
Male work force (mwf)	2.13	2.15	3.1	2.16	2.18	2.38	1.98	2.49	1.92	1.81	2.39	2.41	2.22
Female work force (fwf)	1.49	1.75	1.46	1.45	1.58	1.56	1.48	1.55	1.52	1.3	1.761	1.33	1.52
Consumer-worker ratio (cwr)	1.71	1.84	1.65	1.69	1.73	1.75	1.74	1.71	1.7	1.68	1.73	1.76	1.72
Education of household head	2.36	1.17	1.75	2.16	1.85	2.92	2.18	1.95	2.81	2.32	2.49	2.48	2.19
Ratio of rented in land to operated holding (rrl)	0.10	0.04	0.1	0.1	0.1	0.16	0.13	0.1	0.1	0.18	0.1	0.03	0.1
Livestock holding in tropical livestock unit	1.66	1.43	2.13	1.54	1.88	1.61	1.45	1.86	1.62	1.58	1.6	2.02	1.68
Total value of food crops over total food crop area (fcropdvty)	1262.1	334.13	433.84	947.53	1021.6	1484.3	1001.8	1231.2	722.53	1561.0	1092.43	342.77	1068.8
number of consumers in standardized unit (cu)	5.9	7.08	7.2	5.86	6.22	6.64	5.83	6.56	5.63	5.1	6.78	6.37	6.14
Number of oxen owned by household (oxen)	0.27	0.133	0.166	0.27	0.27	0.15	0.27	0.29	0.11	0.26	0.25	0.23	0.246
Size of total operated holding in timad (tophold)	1.58	1.99	1.78	1.45	1.84	1.69	1.56	1.9	1.13	1.46	1.72	1.74	1.64
Land allocated to food crops in timad (fland)	0.59	0.65	0.46	0.65	0.47	0.64	0.7	0.6	0.33	0.64	0.49	0.7	0.58
Value of fertilizer in Birr over fland (fertland)	47.28	1.23	5.56	53.15	27.73	15.49	18.1	60.88	10.45	71.97	27.52	20.27	37.63
Labour in days applied per timad of fland (labland)	40.18	21.6	25.1	25.52	46.89	45.24	29.94	40.96	37.22	46.1	39.7	21.77	36.44
Number of oxen days per fland (oxland)	2.98	0.77	0.00	0.77	2.29	7.16	0.42	4.68	0.1	0.5	5.0	0.23	2.44
Value of seed per fland (seedland)	118.84	35.8	47.76	58.21	135.47	152.68	70.88	108.74	150.24	122.28	125.77	44.19	101.82
Distance of household from market in hours (mktdist)	1.92	2.31	2.24	1.85	2.28	1.81	1.93	2.19	1.62	1.52	2.34	1.93	1.99

* coffee and enset do not include trees less than two years o

[1] The figures in the cells show average values of the variables based on the criteria

5.2.2. Impacts of cash crops and enset on food production

In the second stage, we estimate equations (17) and (18) including the IMR generated from the probit model in the first stage. Model 2 of Table 4 provides estimation results of the determinants of food crops production. The coefficient of IMR is not statistically significant in (c), which also uses the predicted values of the four crop production indices, suggesting that there is no selectivity bias resulting from using the sub sample for which food crop production is greater than zero. Subsequently we estimated model (d) excluding IMR and using unpredicted crop indices. This enables us to test whether these indices are endogenous in the model. The test for endogeneity shows that we cannot reject the exogeneity of these variables with F= 1.96. The test for heteroskedasticity also shows that we cannot reject the homoskedasticity of the variance (Model (d)). This means that we can use OLS estimates with ordinary standard errors to get the consistent parameter estimates of the household total food crop production determinants. These estimates are given in column (e) of Model The estimates in column (e) show that the intensity of chat production is associated with reduced total household food crop production. This may be because the results of competition for resources including land may outweigh the potential synergies between chat and food crops. In addition, the frequent harvest of chat may not be suitable for food crop production. Farmers may also neglect food crops altogether and commit resources to chat affecting food crops adversely. This is evident in some areas where farmers replace food crops and other perennial crops such as coffee with chat.

On the other hand, sugarcane production is correlated with increased food crop production. Thus, an increase in the area of sugarcane by one percent is associated with 0.08 percent increase in value of total food crop production.[1] While sugarcane production apparently competes for land (although they can be intercropped) with food crops, the synergies between the two crops possibly resulting from reduced soil erosion, saved resources other than land and use of modern inputs may outweigh the loss of production due to competition for land. Coffee and enset production do not have significant effect on food crops. This could be because of the counteracting effects of competition for resources and synergies between the perennials and food

[1] This is a measure of elasticity because both variables are expressed in logarithm form.

crop productivity and shows that these two crops can be grown at little expenses to food crops.

The availability of male workforce is positively and significantly associated with food crop production as expected. This is believed to be because of the fact that food crop production requires male labour for ploughing, threshing, and other activities. On the other hand, female workforce is negatively and significantly related with food crop production. This was not expected. Possible explanation is that enset is the main alternative to food crop production in areas of high population density and it is female labour intensive. The educational level of household head is also positively and significantly associated with food crops after controlling for other variables.

Household food crop production is positively and significantly associated with the size of land planted to food crops as expected. A one percent increase in land is associated with about 0.5 percent increase in the value of food crop production, other factors held constant. This result is similar with previous studies (e.g. Govereh and Jayne, 2003).
Household food crop production is also positively and significantly associated with labour and seed inputs.

5.2.3. Effects of cash crops and enset on food crop productivity

Given that the IMR is not significantly different from zero (F statistic) and that we cannot reject the exogeneity of the cash crops and enset production indices in the model (g), we use the OLS estimates of the food crop productivity model with robust standard errors since homoskedasticity is rejected (column (h) of Table 4).

Similar to our estimation results for total food crop production model (e), there is negative and significant relationship between chat production and food crop productivity (yield). This would be associated with the decreased use of inputs such as labour and seed per hectare with the intensity of chat production (Table 3) and other effects not measured in our data. On the other hand, food crop productivity is positively and significantly associated with the intensity of sugarcane production. Possible explanations could include the fact that more intensive sugarcane production is associated with higher use of labour and seed per hectare of food crops in addition to other possible synergies in terms of preventing soil and moisture.

However, the intensities of coffee and enset production do not have any significant effect on food crops productivity. While coffee production is associated with the increased use of labour, seed, and fertilizer inputs per unit of food crop area, the intensity of enset production is associated with decreased use of seed, labour and fertilizer for food crops indicating the shift of attention from other food crops to enset. Nevertheless, the decreases and increases may not be big enough to affect food crop productivity significantly.

Other variables influencing food crop productivity include educational level of household head. Total area of food crop production has a negative and significant effect on food crop productivity, other factors held constant. Farmers with smaller area of food crops have higher yields. Results in column (h) suggest that a one percent increase in food crop area reduces yield by about 1.05 percent, which is an inverse relationship between farm size and productivity. This is in line with the results found by, among others, Assuçãno and Ghatak (2003) and Heltberg (1998).

Labour and seed inputs measured by man-days and Eth. Birr, respectively, and normalized by total area of food crops are positively related with food crop productivity, with labour input having the biggest elasticity of the conventional inputs. Total male labour force available to households has a positive effect on food crop productivity suggesting the importance of male labour in food crop production. Surprisingly, the ratio of rented in land to total operated holding has a positive and significant effect on food crop productivity. Since this is the total rented in land rather than the rented in land dedicated to food crops, it may suggest that farmers use more of this land for food crop production and thus use more inputs for food crops which outweighs the negative impact of tenure insecurity. In addition, the type of land contract is mostly of fixed rent and this minimizes the presence of inefficiency resulting from share tenancy.

Table 4. Results of econometric estimation of impacts of cash crops and enset on food crop production and productivity

Variables	Model 1: Probit model for probability of food crop production		Model 2: Value of food crop production per household in Eth Birr			Model 3: Value of food crop production per timad of land (Eth Birr/timad)		
	(a) 2SLDV(predicted indices)[a,+]	(b) one-stage Probit [p]	(c) Heckman 2SLDV	(d) OLS	(e)OLS [p]	(f) Heckman /2SLDV	(g)CLAD (without prediction)	(h) OLS [p]
	coefficient (std. errors)	coefficient (std. errors)	coefficient (Std. errors)[a]	coefficient (Std. errors)[b]	coefficient (Std. errors)[c]	coefficient (Std. errors)[a]	coefficient (Std. errors)[a]	coefficient (Std. errors)[b]
imr	-	-	-.2238(.5224)	-	-	-.2577(.5612)	-	-
lnchathold	-.1344(.2894)	.0639(.1238)	-.0318(.1488)	-.1217**(.0564)	-.1217* (.0646)	-.1783(.1565)	-.2002***(.076)	-.1682***(.063)
lncofhold	.0270(.0427)	-.1939*(.1043)	-.0135(.0147)	-.0137(.0505)	-.0137(.0553)	-.0184(.0177)	-.0359(.0730)	-.0031(.0570)
lnensethold	.0658(.5518)	.0563(.0655)	-.2950**(.1459)	.0023(.0356)	.0023(.0356)	-.2709(.3477)	.0225(.0465)	.0199(.0413)
lnsughold	-.1174(.3177)	-.0762(.0817)	-.0285(.0749)	.0801*(.0417)	.0801*(.0439)	-.0259(.1646)	.1360**(.0676)	.0995** (.0445)
lnage	-1.3735(1.3967)	-.4095(.5862)	.4316(.4705)	.2497(.3275)	.2497(.2966)	.7233(.5552)	.6519(.5269)	.5788(.3706)
sex	.7011(.5334)	.5517(.4925)	-.0607(.4329)	-.0775(.3692)	-.0775(.3683)	-.2351(.4331)	-.4654(.6255)	-.2648(.4663)
lnmwf	3.3722*(1.7664)	3.6351**(1.7416)	.9258***(.3270)	.8065**(.2685)	.8065***(0.304)	.8288(.5908)	.8806**(.4191)	.7524**(.3166)
lnfwf	2.1364(1.3312)	2.2476*(1.3437)	-.2177(.3099)	-.5791*(.3138)	-.5791**(.2769)	-.0587(.3999)	-.1363(.5357)	-.4968(.3237)
cwr	2.6709* (1.4813)	2.9167**(1.2178)	.2727(.3985)	-.2102(.3447)	-.2102(.3181)	.4200(.9540)	-.1218(.4476)	-.2008(.4134)
edu	-.1281(.0900)	-.0698(.0554)	.1045**(.0438)	.0843***(.0292)	.0843**(.0334)	.1113**(.0435)	.0885*(.0497)	.0907***(.0322)
rrl	-.3158(1.5889)	-.8572(.5943)				.2830(1.1507)	1.2719*(.7215)	.9466*(.5050)
lntlu	.3781(.6282)	.4834(.3519)	.2965(.2827)	.1340(.2004)	.1340(.1954)	.3809(.4005)	.1213(.2412)	.1667(.2247)
lncu	-3.4269*(1.9263)	-3.4913*(1.8539)						
oxen	.1958(.5380)	.3069(.3383)	-.1881(.2046)	.0234(.1673)	.0234(.1679)	-.2844(.3101)	-.0861(.3550)	-.0173(.1994)
lntophold	.2836(.7084)	-.3435(.2818)						
lnfland			.3837(.3264)	.5053(.3647)	.5053*(.2751)	-.9534***(.335)	-1.053***(.390)	-1.052***(.307)
lnfert[±]			.0597(.0620)	.0687(.0618)	.0687(.0589)	.0435(.0634)	-.0012(.0716)	.0567(.0553)
lnflab[±]			.3105**(.1436)	.2674**(.1345)	.2674**(.1309)	.3237** (.1455)	.3501*(.2008)	.2671*(.1384)
lnfoxen[±]			.0693(.1466)	.0590(.1291)	.0590(.1192)	.1033(.1565)	.1829(.1651)	.0760(.1065)

Table 4 continued

Variables	Model 1: Probit model for probability of food crop production		Model 2: Value of food crop production per household in Eth Birr			Model 3: Value of food crop production per timad of land (Eth Birr/timad)		
	(a) 2SLDV(predicted indices)[a,+]	(b) one-stage Probit [p]	(c) Heckman 2SLDV	(d) OLS	(e)OLS [p]	(f) Heckman /2SLDV	(g)CLAD (without prediction)	(h) OLS [p]
	coefficient (std. errors)	coefficient (std. errors)	coefficient (Std. errors)[a]	coefficient (Std. errors)[b]	coefficient (Std. errors)[c]	coefficient (Std. errors)[a]	coefficient (Std. errors)[a]	coefficient (Std. errors)[b]
lnfseed[±]			.1517*(.0794)	.1525**(.0599)	.1525**(.0702)	.1583**(.0787)	.1958*(.1078)	.1671***(.0611)
constant	.5387(5.3606)	-2.8132(3.3137)	1.9731(1.4707)	2.6758**(1.187)	2.6758**(1.283)	1.8728(1.6004)	1.7624(2.0875)	2.6369*(1.3391)
No.of observations	124	124	94	94	94	94	136	94
No.of replications			100	100	100	100	100	-
Log likelihood	-58.5683	-56.4719						
Pseudo R2	0.1463	0.1769						
LR chi2(15)	20.08	24.27						
Prob > chi2	0.1688	0.0606						
Breusch-Pagan/ Cook-Weisberg				chi2(1)= 0.08	-			chi2(1) = 4.31
test for heteroskedasticity				Prob>chi2=0.774				Prob>chi2=0.038
Endogeneity test		chi2(4) = 6.66		F(4,73) = 1.96	F(4,73)=1.61			F(4,71) =1.74
for crop indices		Prob >chi2=0.1551		Prob >F=0.1098	Prob.>F=0.1797			Prob >F=0.1514
F				F(17,76)= 12.05	F(17,76)= 8.93			F(18,75)=4.18
Prob > F				0.000	0.000			0.0000
R-squared				0.6663	0.6663			0.5315

[a] numbers in parentheses are bootstrap standard errors; [b] numbers in parentheses are robust standard errors; [c] numbers in parentheses are ordinary standard errors; [p] preferred model; *, ** and *** denote significance at or below 10%, 5% and 1% levels.[+] indices predicted based on separate regressions. [±] these inputs are normalized by the size of land planted with food crops in Model 3.

5.2.4. Effects of cash crops and other food crops on enset Intensification

Results of the estimation of number of enset plants per total operated holding are presented in Table 5.Having rejected the hypothesis that the model is a system of simultaneous equations and heteroskedasticity, we estimated the model using OLS. These results are reported in the third column of Table 5 (Model 5). In addition, we estimated the equation using the two-stage limited dependent variable (2SLDV) procedure since the cash crop indices are estimated using tobit models for comparison purpose. These results are presented in the third column of Table 5 (Model 4). The signs of the two model estimates are similar. However, the OLS estimates are more efficient owing to the fact that the 2SLDV procedure gives inefficient estimates in the absence of simultaneity (Gujarati, 1995). Therefore, the following discussions are based on results of Model 5.

Table 5. Results of econometric estimation of impacts of cash and food crop production on enset intensification: Dependent variable: laensethold

Explanatory Variable	Model 4. 2SLDV estimates of number of enset plants per operated holding	Model 5. OLS estimates of number of enset plants per operated holding
	Coefficient (Standard error)[a]	Coefficient (standard error)
mktdist	-.0353(.0987)	-.0538(.0294)*
lfcropvalue	-.00004(.0002)	-.1412(.1455)
lacofhold	-.0068(.0292)	.2237(.09383)**
lchathold	.0139(.0075)*	.0619(.0967)
lsughold	.0032(.0064)	-.0616(.0670)
lage	.8806(.8407)	.1281(.4773)
sex	.9082(.5996)	.8945(.5376)
fwf		-.5745(.2726)**
mwf	-.1473(.1812)	-.2179(.1920)
edu	-.0150(.0819)	-.0758(.0539)
cu	.0301(.0984)	.2530(.1395)*
rrl	.3876(2.7426)	.8783(.6571)
oxen	.4370(.5272)	.2123(.2103)
ltophold	-.6340(.4016)	-.2741(.2585)
_cons	2.5334(2.8977)	4.4211(1.9348)**
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity. H0: constant variance		$chi^2(1)$ =2.13 prob> $chi^2(1)$ =0.0.1442
Simultaneity test for cash and food crops. H0: No simultaneity	F(4,74)=1.15 Prob>F=0.3385	
Adjusted R^2		0.1382
Number of observations	93	93
F		F(15,78)=2.05 Prob>F=0.0238
Number of replications	100	

[a]standard errors are bootstrapped

We excluded female workforce (fwf) from Model 5 because it was found to be collinear with consumer unit and yet insignificant. Total livestock unit (tlu) was also omitted from both models due to its collinearity with oxen. Results of Model 5 show that the distance of the household from markets is negatively and significantly correlated with enset intensification. This may be because households want to insure themselves with other types of crops when markets far. The intensity of coffee production is positively and significantly correlated with enset intensification. Possible explanations include the fact that enset may provide shade to coffee, which is needed for planting coffee, hence the complementarity between the two crops. The number female labour unit is negatively correlated with the intensity of enset. On the other hand, the larger the number of consumer unit, the higher is the intensity of enset production. This is in line with the fact that enset can insure food security from a relatively smaller landholding.

Although there are apparent competitions between enset, on the one hand and cash and food crops on the other hand, for some resources, these competitions do not seem to reduce the intensity of enset production. Unlike among cash crops and other food crops, most of the synergies among cash crops and enset may be a result of intercropping possibilities and other positive interactions, which make it possible to get more benefits from engaging in the production of many crops rather than specializing in certain crops.

6. Summary and Conclusion

This study addresses the impact of emerging cash crop production activities on enset intensification and on other traditional staple food crops production and productivity and the potential for the cash crops and enset production. In addition, we analyse the interaction of the two types of food crops. We hypothesized that in view of the decreasing landholding owing to population pressure, cash crops can have negative and positive impacts on food crop production and productivity, respectively, through competition for resources and enabling farmers to get more and stable cash income for purchasing and using productive inputs and through their impact on maintaining soil fertility. We also hypothesized that the intensity of enset production can have negative impact on other food crops since farmers may substitute this crop for food crops, as it is a food crop itself and can be produced from smaller plots more efficiently. Moreover, food crop production can reduce enset intensification due to competition for resources. Results show that after controlling for other relevant variables, chat production reduces both the total production and productivity of food crops supporting the claims that chat is replacing food crops while sugarcane production increases both production and productivity of food crops and coffee and enset do not have any significant impact on either of them. On the other hand, intensity of coffee production is positively and significantly related to enset production.

These points to the fact that cash crops can have both positive and negative impacts on food crops depending on the types of the cash crops and other institutional factors

such as market interlinkage and also other complementarities. Whilst there are frequently heard assertions that cash crops production comes at the expenses of food crops, some authors (e.g. Govereh and Jayne, 2003) found out that there are synergies between cash crops (cotton) commercialisation and food crop productivity through interlinked markets and regional spillovers (Dorward et al, 1998; Govereh and Jayne, 2003). However, our results show that there is no guarantee that cash crop production per se can improve the production and productivity of food crops in areas where there are no spill-over effects and interlinked markets. Moreover, interlinked markets are not necessary for cash crops to have positive impact on food crops. Thus caution must be taken when advocating rural development policies based on the trade-offs or synergies between cash crops and food crops under all conditions.

Although there are tradeoffs between chat production and food crops, the impact of this cash crop on household welfare depends on the level of income from chat production and the foregone food crop production. Given that farmers have access to reliable food markets and other ways of using income from chat production, these crops can promote the general welfare of households.

On the other hand, coffee and enset can be grown to bring additional income to the household without significant costs to food crop production, while sugarcane is beneficial both for additional cash income and its positive impact on food crop production and productivity. The results also suggest that complementarity exists between coffee and enset production.

The policy implication thus is that improving market infrastructure to reduce marketing costs and transaction costs can improve household welfare by encouraging farmers to produce cash crops, enset and other food crops, which can alleviate problems arising from population pressure because cash crop and enset productions are ways of farm intensification in the area ensuring food security.

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