IMPACT OF FOOD-FOR-WORK IN TIGRAY, ETHIOPIA.

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ABSTRACT

FFW is the most widely used type of public work programmes in Ethiopia through which a higher share of the food aid is distributed. In this paper we have tried to assess the impacts of FFW in the form of reducing vulnerability of households in a chronically food insecure region in Ethiopia, Tigray. This paper evaluated the contribution of FFW in relieving liquidity constraints in the face of poor credit market access and in protecting households' productive assets during shocks. A Heckman selection model on the adoption and intensity of fertilizer use demonstrated that FFW positively influenced the decision to adopt fertilizer and there was no evidence of disincentive effect. We also found a positive contribution of FFW in protecting households' productive assets. A probit estimate on distress sale of livestock showed that FFW participating households were less likely to engage in this coping response.

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Introduction

Ethiopia hosts the biggest Food-for-Work (FFW) scheme in Africa and has more than 30 years of experience with FFW programmes. The country receives 20 - 30 percent of all food aid to Sub-Saharan Africa. A significant portion of this food aid is distributed through FFW projects. World Food Programme (WFP) alone distributes 20 to 30 percent of its food aid through different FFW projects (Admassie et al. 1985, Webb et al. 1992, Webb and Kumar 1995 and Humphrey, 1999). FFW in Ethiopia is a way of utilizing the food aid available to developmental ends while at the same time transferring food to the poor. As a matter of policy, the government of Ethiopia decided to channel 80% of its food assistance resources to FFW programmes (FDRE 1996).

Dozens of studies have been undertaken about workfare programs in general and Food-for-Work in particular. The majority of these studies explore in detail efficiency in targeting the poor (Dev 1995, von Braun 1995, Webb and Kumar 1995, Subbarao 1997, Ravallion 1999, Clay et al. 1999, Gebremedhin and Swinton, 2001, Jayne et al., 2002, Barrett and Clay, 2003 and Hagos 2003); the production disincentive effect (Abdulai et al., 2004, Fitzpatrick and Strong 1988 and Maxwell et al., 1994) and the cash versus food debate (Clay 1986, Faminow 1995, Dorosh and Haggblade 1997 and Arndt and Tarp 2001). However, compared to the size of the FFW programme available in Ethiopia and the attention it has received in the past decade, the wealth of research exploring the direct and indirect *impacts* of FFW in Ethiopia on the welfare of the poor has been quite meager. Exceptions are Quisumbing (2003) and Yamano et al. (2005) who found a positive effect of FFW on child growth. In a recent paper, Holden et al. (2006) discussed the conditions under which FFW might crowd in private investments on soil conservation

In this study we tried to evaluate the impact of FFW on households' welfare, particularly its impact in form of reducing vulnerability. Households' ex-ante production choice and their coping responses in the event of shocks ex-post are among the most important determinants of vulnerability. Using survey data from one of the poor regions in Ethiopia, this paper examines the effect of FFW in encouraging fertilizer adoption and preventing distress sales of livestock during shocks. We are not aware of any similar studies before. We find evidence of positive influence of FFW on the probability of fertilizer adoption and there was no evidence of disincentive effect to farming due to households' supply of labor for FFW. We also found that FFW participating households were less likely to engage in distress sale.

Survey setting and scope of the paper

This paper is based on a survey that was conducted in Ethiopia in June and July of 2001 and 2003. Ethiopia uses the Julian calendar, which is seven years and eight months behind the Gregorian calendar. The Ethiopian New Year (hence fiscal period) begins on 11 September. However, for farmers in Tigray and most part of Ethiopia this is the time when all production decisions have already been made and they have planted their crops. Hence instead of the fiscal year this survey adopted a recall period consistent with the agricultural calendar. Data collected in 2003, for example, refers to recall period from beginning of May 2002 to May 2003.

The villages in the survey were selected in such a way as to reflect the difference in distance to market, population density, rainfall variability and agricultural potential. Within these villages, lists of all households were obtained and simple random sampling was used to select 25 households from each community (see Hagos and Holden, 2002 and Hagos, 2003 for detail). The sample include 400 households in 2001 but only 372 in 2003 since some of the households could not be reached for different reasons. The 2001 data is used to analyze the impacts of FFW on adoption of fertilizer while the 2003 data is used to examine its impact on coping response. There was drought in 2002-2003 which made the data collected in 2003 unsuitable for analysis of fertilizer use but ideal for studying coping responses.

The average farm size in the sample was 1.1 hectares with only less than 10% having more than 2 hectares. The median number of plots per household is three and very few (less than 5%)

households have more than 7 plots. Households also rent in or rent out plots, hence operated holding could be different from owned land. There were a total of 1755 plots. About three fourths of the plots were owner operated. Fertilizer was applied only on 808 of the plots accounting for about 46 percent.

Survey area: Tigray

Tigray is the northern most region of Ethiopia that has a common boundary with Eritrea in the North and Sudan in the west. It has a total population of more than four million that is growing at 3%. The greater part of the population in Tigray (81%) lives in the rural areas and is engaged mainly in agriculture (CSA, 2005). Tigray has a rainfall that is lower than the country average but is higher in variability (REST and NORAGRIC, 1995). Kiremt (summer) is the main rainy season. The peak agricultural season is from June to August while the slack period is from December to April. The rains start in late June/early July and ends in late August/early September. The main challenge in Tigray has always been chronic food insecurity that is exacerbated by repeated drought. Even in a normal year, less than 15% of the households meet their food requirement from own production and the majority of households are net buyers (REST and NORAGRIC, 1995). The agricultural sector has been highly constrained by severe degradation problems in the form of soil erosion and nutrient depletion (Hagos et al., 1999).

Tigray is one of the first regions in Ethiopia to have experience with FFW projects. It is also the region which is receiving the highest share of food aid - both free food and FFW (Clay et al., 1999). FFW projects in Tigray mainly focus on natural resource rehabilitation. The main activities are: construction of ponds, soil and water conservation structures, rural access roads, area enclosures and afforestation (when there is enough precipitation). The FFW participants are selected through administrative criteria (see Gebremedhin and Swinton, 2001). The criteria differ slightly from place to place and in drought versus normal periods.

FFW in Ethiopia

Public works programs have been widely used in Ethiopia since the early 1960s. Most started as rehabilitation activities and some have evolved into long-term development projects (von Braun et.al 1991). FFW as a specific kind of public work program came into effect in 1972 with the WFP funded projects in Eritrea, Tigray, Wello and Harar between July 1972 and August 1975 following the drought in the these areas. The FFW activities then implemented were conservation and reforestation activities that were later enlarged and consolidated to create the huge project of reforestation and agricultural and grazing land rehabilitation (Admassie et al., 1985).

Both Government agencies and NGOs are involved in the FFW programmes in Ethiopia. The WFP is the single largest player in FFW program in Ethiopia (Webb et al. 1992). It uses 20-30 percent of the total food aid to Ethiopia to support this FFW project which is the largest in Africa. The government implements WFP supported activities through its ministries of agriculture and environment and through the relief and rehabilitation commission (von Braun 1995). There are basically two types of FFW programmes in Ethiopia. One is the relief type of FFW (called EGS) that is designed to provide employment for able-bodied people affected by a disaster or threatened by severe food shortage. Such employment may be provided by expanding an ongoing labor-intensive project or by initiating new ones when the need arises (DPPC, 1997). The other is the more long run type of development programme implemented in selected areas. Such development-oriented FFW is typically programmed with a 5-year time frame in which the amount of food targeted for recipient Woredas is based on the amount of workdays needed to accomplish the task (Jayne et al. 2001). Since the objective of this paper is to examine the impact of FFW through the food payment and not through the investment projects, we do not make any distinction between the two types of workfares.

The customary daily wage rate paid for FFW in Ethiopia is 3Kg of wheat and 12grams of vegetable oil per person. This wage level is a continuation of the original FFW ´ration´ devised in the early

1970s for rehabilitation after famine. The ration was intended to cover the energy requirements of the average family of six people including the FFW participant, offering some 1800kcal per head per day (Admassie et al., 1985).

Theoretical Framework

Here we will present a simple non-separable household model with missing market for land and partly missing markets for labor and credit. The analysis will help highlight the mechanism through which FFW reduce vulnerability. The model builds on a static model of household labor allocation developed by Holden et.al (2006). Let the household maximize its utility

U = U(C,Le)

Where **U** is quasi-concave, continuous and non-decreasing utility function; **C** is a vector of consumption goods and **Le** represent leisure. Utility of the household is subject to the following constraints.

Production technology constraint:

$$q = q(L_a, K, A) \qquad (1)$$

Time Constraint:

$$T = L_a + L_e + L_{ffw} \qquad (2)$$

Income Constraint:

$$C = P_q q - P_k K + W_{ffw} L_{ffw} + S \qquad (3)$$

Liquidity Constraint:

$$C + P_k K = FS + W_{ffw} L_{ffw} + OC \qquad (4)$$

FFW participation constraint

$$L_{ffw} \leq \overline{L}_{ffw} \qquad (5)$$

The non-negativity constraints*:*

$$L_a \geq 0,\ L_{ffw} \geq 0,\ L_e \geq 0\ ,\ C \geq 0\ ,\ K \geq 0 \qquad (6)$$

$\mathbf{L_a}$ is the labor input in farm production; **K** is a vector of non-labor variable inputs such as fertilizers and **A** represents the stock of fixed assets such as land. Leisure is represented by $\mathbf{L_e}$ and $\mathbf{L_{ffw}}$ stands for labor time in FFW. $\mathbf{P_q}$ **,** $\mathbf{P_k}$ and $\mathbf{W}_{ffw}$ represent market prices for agricultural output, non-labor farm input and food-for-work labor respectively. It is assumed that there is no market for formal credit, land and farm labor. **S** represents net transfer received including food aid and **FS** represent the food stock available. The term **OC** refers to other sources of cash which includes cash from sale of assets, remittance and gifts and loan from relatives and friends. Because of the imbalance between the demand for participation in FFW and the supply of job opportunities in FFW, there is rationing in FFW employment and $\overline{L}_{ffw}$ represents the maximum number of labor days a household can supply for FFW

The Liquidity constraint is highly relevant especially during the so called 'hunger season', the cultivation period during which the food stock is depleted and cash for input purchase is needed. In view of the missing formal credit market and the undesirability of sale of productive assets, the constraint also indicates the importance of FFW in drought period and for deficit producing households.

$$L = U(P_q q(L_a, K, A) - P_k K + W_{ffw} L_{ffw}, T - L_a - L_{ffw}) + \delta(FS + W_{ffw} L_{ffw} + OC - P_k K - C)$$
$$+ \gamma(\overline{L_{ffw}} - L_{ffw})$$

The first order conditions for interior solution imply the following equilibrium conditions.

$$P_q \frac{\partial q}{\partial L_a} = W^*_{La} = \frac{\partial U / \partial L_e}{\partial U / \partial C} \qquad (7)$$

$$W_{ffw} = \frac{\partial U / \partial L_e + \gamma}{\partial U / \partial C + \delta} \qquad (8)$$

$$P_q \frac{\partial q}{\partial K} = P_k + \frac{\delta P_k}{\partial U / \partial C} \tag{9}$$

Equation (8) shows that liquidity and participation constraint work in opposite directions on the decision of the household labor supply at the given wage rate. Liquidity constraint introduces additional value on FFW income and the participation constraint imposes a limit on the amount of labor a household can supply.

The additional term $\frac{\delta P_k}{\partial u / \partial C}$ in equation (9) indicates that for households with liquidity constraint non-farm input is effectively more expensive than it actually is in the market place. The stronger the liquidity constraint, the more expensive the input will be for the particular household. This will decrease the probability of use and the amount of use of these inputs. Access to FFW may relax the liquidity constraint and therefore reduce the 'decision price' of a non-labor input like fertilizer.

Econometric method and specification

The focus of this paper is the impact of FFW on vulnerability through the reduction of liquidity constraint and provision of safety net during crisis. In particular this paper poses and tries to answer the following two questions – (1) Can FFW help households adopt fertilizer? (2) Does FFW prevent distress sale in the event of shocks like drought?

Can FFW help households adopt fertilizer?

In a county like Ethiopia, poor farmers who might have been convinced of the benefit of improved technology may not adopt it even when they are not concerned about risks and outcomes. When there is a liquidity constraint, as is the case in the research area, the 'decision price' for fertilizer will be higher than the market price and hence fertilizer will be less attractive for farmers. Only around 30% of the farmers in the research area have access to credit for farm inputs (Hagos and Holden, 2002). We argue that by helping relieve the liquidity constraint, FFW may encourage adoption of fertilizer. FFW eases the liquidity constraint either by providing food income, which can be sold at the local market, or by reducing the need to buy food for household consumption.

Conversely, FFW can also be argued to have a disincentive effect on farm intensification. The disincentive effect of both free food aid and FFW has been one of the most widely discussed issues in the food aid literature (FAO 1982, Fitzpatrick and Strong 1988 and Maxwell et al., 1994). It can be argued that FFW competes for labor with agriculture thereby putting pressure on farming. The increase in food availability through payment from FFW may also reduce the need to be self-sufficient. We use a Heckman selection model for input use to test these opposing hypotheses. If FFW is important in releasing the liquidity constraint but there is a disincentive effect, then the coefficient on FFW income will be positive and significant in the selection equation and negative in the intensity equation. We estimated the following function.

> K = f(household characteristics, wealth, household labor, access to credit, food aid income, FFW income, non-farm income, biophysical characteristics of plot , distance from homestead, distance from market)

Where the dependent variable (**K**) represents fertilizer use in Kilograms per plot in 2001. We used the lagged value of FFW income. In the selection equation the dependent variable in the first stage (selection equation) is a binary variable, which is one if households adopt fertilizer and zero otherwise. In the selection equation we use access to food aid Instead of the amount of income from food aid, and we also include extension service and access to credit. These differences in the two equations solve the identification problem.

‘**Household characteristics’** includes age, education level and sex of the household head as well as the household’s demographic structure. ‘**Wealth’** is proxied by farm size, the values of durable assets and livestock holding. ‘**Household labor’** is separated into male labor and female labor. A household is considered to have ‘**access to credit’** if the household obtained credit for farm inputs in the last three years. It is represented by a dummy, which is one if the household had access. Wealth and access to credit are expected to have a positive effect on fertilizer adoption. Food aid can be expected to positively influence the decision to use fertilizer as it may relax the liquidity constraint. On the other hand, according to the regulations no able-bodied person is supposed to receive free food aid (Jayne et al. 2002). This implies that food aid participants may have less capacity to do farming than the others. This and a possible disincentive effect of food aid may cause food aid to be negatively associated with fertilizer adoption after controlling for differences in ability in the form of adult labor available . To differentiate between the two opposing forces, we include ‘**access to food aid’** in the participation decision and ‘food aid income’ in the intensity decision. A lagged value of ‘**food aid income’** was used. Oxen holding, which is used for ploughing, is expected to have a positive effect. Other non-farm income sources are also expected to affect households’ decision in adopting fertilizer and its intensity once adopted. ‘**Non-farm income’** is proxied by an ‘occupation’ dummy that is one if the household participated in any non-farm income generating activity. ‘**Biophysical characteristics** ‘ is a vector that includes the type of soil, the size of plot, the quality of land, the degree of degradation, susceptibility to erosion, whether there is conservation structure and irrigation on the plot and the agroecological zone the plot is found. ‘**Distance from homestead’** and ‘**distance from market’** are given in terms of the time it takes (walking) to the respective locations.

This model is estimated using data collected in 2001. We use plot as the unit of analysis to account for the effect of soil characteristics and other plot specific traits on households’ adoption of fertilizer. We also included dummies for region to control for regional differences.

Does FFW prevent distress sale?

As we have seen in the conceptual discussion, when the food stock from production is too small example due to drought, households have to depend on other sources of income to cover their food expenditure. In the research area, sale of livestock was among the most commonly adopted coping response during the drought in 2002/2003. Sale of livestock, however, may have long-term impact on household vulnerability. It compromises future income by reducing the benefit streams in the form of animal products. Livestock are also important factors of production for farm households in Tigray who use oxen for ploughing and other draft animals for transportation. However, we can not argue that all sales of livestock during drought qualify as distress sales. It is possible that households keep some livestock partially as insurance item to be sold in stressful times. Chicken seems to play such role since it is the most commonly owned animal and ranked by majority households as the first to be sold in case of emergency. Sale of animals because of an increase in cost of animal feed, even if a result of crop failure in the region, does not constitute a distress sale. In this paper **distress sale of livestock** *is defined as the sale of the most valuable livestock of households to buy food*. We argue that FFW serve an asset protection function during shocks by providing food transfer and thereby reducing the pressure to sell livestock.

For this analysis we use data from the 2003 survey which was a drought year causing severe crop failures in the study area. Although we know that 40% of households admitted to selling livestock as a coping response during the drought, the questionnaire did not go further to explore whether such sales are distress sale as defined above. To differentiate between the sale of those livestock that are held as insurance or commercial items and those sold out of desperation to protect life, we tried to make use of the ranking households made in the 'normal' period in 1998. Households ranked different types of livestock based on priority and importance. Three types of animals- cows, oxen and donkeys were ranked by the majority of households as the most important livestock in terms of their function. They are ranked among the last to be sold at the time of need (the very last being calves) and among the first to be bought if households were to get the necessary fund. Based on this ranking, we considered sale of cows, oxen and donkeys as distress sales. Webb et al. (1992) have also treated sale of these three animals as distress sales in their study of famine in Ethiopia. We admit that this is not the ideal way of identifying distress sale.

To test for the impact of FFW in preventing distress sales, we estimated a probit model. The dependent variable was binary which takes one if the households sold any of the three animals. Our hypothesis was that households participating in FFW were less likely to sell their livestock as a coping response. Data on Income from FFW was incomplete but the number of labor-days supplied in FFW job was reported for all participating households. Since FFW income is linearly proportional to the number of days (payment is per day not per hour), it can serve as the best proxy for FFW income. To avoid endogeneity problem we estimated a heckman selection model for 'FFW income' and used the predicted amount instead of the actual.

Other factors that may influence whether a household will engage in distress sale are: characteristics of household head (sex and education), labor resource of the household, consumer-worker ratio, wealth (given by farm size and value of assets), dummy for savings in cash, food aid income, livestock owned in the previous period and 'occupation' dummy representing other source of income. Wealth is expected to negatively influence distress sales. Households with educated household heads, high labor endowment, other sources of income and savings in cash are also expected to be less likely to engage in distress sales. We split livestock into two types. Livestock type1 refers to the three animals: oxen, cows and donkeys the sale of which is considered distress sale. Livestock type2 includes all other livestock such as goats, horses, mules and others. Livestock was measured in tropical livestock units (TLU). Livestock type1 is expected to be positively correlated with distress sale while Livestock type2 is expected to have the opposite effect. Households with high consumer-worker ratio are expected to be more likely to engage in distress sale. Female headed households are also more likely to sell livestock as they are often the poorest and have fewer resources to absorb the shock. Alternatively, it can be argued that because of their poverty and lack of opportunity, restocking will be more difficult for female headed households and hence they may be more reluctant to sell their valuable livestock.

Results

The sample size was 400 in 2001 and 372 in 2003 with sample attrition of 7%. The number of participants in FFW in 2001 and 2003 were 234 and 245 respectively. As indicated earlier, supply of FFW was constrained. The administrators determined who was considered eligible to participate and how many days of labor an eligible household can supply. As a result, many of the participating households were not allowed to work as many days as they wanted to. In 2001 and 2003, roughly 60% of those who participated in FFW have indicated that they would have liked to supply on average an additional 45 days of labor and 81 days of labor per household respectively.

FFW and adoption of fertilizer

From 400 households interviewed in 2001, 60% have used fertilizer. And of those who have used fertilizer, roughly two-thirds were FFW participants. The FFW participants received on average 154 Kg of wheat as FFW income in that year. Those households that have adopted fertilizer have used on average 58 Kg of fertilizers in their farm (which typically has more than one plot).

Probability of Fertilizer Use

The results from the regression using the Heckman model is given in Table 1 and the description of the variables used in this estimation are given in the appendix. The probit result on probability of fertilizer use shows the coefficient of FFW income to be positive and significant at 5% level. This may indicate a positive impact of FFW in the form of relaxing the liquidity constraint of households and enabling them to adopt fertilizer. This result also conforms to the findings by Bezuneh et al.

(1988) in Kenya. They found that FFW helps relieve the seasonal constraints of participants, enable farmers to adopt higher value crops and to hire-in labor in peak seasons.

(TABLE 1 ABOUT HERE)

Intensity of fertilizer use

The regression results show that there was no indication of FFW's disincentive effect. FFW income was not significant in the intensity equation. Although there have been arguments for disincentive effect of food aid and FFW in the literature, this result should not be surprising for the study area. FFW jobs are often organized to be undertaken during the slack season and hence the competition for labor between FFW job and that of farming may not be significant. Moreover, we have seen earlier that participating households indicated an excess demand for FFW suggesting that there is no crowding out at least at this stage. Another argument for the disincentive effect could be the possible reduction in the need to be self-sufficient because of the food income. However, a statistical computation on the food production and food requirement of households indicate that more than 85% of the households are not food self-sufficient in 2001 and for those deficit producers who were participating in FFW jobs the food income satisfied on average only less than 20% of the deficit. This observation indicates that households are far from 'satisfied' in their demand for food and the income from FFW may not yet be a source of disincentive. Admassie et al. (1985) also came to a similar conclusion about FFW in Ethiopia. They indicated that farmers consider FFW as an additional source of income rather than an alternative and hence FFW does not reduce production. The disincentive effect of FFW on farming has also been rejected by FAO(1982), Holt (1983), Kohlin (1987), Webb et al (1992) and Maxwell et al., (1994), based on household surveys in different parts of Ethiopia. In fact, the claims on disincentive effective of food aid and FFW, as widely discussed as they are, have not been often substantiated by empirical findings. Abdulai et al. (2004) undertook an in-depth examination on the veracity of disincentive effect of food aid using household level data from Ethiopia as well as macro level data from a number of sub-Saharan countries. The study rejected disincentive effect both at micro and macro levels. However, the study showed that it is possible to find signs of disincentive effect if one fails to “control properly for endogeneity associated with targeting-related placement effects.”(ibid. P.17).

This model is estimated using Heckman’s two-step consistent estimator. We get a comparable result when we use full maximum likelihood estimation controlling for clustering at household level. We will not discuss in detail the other factors affecting fertilizer use. However, we should say something about the variable that seems to have counter intuitive effect. The first is the negative coefficient on the variable ‘education of HHH’, referring to a dummy for literate household head, in the intensity equation. This may be because literate household heads are engaged in other non-farm activities and hence there is competition for head’s labor. One fourth of literate household heads are church educated and may work as priests. The other unexpected result is the negative correlation between irrigated plots and intensity of fertilizer. In explaining a similar result in the research area, Hagos(2003) ‘observed’ that farmers often use manure on irrigated plots. This is probably because fertilizer availability outside the main season is limited (ibid, P.125).

FFW and distress sales of livestock

Almost all of the FFW participant households indicated using FFW to cope with the drought in 2003. About 80% of them ranked FFW as the most important or the second most important coping mechanism. This is contrasted with the responses in the 2001 survey. For a hypothetical question about possible coping responses in case of moderate to severe drought, majority of households ranked FFW as the third most important in 2001 indicating that FFW may have become a more important safety net in time of crisis.

The average total livestock owned (in TLU) excluding chickens was 3.4 before the drought and 2.4 after. In the year before the drought, 26% of the households have none of Livestock1(cows, oxen and donkeys) and the average for those who do was 2.4. After the drought, the percentage of those who do not have Livestock1 increased to 28% and the average for those who do decreased to 2.0.

(TABLE 2 ABOUT HERE)

The results from the probit estimation of probability of selling cows, oxen and donkeys are given in Table 3. The observations in this estimate include only those households who have at least one of the three animals in the period before the drought.

(TABLE 3 ABOUT HERE)

The coefficient on the variable indicating 'FFW income', as proxied by predicted number of labor-man-days supplied, was found to be negative and significant at 5 percent level. This shows that FFW income reduces the probability of distress sales possibly indicating towards the success of FFW as a safety net in the event of shocks like this. Households' own perception also point to a similar direction. A significant share of households who had participated in FFW (64%) stated that one of the benefits of FFW is reducing sales of livestock. Barrett et al. (2001) also found a similar result from a study in Kenya. They have shown that, compared with the non-participants in the poorest half of the income distribution, FFW participants in the same group are found to be less reliant on sale of livestock for immediate cash needs. The asset protection function of FFW can also be appreciated when one considers the alternative. Kristjanson et al. (2004) showed that relinquishing livestock asset, particularly slaughtering for a funeral, contribute to a descent into poverty of households in Kenya. Similarly, as Hoddinott (2006) highlights in the case of Zimbabwe, reducing consumption during drought to protect assets is not a good alternative either. It may lead to permanent damage on human capital and especially for children.

Conclusion

FFW is the most widely used type of public work programme in Ethiopia through which a significant part of the food aid is distributed. In this paper we tried to evaluate the impact of FFW in terms of reducing vulnerability of households using a household survey data from Tigray.

We tested the hypotheses that FFW stimulate adoption of fertilizer in a year with normal rainfall (2001) and prevent harmful coping responses like distress sale of livestock in a drought year (2003). The results from the Heckman model for fertilizer adoption show that FFW encouraged adoption of fertilizer. The results also show that FFW had no production disincentive effect. On the other hand, a probit estimate on the factors affecting distress sales (sale of cows, oxen and donkeys during the drought in 2002/2003) has shown that FFW participants were less likely to adopt this coping response. Households' own perception of the benefit of FFW, as revealed in the interview, confirmed the econometric finding.

In general, the analysis in this paper has shown that FFW has positively contributed to reduce vulnerability of households by relaxing their liquidity constraints and thereby promoting adoption of technology ex-ante and protecting households' productive asset in case of shocks. However, the study also revealed that there is room for improvement. FFW seems to be thinly distributed. Because of the excess supply of labor for FFW at the given wage, there is an administrative rationing on the amount of labor a household can supply. Around 60 percent of households had revealed unsatisfied demand for FFW job. The relative high FFW wage may have crowded in less needy households at the expense of more needy ones. A hypothetical question posed for participating households revealed that more than 70 percent were willing to supply labor at a price as low as 2Kgs of wheat per day as opposed to the present wage rate of 3kgs. However, if such prices are to be adopted the nutritionally efficiency has to be examine first.

There is still some more work to be done in evaluating the impact of FFW in reducing vulnerability of households. One of the issues that can be considered for further research would be the impact on productivity of the conservation structures constructed through FFW and the knowledge transfer from participating in such activities. This is a very crucial question for food security in the long run and is often one of the justifications for implementing the programme in the first place.

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Table 1. Determinants of fertilizer use, Heckman selection model

	Probability of fertilizer use		Intensity of fertilizer use	
Variables	Coefficient	Std. Err.	Coefficient	Std. Err.
Sex of HHH	0.06023	0.125329	-27.784	6.465786***
Ln (HHH age)	-0.18223	0.129954	-2.51933	6.565607
Education of HHH	0.010308	0.079206	-8.20498	3.96668**
Female labor per hectare	0.037307	0.028983	1.080915	1.27912
Male labor per hectare	0.00504	0.030615	2.20248	1.441496
Ln(consumer-worker ratio)	-0.05962	0.106598	4.411187	5.374648
Occupation	-0.04225	0.11435	27.86143	5.828413***
Ln (farm size)	-0.05783	0.103988	13.95557	4.975538***
Ln (livestock)	0.001494	0.007167	0.312438	0.365531
Oxen per hectare	0.087478	0.041498**	-0.47147	2.051653
Aid access	-0.07703	0.069841		
Credit access	0.535148	0.102078***		
Ln (ffw income)	0.011498	0.005502**	0.144315	0.307693
Ln (aid income)			0.085537	0.26973
Distance to market	-0.00331	0.000446***	-0.18265	0.040806***
Distance to plot	-0.00382	0.001503**	-0.33481	0.097579***
Poor quality land	-0.05259	0.088595	-7.90473	4.493464*
Degraded plot	0.085012	0.141148	-2.68847	7.235819
Owner-operated plot	0.148358	0.107173	-2.47606	6.010217
Rented-in plot	-0.05536	0.151907	6.862017	8.034871
Eroded land	-0.09341	0.124029	-1.25238	6.45894
Conserved plot	0.303371	0.088478***	7.506283	5.444001
Plot size	0.041402	0.029662	14.82828	1.863517***
Soiltype2	0.097897	0.09781	2.738419	5.102265
Soiltype3	0.135862	0.096214	0.805733	5.112729
Soiltype4	0.187065	0.108004*	-7.95504	5.561071
Soiltype5	0.036995	0.165292	6.219859	8.463983
Irrigated	-0.19215	0.146311	-18.8144	7.943726**
Agroecology2	0.157383	0.078616**	7.328516	4.164142*
Agroecology3	0.193852	0.18719	-2.25051	10.00942
Region2	-0.13926	0.101456	-37.2596	5.759853
Region3	0.43874	0.115239***	-5.97919	6.755158
Region4	0.106883	0.107286	-16.4553	5.802055
Extension	0.031999	0.137196	45.1753	30.82879
Constant	0.033505	0.584356	-16.4553	5.802055
Mills lambda			39.41612	15.87853**

Number of observations =1535
Censored observations =814
Wald chi2(28)=475.04
Prob > chi2=0.0000

***, **, *** represent levels of significance at 10, 5 and 1 percent respectively**

Table 2. Livestock type 1(cows, oxen and donkeys) owned and sold

	Cows	Oxen	Donkeys	At least one of the three types
Total owned in 2002	289	331	216	
Sold during 2003 drought	52	80	24	
No. of HHs who own in 2002	178	231	160	271
No. of HHs who sold in 2003	38	67	15	95

Table 3 probit estimate on distress in 2003

Dependent variable: binary (0/1) for distress sale

Variables	Coefficients	Bootstrap Std. Err.
Female HHH	-0.15213	0.221538
Formal education	-0.11173	0.397251
Church education	0.125924	0.314016
Female labor	-0.09137	0.113178
Male labor	-0.10094	0.106004
Consumer-worker ratio	-0.00773	0.110071
Farm size	-0.22157	0.122523*
Ln(Asset holding)	0.079516	0.057412
Occupation	-0.30948	0.423207
Savings in cash	-0.11446	0.353819
FFW income	-0.0118	0.005684**
Livestock type1	0.343433	0.084148***
Livestock type2	-0.0991	0.092226
Region2	0.019698	0.29458
Region3	-0.11593	0.322654
Region4	-0.63627	0.31076**
	Number of obs=	271
	Wald chi2(18)=	51.97
	Prob > chi2=	0.0000
	Log likelihood =	-152.88

***, **, *** represent levels of significance at 10, 5 and 1 percent respectively*,**

Appendix

Fertilizer use: Description of Variables and Summary Statistics

Variable	Description	Mean	St.Dev
Household Level			
Fertilizer used	Dummy for fertilizer use (yes = 1)	60%	
Sex of HHH	Sex of household head (female=1 and male=0	27%	
Education of HHH	Whether the household head is literate or not (yes=1)	37%	
FFW participation	Dummy for FFW participation (yes=1)	58%	
Aid access	Dummy for access to food aid (access =1 if the household received food aid in the last three years and zero otherwise)	58%	
Credit access	Dummy for access to credit for farm input (access =1 if the household received credit for input in the last three years and zero otherwise)	74%	
Occupation	Dummy for participation in off-farm activities by at least one member of household	26%	
HHH age	Age of the household head	51	15.6
Female labor per hectare	Number of female adults per hectare	1.8	2
Male labor per hectare	Number of male adults per hectare	1.6	1.6
Farm size	Owned farm size	1.1	0.72
Consumer-worker ratio	Consumer-worker ratio	2.2	0.94
FFW income	Food income from food for work in Kg	154	173.7
Aid income	Income from free food aid	169	143.9
Livestock	Monetary value of livestock owned (excluding oxen)	1392	1919
Oxen per hectare	Oxen holding per hectare	1.3	1.74
Distance to market	Walking distance to district markets in minutes	143	91.8

	Plot Level		
Fertilizer in Kg	Total Urea and Dap applied in each plot (in Kilograms) for all sample	23	43
Plot size	Size of plot in 'tsimidi'. 1 tsimidi = 0.25hectars	1.24	1.17
Distance to plot	Distance from homestead to plot in minutes	25	27
Poor quality land	Land quality considered poor by household	21%	
Erosion exposure	Plot exposed to moderate to high susceptibility to erosion	23%	
Degraded plot	Highly degraded plot according to household perception	17%	
Land Ownership	Owner operated plot, Rented-in plots, plots in other arrangements Owner operated plot =	77%	
Conserved plot	Dummy for conserved land (yes=1)	76%	
Soil type	Soil type as classified by the household (1= clay, 2= black, 3= sandy, 4= red 5=other)		
Extension	Dummy for extension support (yes=1)	87%	
Irrigated	Dummy for irrigated plot (yes=1).	6%	
Agroecology	Dummy for agro-ecological zone (1=Degua, 2= Hausi degua, 3= Hausi kola)		
Region	Dummy for Zone (1= Southern, 2= Eastern, 3= Central and 4=Western)		

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