Farmers' Post-Harvest Grain Management Choices under Liquidity Constraints and Impending Risks: Implications for Achieving Food Security Objectives in Ethiopia

Abebe H. Gabriel

Bekele Hundie

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1. Introduction

Food grains (cereals, pulses and oil crops) constitute the major source of food in Ethiopia, accounting for 82% and 70% of total calorie intake and food expenditure, respectively (CSA, 1988; Abebe, 2000:260). Cereals alone provide about 70% of the average Ethiopian's calorie intake (Howard, et al, 1995). Hence, concern over marketed food grain surplus has always been at the center of the country's policy formulation and implementation.

The crucial importance of ensuring sustained levels of marketed food surplus, both in terms of quantities and fair prices, cannot be overemphasized if food security is to be attained in Ethiopia. However, government policies have been more focused on aspects of production and marketing and less on what happens in between production and consumption. For example, there has been a lot of emphasis on supporting increased grain production through improved agricultural technologies. Indeed, efforts to improve grain production technologies have, for some food grain crops such as maize, yielded remarkable results to such an extent that prices had declined dramatically. This, in turn, has generated arguments as to whether market stabilization mechanisms should be introduced to absorb price shocks thus preventing depressed market prices from causing production disincentives.

Estimates suggest that the magnitude of post-harvest loss in Ethiopia was tremendous ranging from 5% to 26% for different crops (Dereje, 2000). This figure is quite large especially for Ethiopia where a great majority of people are food insecure. It is ironical that the immediate victims of food insecurity have traditionally been farmers, i.e., the very producers of food. Each year, despite weather condition, hundreds of thousands of rural households suffer food insecurity; literally depending on food-aid for their survival.

It is important to recognize that post-harvest grain management (PHGM) practices and capacities (and not just production and marketing) are important for many reasons including the achievement of food security objective. Clearly a better PHGM capacity and practice would minimize the magnitude of loss. This is in addition to the potential employment and income linkage effects and gains from the activities. Unfortunately, this crucial area has not received the attention it deserves among researchers and policy makers. Those studies that remotely touch on post-harvest aspects focus on marketing only and understandably their policy recommendations do not go beyond the improvement of transportation, storage and information infrastructure and/or regulatory frameworks (see, for example, Alemayehu, 1993; Wolday, 1994, 1998; Bekele and Mulat, 1995), with little mention of processing as an important post-harvest grain management activity. A few studies (e.g., Jonsson, 1972; Dereje, 2000) focused on engineering and design aspects of storage infrastructure without any reference to wider perspectives such as food security. Moreover, the efforts made by policy makers and development practitioners are to raise the national production and productivity while post

harvest grain management issues remain untouched. This is probably because of the often easily held assumption that what matters is production, and that success in increasing production and productivity will lead to increased availability of grains both at the household and market levels (see also Goletti and Wolff, 1999)

Therefore, this study is initiated with the objective of exploring the relationship between farmers' post-harvest grain management practices and capacities and levels of household food (in)security. The findings are based on the household survey data from 300 randomly selected peasant households in three sites of Ethiopia producing major food grains. Descriptive statistics are widely used while a tobit regression output complements the descriptive results.

The remainder of the paper contains three sections. Section 2 presents the conceptual framework. The findings are presented in section 3 while section 4 concludes the paper.

2. A Conceptual Framework

Post-harvest grain loss is the loss of grains (quality and/or quantity) between the moments of harvest and consumption. Reduction in food losses is sometimes considered as the 'third dimension' to the world food supply equation, i.e., in addition to increase in food production and increases in population (Toma, Fansler and Knipe, 1990). Crop losses occur at all stages of the post-harvest handling, including pre-processing, transportation, storage, processing and packaging and marketing. In a more wider sense,

the magnitude of post-harvest loss goes beyond the physical and deterioration in quality and includes 'sunk' cost in terms of inputs used to produce the lost grain. The relationships between post-harvest grain management practices and food security can be conceptualized as depicted in Figure 1.

At the household level, food security can be defined both by availability and sustained access to adequate food. It is determined by (a) the amount of output produced which is itself a function of resources endowment, (b) the amount of post-harvest grain losses (3), and (c) food prices (2).

Grain losses could either be in terms of quantity damaged or in quality deteriorated, but it is related with post-harvest grain management practices (5), i.e., storage, handling, processing and stock management, which in turn is a function of endowment and access to resources including credit (6). Output level may also influence the choice of grain management practices (7), which would determine the magnitude of post-harvest grain losses (8) as well as farmer's stock management behavior.

The magnitude of post-harvest grain losses, whether actual or expected, would influence farmers' behaviors in marketplace (8); that is, in absence of a working insurance markets, the fear of running high risk of grain loss may induce farmers to dispose most of their produces immediately after harvest time and probably repurchase at some future date. Obviously, this would entail inter-seasonal price discrepancies (9), which would affect the level of farmers' income and therefore access to food (2).

Hence, the level of household food security may be affected directly by the magnitude of post-harvest physical grain loss or indirectly by loss of grain prices due to quality deterioration and inter-seasonal price variations.

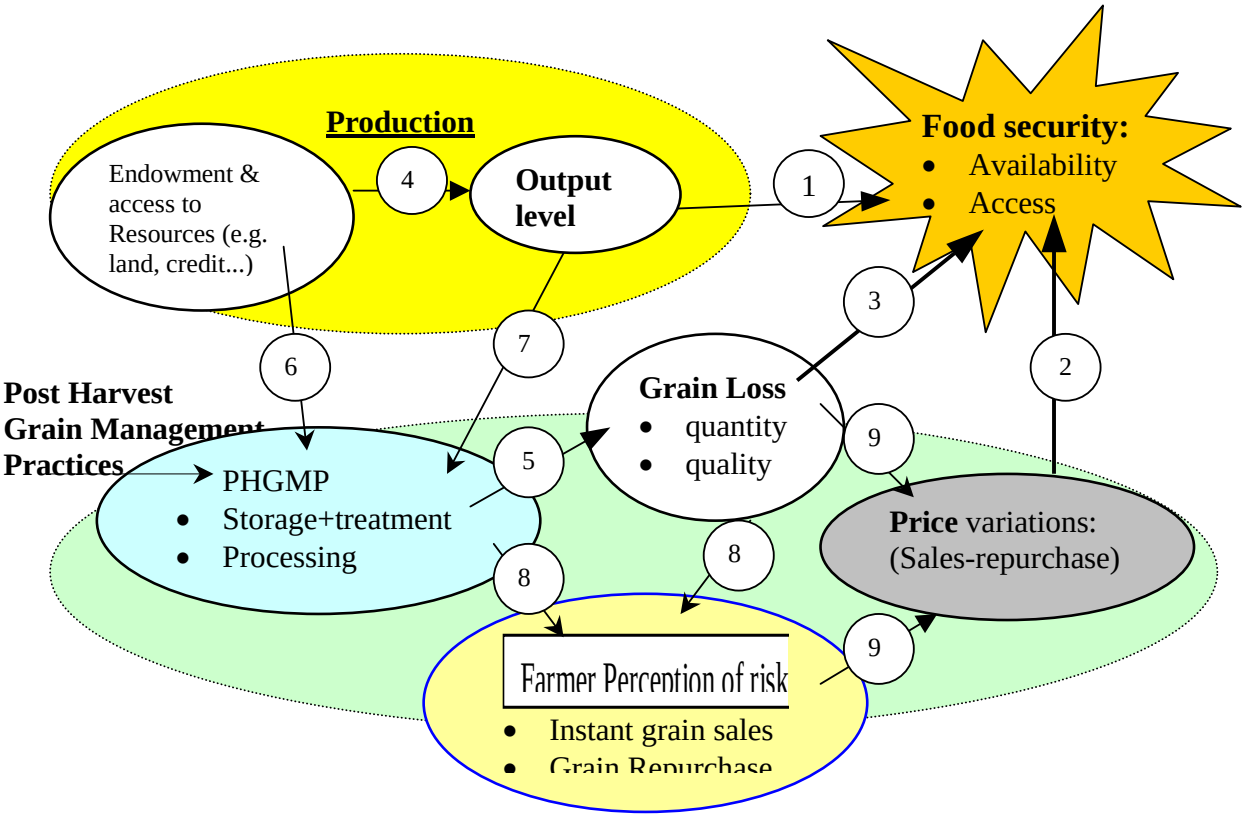

Fig. 1. A Conceptual Framework: Post-Harvest Grain Management as determinant factor for household food security levels.

3. Results and Discussion

3.1. PHGM Practices and Extent of losses

3.1.1. PHGM Practices and Capacity

Unlike what is observed in mechanized farms where mowing and threshing could be undertaken simultaneously, grain harvesting by Ethiopian farmers takes place manually and involves hand mowing of crops using sickles and later threshing by letting a group of animals trampling upon it. Harvesting of maize is unique in a sense that it is undertaken by removing the ears by hand. Several days could elapse before mowed crops are threshed; i.e., crops stay piled for some time either around homestead or *in situ* before threshing.

Farmers use various methods and types of facilities to store their crops. The traditional grain stores identified in the study areas include *gotera* (grain pits), bags (made of polyethylene, sisal or goat skin[1]), earthen pots and some others. More than 70% of the respondents used polyethylene bags and sacks made of sisal while about two-third of them use *gotera* (Table 1). The latter is usually preferred to store crops for longer period of time and also in a larger quantity.

The average storage capacity of the sample households was 3.27 metric tons, which can only hold food grains for one or possibly two production seasons. If all kinds of storage

[1] This traditional container is commonly known as *silicha* and it is estimated to hold 50 to 60 kilograms of grain. To produce *silicha,* a special skill and care is required when the goat is skinned.

mechanisms (temporary and fixed) are considered,[2] few households could store more than 5 metric tons of food grains. If, on the other hand, bags and sacks are excluded, the average storage capacity per household could be reduced to 2.52 metric tons. This is quite low as compared to the average volume of total grain produced (4.39 metric tons) indicating the existence of storage constraints in the survey areas.

Table 1: Types of Stores Used Across the Study Sites

Type of Storage	Hetosa		Ada		Bako		Total	
	No.	%	No.	%	No.	%	No.	%
Gags/ sacks	93	94.9	84	84.0	33	33.0	210	70.5
Gotera	73	74.5	49	49.0	80	80.0	202	67.8
Pots	14	14.3	9	9.0	5	5.0	28	9.4
Underground pits	1	1.0	-	-	-	-	1	0.3
Others	4	4.1	32	32.0	18	18.0	54	18.1

Source: survey data

3.1.2. Post Harvest Grain Losses

Grain losses could arise either from poor post-harvest handling or from production over and above the capacity of the available stores, or both. In case production exceeds total storage capacity, two options are possible to solve the problem: instant disposal of the excess produce (e.g., sales, loans, etc.) or increase storage capacity. If grain markets are demand constrained, or supply is price elastic, as it is true in the case of grains, instant sale of grains immediately after harvest will have a price reducing effect. Hence normally this option seems to be less preferable for producers. In the study sites, however, the

[2] Strictly speaking, bags and sacks are not permanent grain stores. Rather they are used to store grains which would be disposed to the market instantly.

majority of the sample farmers (about two-third) opted for selling their grains whenever production was in excess of their storage capacity.

The majority of the farmers (93.3%) perceived an imminent risk of grain lose due attack by storage pests and/or other factors if they stored their crops for longer period of time. The per household average actual loss (as opposed to expected loss) was about 500 kilograms of total grain output during the previous year, which is equivalent to 12 per cent[3] of the average total grain produce of the sample households. Farmers in Bako and Hetosa areas reportedly lost about 700 and 620 kilograms of crops, respectively, due to post harvest damages, while the figure for Ada was much less. Of course, these variations reflect differences in cropping patterns among the three sites and therefore the high degree of susceptibility of some crops such as maize and wheat than the others such as *teff*[4].

Maize is the most affected crop; on average, a maize grower lost 500 kilograms of grain within 12 months preceding the survey period. The average loss for wheat producers could be around 250 kilograms. On the other hand, as expected, *teff* was reported to be less susceptible to post harvest loss enhancing factors as compared to wheat and maize.

There are several causes for the observed post-harvest losses experienced by peasant households. Attacks from weevils and rodents, and moisture or growth of molds are

[3] Other studies (Coursey and Proctor (n.d)) have reported wheat loss (by weight) ranging between 8 - 52 per cent for India, 6 - 19 per cent for the Sudan, and 15 - 20 per cent for Brazil.

[4] *Teff* is a small grain crop widely grown in Ethiopian highlands.

among the factors and agents contributing to the losses. Among these, weevils' attack was reported as the most important and commonest cause. Rodents and moisture and/or growth of molds are also important in areas such as Hetosa and Bako.

The majority of the sample farmers (83.2%) used chemicals to reduce grain losses that would result from pest attack because storage losses without chemical treatment can be substantial. Chemicals are usually used to treat maize and wheat since these crops are among the most susceptible to weevils' attack as indicated earlier. In addition, a quarter of farmers reported that they use aeration.

3.2. Grain Marketing Practices and Patterns

The proportion of marketed surplus of grains to total grain output for Hetosa, Ada and Bako were respectively 40%, 63% and 48%. With the exception of Ada, more than one-half of total grain production does not reach market place; it is consumed within the farm household. The fact that farmers do produce large assortment of crops and sold some proportion (not most of it) mirrors the extent of production orientation towards household consumption rather than for sale. On the other hand, the proportion of total production that is marketed, i.e., the extent to which a given crop resembles a "cash crop," varies among crops as well as among sites.

On aggregate levels, proportion of actually marketed output during the first quarter of 2002 was about 51% of total marketable surplus for the entire year. The average percentage of crops sold declines as one moves from the first quarter through to the forth

quarter (Fig. 2a). The commonly held view, which apparently happens to be true most of the times, is that crop prices would be the lowest during the first few months following harvest and start to rise monotonically until they reach maximum during the months of July-August after which, in some cases, they start to decline (Fig. 2b-2d).

Such a general pattern of seasonal price fluctuation is apparently known by farmers. The farmers reported that they were in fact aware of the fact that prices would increase after the first quarter, especially during the lean season. Then, it would be interesting to ask the question that, if farmers actually expect that grain prices would rise during the lean months, why would they want to sell large proportion of their marketable surplus immediately after harvest when grain prices are the lowest in the year?

One important reason could be the high demand for cash during the first quarter. That particular season is the time when farmers need money to settle various types of dues including social obligations (such as marriage, religious festivals and ceremonies), input loan repayment, payments for land tax etc. For instance, the interviewed farmers reported that about 33 per cent of their marketed grains during the first quarter went to finance repayment of input loans and/or pay land taxes.

The other important reason might be fear of risk associated with post harvest grain losses. As indicated earlier, the majority of the interviewed farmers perceived that post-harvest problems are matters of grave concern.

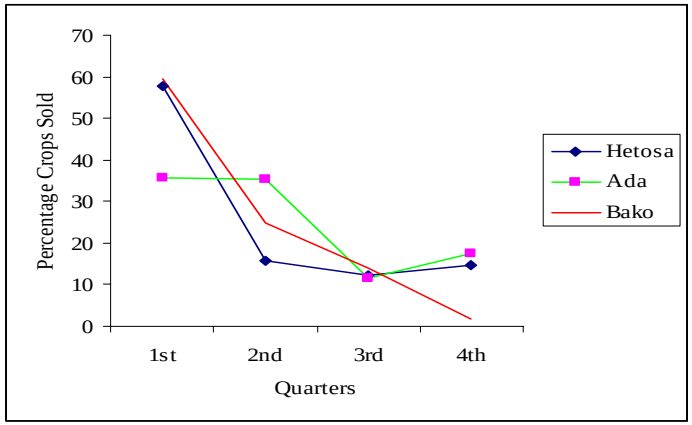

Fig. 2a. Movement of Crops Sales by Quarter (Percent of total sales)
Source: Survey data

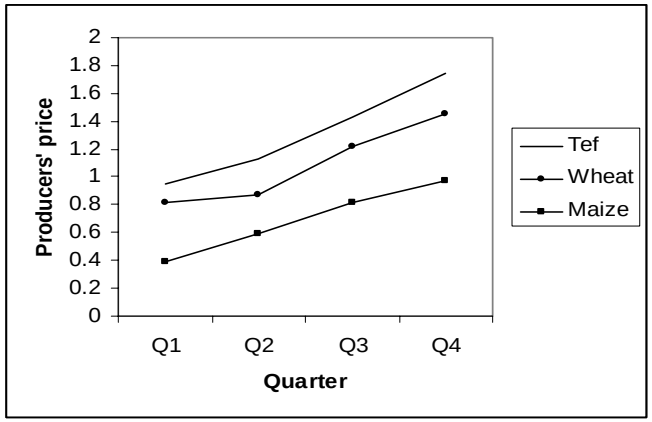

Fig. 2b. Producers' Prices Movement for Selected Crops (W. Shoa,Bako)
Source: CSA, 2002

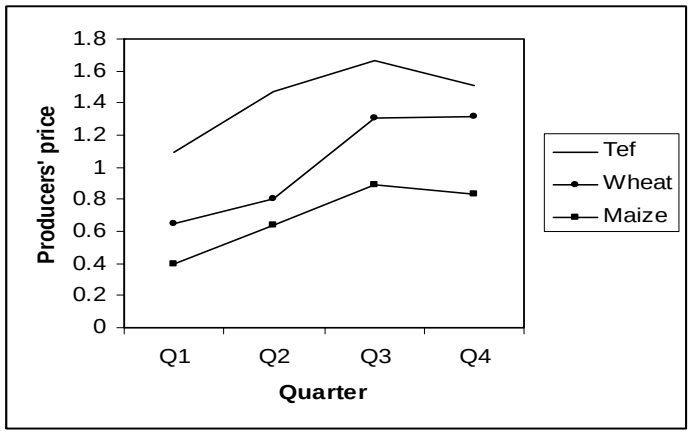

Fig. 2c. Producers' Prices Movement for Selected Crops (Arssi, Hetosa)
Source: CSA, 2002

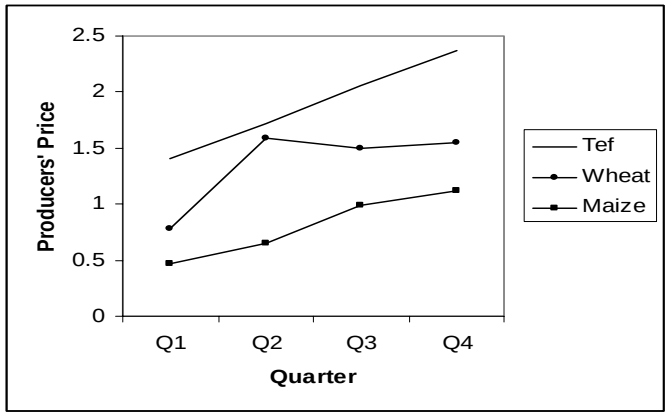

Fig. 2d. Producers' Prices Movement for Selected Crops (E. Shoa, Ada)
Source: CSA, 2002

3.3. Regression Results

Table 2 presents the tobit regression results. Our dependent variable is farmer's instant disposal behavior defined as the proportion of crops sold immediately after harvest. The explanatory variables are those indicating risk of post-harvest grain loss, characteristics of the post-harvest grain management practices, grain prices, household characteristics, and farmers' resource endowments. As could be seen a total of six variables have turned out to be significantly related to the dependent variable. Moreover, with the exception of the SEX variable, the signs of all of these variables are also according to *apriori* expectations, and the results are summarized as follows.

(i) The pressure on households triggered by larger family size to meet non-grain purchased consumption needs tends to induce farmers to instant crop sales;

(ii) Female-headed households are more susceptible to instant crop sales than male-headed ones. This may be ascribed to fewer options available to female-headed households in terms of resorting to other sources of incomes (e.g. livestock sales);

(iii) Application of chemicals (insecticides) reduces the risk of pest attack hence that of the tendency to instant sales;

(iv) Livestock ownership reduces the pressure on cash needs as households tend to resort to livestock sales and of its products rather than crop sales;

(v) Inter-crop differences are important in explaining households' behavior in sales decisions; i.e., farmers who mainly grow maize and wheat (more susceptible

crops) tend towards instant sales than those who mainly grow *teff* (a less susceptible crop); and

(vi) Households' immediate cash needs to meet various obligations explain the reason as to why they dispose their grain crops instantly at cheaper prices.

Table 2 : Tobit Regression Output

Variables	**Coefficient**	**T-ratio**
Constant	0.7694***	6.296
FSIZE	0.0135**	2.119
SEX	-0.1407*	-1.926
EDUC	0.0014	0.303
CHEM	-0.0762**	-2.440
STCAP	-0.0011	-0.183
TLU	-0.0084**	-2.547
PRICDIF	-0.3026**	-2.429
EXPLOSS	0.0984	1.081
TAXLOAN	0.0001***	3.150
Sigma	0.2598	
Number of samples	292	
Log likelihood function	-30.9562	

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

4. Conclusions and Policy Implications

Traditionally there has been a policy focus on production and marketing of food grains almost to a complete neglect of PHGM practices. This is true both at macro and micro levels of organizations. Not surprisingly, to date there is very little capacity of an efficient and effective PHGM system in place at macro (national), meso (regional, community) or micro (household) levels. As a result, grain markets are characterized by high inter-seasonal as well as inter-temporal volume and price fluctuations. On the one hand, there

is a high incidence of food insecurity in the country. On the other hand, an important opportunity seems to have been lost by way of reducing post-harvest losses. Hence, it is important to consider post-harvest grain management as strategic policy concern. In particular, it is significant that policy makers raise their awareness of the state of affairs and appreciate the importance of PHGM practices not just from the perspective of reducing losses, but also equally important, from the view point of considering it as an economic activity with employment, value and income linkages.

Liquidity constraints and impending risk of post harvest grain losses are the two most important factors explaining farmers' tendencies to instant sales of their grain crops immediately after harvest when grain prices are at their lowest levels. Liquidity constraints could be relaxed through the operation of credit markets and/or through rescheduling of financial obligations that are due to government (e.g., payment of land taxes, input loans repayment). Diversification of cash sources and in general integration of the production process with markets so that farmers would be more market informed and oriented in their decisions than subsistence driven is necessary for relaxing the liquidity constraints.

The problem is that quite often markets do not perform well. Hence there is clearly a need for introducing and strengthening appropriate institutions so as to enable markets work better. One viable option could be to introduce grain warehouse receipt system[5] so

[5] In warehouse receipt system, farmers store their marketable surplus (and/or part of their produce not required for immediate consumption) in a modern warehouse located in their villages. To certify their deposition they receive a receipt from warehouse managers that indicate the type and amount of produce they stored. (see, Coulter and Onumah, 2002; Gunther and Muck,1995 for more information).

that farmers would deposit their marketable surplus to be sold when prices get higher. There are legitimate reasons to suspect that increased production and availability of grains could lead to increased consumption instead of marketed surplus at household level. One of the reasons as to why warehouse receipt system of grain management makes a lot of sense, in addition to preventing post-harvest loss, is because it helps to reduce availability of grains for direct consumption by the producers, ease access to finance at all levels in the marketing chain, moderating seasonal price variability, maintaining quality standards, forward marketing and promoting instruments to mitigate price risks. Above all, the introduction of well-managed warehouses in rural villages will reduce post-harvest grain losses which ultimately support the country's effort to ensure national food security.

Finally, further studies are necessary to inform policy on credit and saving options (including options for introducing grain warehouse receipt systems), traditional methods of grain treatment (effectiveness, economy, health issues, etc.), and farm-nonfarm linkages and the scope for the development of agro-processing industries, including those small-scale farmer-managed grain processing technologies.

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