Diminishing Choices: Gender, Small Bags of Fertilizer, and Household Food Security Decisions in Malawi

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Abstract: This paper examines two decisions farmers in southern Malawi make every planting season: whether or not to acquire increasingly expensive chemical fertilizers and whether or not to buy and plant equally expensive hybrid maize seed. Both choices are interrelated. Maize is the staple food crop in Malawi and the key to food security; and traditionally, 95 percent of the total land area cultivated in maize has been planted to local open-pollinated varieties instead of the newer semi-flint hybrids. Local maize is very popular with smallholder subsistence farmers as is hybrid maize, that when fertilized, intensifies production improving food security at both household and national levels. In the current economic environment, however, planting hybrid maize has two drawbacks. The first is the high price of seed and the second is its high requirements of fertilizer. With fertilizer unaffordable to many farmers, especially to women farmers of poorer female-headed households, planting hybrid maize is impractical. This paper disaggregates Malawi's farmers into subgroups of men, married women, and female headed households, describes the decision processes they make, and examines whether small bags of fertilizer will make any difference to the dilemma they now face.

Introduction

It is the middle of September 1998 in Mayaka trading center in the southern region of Malawi. Just on the edge of town, there is an ADMARC, Malawi's agricultural marketing parastatal established in the early post independence years as is the key player of the Malawi government's relationship with the peasants [1] . As at so many other ADMARC centers at this time of year, people start queuing here early in the morning, waiting to buy whatever amount of maize they could afford to feed their families.

A woman in that line comes to ADMARC twice a week to buy maize for her family – if she has any money. There is absolutely no money for other necessities, such as soap, sugar, etc. She is no longer married as her husband died a few years ago. She is the main provider for her family. Her village is approximately six kilometers away and she walks the distance. She cannot afford to spend what little money she has on transport. The queue is long now, and so is the wait. The hungry season is upon her and will remain so until the first green maize is harvested sometime in late February or early March. In the coming year, if the rains are good and are on time, she and her family will be eating their own maize grown in her small garden. However, she now plants local maize and this means the hungry season will linger for a greater stretch because local maize takes longer to mature. Nevertheless, she is prayerful of a good

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harvest when she will gather in enough maize to keep her family fed until the end of October when the maize will run out and the hungry season returns. That is when she will begin her twice-weekly walk to ADMARC to buy maize – if she has money.

In that September of 1998, if she wanted to buy a 50kg bag of maize, she would have paid Malawi Kwacha (MK) 350. In September 2001, she would most likely not be buying at ADMARC due to ADMARC's low maize stocks. [2] Having to turn to the private market, the price would range between MK 15 – 17/ kg. If she continued to buy into December 2001, the price would be MK22 to MK25 / kg or MK1175 for a 50kg bag, three times as much as the price three years ago.

Maize is not the only commodity that has risen in price. Over the last half dozen years, the inflation rate has ravaged what meager savings she could scrape together. 1995 was the worst when food prices went up 133% while overall inflation was 98% (FEWS). By 2001, according to the National Statistical Office of Malawi, the inflation rate stood at 25% but this certainly was not the case with maize. No one would dare use this number to try to tell her that things were getting better. She knows better. She knows food is unaffordable as is the fertilizer she needs for her crops. She knows that the price for CAN went from MK 265 for a 50kg bag in 1998 to MK662 in 2000; that 23:21:0 + 4s went from MK347 to MK837 in the same period. If inflation is coming down it isn't on what matters most to her. And she knows that in this same time period her kwacha buys far less than it used to while the wages she earns doing casual labor – what is called "ganyu" - has remained stagnant.

Her food security situation is not exceptional. Many smallholder and subsistence farmers, men and women, are no longer able to produce enough food for their families. They are subsistence farmers who cannot afford the inputs necessary for an abundant harvest. It is a sad reality for far too many families in Malawi today. Even under the most favorable climatic conditions, they cannot afford to purchase fertilizer ever since the subsidy was removed under structural adjustment reforms, which started in 1986 and were not really effective until 1994. [3] Without fertilizer, the soil doesn't produce enough maize. Without fertilizer, they plant less hybrid maize, an expensive but less risky alternative to local maize. And with less maize, the number of households affected by an ever-deepening crisis of food insecurity is steadily increasing. [4] Njala – the Chichewa word for hunger – is heard in villages throughout Malawi.

Malawi's soils are losing their ability to produce. Food self-sufficiency is a distant and fading goal. Declining soil fertility is constraining food production and has been for a number of years now. [5] This fact was clear to everyone - not only the farmers themselves back in 1996, but also agronomists and soil scientists, technocrats and politicians. Poor yields and hungry children provide disturbing yet ample evidence of a problem growing only worse every day. As the price of fertilizer exceeds farmers' reach, hunger spread throughout the country and the hunger season lengthens. As the depletion and degradation of Malawi's soils continues people who depend on these soils for subsistence are finding that their options to deal with the crisis are severely limited.

This paper examines two of those options, the use of inorganic fertilizer and the planting of hybrid maize. Both options are interrelated. Maize is the staple food crop in Malawi with two general categories: local and hybrid. Local maize is very popular and many smallholder subsistence farmers plant it. Hybrid maize was developed to intensify production and

therefore improve food self-sufficiency. Compared to local maize, hybrid has two distinct advantages. First, it produces significantly higher yields. Second, it matures much faster than local maize and minimizes the risk of crop loss if the rains should happen to end sooner than normal.

In the current economic environment, however, planting hybrid maize has two significant drawbacks. The first is the price of the seed. Whereas local maize seed can be obtained from the previous years crop, hybrid seed needs to be purchased in order to maintain the advantage of higher yields. The other drawback is the requirement of fertilizer. Hybrid is now an expensive investment. [6] With fertilizer now out of the reach of most smallholder farmers, planting hybrid maize is much riskier. Unfertilized hybrid maize yields generally are not that significantly better than local maize to justify the price of the seeds, although research has shown that in certain climatic and soil conditions it can be. Nevertheless, farmers have seen a steep increase in the prices of both hybrid seed and fertilizer causing many to reconsider the risk of planting hybrid. Using money for unfertilized hybrid seed might be better spent on something else.

Weather has to stand out as the greatest risk all farmers face for the obvious reason that it is outside human agency. Decisions concerning hybrid maize and fertilizer are riskier for poor households in part because the weather can devastate the household's thin economies. If the rains are heavy and the hybrid crop is washed away or the fertilizer leeches through, a significant loss is incurred. Even though rain patterns vary considerably throughout the country, in the past two years floods and drought have devastated much of the country. Many farmers fortunate enough not to have suffered from the flood in 2001 may not have been so lucky in escaping the ravages of the current drought. It seems likely that these experiences will affect future decisions concerning planting hybrid maize. [7]

Although food production is an important aspect of household food security or insecurity, it is not the only one and focusing only on increasing production would not necessarily convert a household from being food-insecure to being food-secure. Other factors certainly influence a household's food security including land size, family size, poverty and outside or off-farm income generating activities, to name just a few. [8] Thus, a household with only 0.35 hectares (ha) of land, limited income, high poverty and seven mouths to feed most likely will never be able to produce enough food to be food secure.

Nonetheless, a trend of increasing production is a key factor contributing to achieving both household and national food security particularly for the poorest countries. [9] For Sub-Saharan Africa, and particularly Malawi, it will not be an easy task. In order to meet nutritional requirements by 2008, grain yields will have to increase by a rate 60% higher than achieved during 1980 –1997. [10]

Increasing production would help close the food gap –shorten the hungry season – and have a positive impact on an impoverished family, simply because the less frequently food is purchased during the hungry season, when prices are typically high, means that more cash can be spent on other necessities. [11] Thus, decisions made by subsistence farmers– particularly women farmers who usually produce the subsistence crops in Malawi– that affect production and yields are vitally important in addressing household food security and poverty.

HOUSEHOLD FOOD SECURITY

The concept as well as the locus of food security has evolved since the early 1970s. Up until the mid – 1980s, analyses of food security were concerned with increasing national food stocks and stabilizing the supply of basic staples. [12] Since the mid -1980s and much due to the writings of Amartya Sen, however, the focus shifted to one of identifying the particular households that were food insecure and increasing their access to reliable food supplies. National food security is now recognized as a necessary but not a sufficient condition for household food security. [13] Household food security is a better construct as it reveals a multidimensional perception of all the factors contributes to food security beyond the supply-side factor of aggregate food production. Household income and poverty on the demand-side of the equation are now considered key in determining whether a household is food secure or insecure. [14] Viewing food security in this way show poor households caught in a vice: they are limited in their ability to purchase food outright while at the same time unable to increase production due to inadequate resources for sufficient inputs (i.e. seed, fertilizer) at the proper time.

As the concept of food security evolved, various themes and sub-themes appeared in the literature. [15] By the late 1980s and early 1990s, nutrition became an important measurable variable in defining household food security and determining whether households were food security. [16] Households are now considered food secure when they are "able to obtain adequate levels of food, either through home production, purchases or exchanges, to maintain a healthy and active life throughout the year". [17] Household purchases of food now become as important as household production of its own food. In addition, household self-sufficiency in food does not guarantee adequate nutritional levels within the household. [18] Intra-household distribution of food may be skewed such that there are individuals within the family who are malnourished.

If adequate nutritional levels are to be achieved and sustained, then reducing poverty and increasing incomes become parallel streams of concern. Sen suggests that more emphasis should be placed on reducing poverty than introducing technologies to increase food production with food insecure households, because they will never be food self-sufficient. Farmers with little land – 0.3 hectares or less – are chronically food insecure when they depend on their own food production. [19] These smallholders either have to find off farm work, be involved in income generating activities, or grow crops for sale. It is this latter point that growing hybrid maize addresses, although clearly not the only reason to grow it. Yet even hoping to sell hybrid to raise cash is problematic for food insecure smallholders as they tend to sell part of their hybrid maize crop right after harvest, partly because it does not store well and partly due to a great need for cash in the household at the end of the hungry season. [20]

Achieving goals of healthy nutrition and food security are intimately linked with issues of poverty alleviation and human resources development. In turn, these issues cannot be adequately engaged without a thorough understanding of gender relations and the role women have in the household. It is therefore necessary to investigate who makes the decisions regarding production, income generation, and crop selection within the household.

GENDER AND HOUSEHOLD FOOD SECURITY

There is no denying that the role of women in agriculture in Africa is extensive [21] . The importance of women in this vital sector was first introduced in Boserup's seminal work *Women's Role in Economic Development* in 1970. Since then, a burgeoning field of research has built on her pioneering work deepening our understanding of the vital position women occupy in food production and their primary position in the household decision process. Even so, it is a sad commentary that women's concerns continue to garner less attention in the food security literature than their obvious prominence would seem to argue for [22] .

This research explores the role of gender and gender relations as they affect food security. How these relations are constructed and maintained reveal much in determining resource distribution within the household. Particularly salient in the study of household food security in Sub-Saharan Africa is how gender factors into a multitude of decisions including what to produce and how to produce it, land allocation, how money should be spent in the acquisition or production of food and what are the opportunities and choices in the decision process. In addition, analysis through gender allows for greater attention to be paid to the constraints that limit women's productivity and the effect on women's workload. [23]

Agriculture is the mainstay of Malawi's economy with over 80% of the population either directly or indirectly dependent on it for their livelihood and welfare. According to statistics from the Ministry of Agriculture, women are the dominant agricultural labor force. In 1993, 92.5% of female labor was involved in agriculture compared to 69.3% of men. [24] Over 30% of Malawi's GDP is produced by agriculture with two - thirds coming from the smallholder sector. Since the mid-1990s the smallholder sub-sector is made up of nearly 1.8 million farms dominated by women with estimates of 30-40% of the families' being female headed. Disturbingly, half of the female-headed smallholder households do not reach the 40th percentile of income, as compared to a third of smallholder male heads of households. [25]

Landholding size has a pronounced effect on the success of smallholder agriculture, as does labor availability and money for inputs like seed and fertilizer. Therefore, it also has an equally pronounced effect on household food security. In 1991/92, 41 percent of smallholders had farms of less than half a hectare. [26] As population pressures increase, landholding size is expected to shrink from 0.46 ha per person in 1987 to 0.31 ha by 2001. [27] The logical conclusion is as clear as it is distressing: already impoverished farmers with the smallest landholdings, half of whom are female headed households (FHHs), will bear the brunt of this downward spiral. [28]

In Malawi, women play a predominant role in producing, storing, processing and preparing food for the family. They concentrate on growing food for their family's consumption compared to men who are often more involved in growing cash crops. As a result, cash income is much less for women as they tend to be involved much more in informal income generating activities. The small amounts of cash these activities provide are very often used to buy additional food to make up for shortfalls. [29]

It is clear that gender and household food security are essentially and fundamentally linked in Malawi as they are in most of Africa. [30] And just as in Malawi, the need to find ways to increase food production is essential as increasing populations and declining soil fertility are creating intolerable conditions for millions. However, advances in food production are constrained by the "invisibility factor," i.e., women do most of the food farming but have little access to the means necessary to significantly increase output and yields. [31] Although African

women supply 46% of the agricultural labor and in some societies produce up to 80% of the domestic food "women's yields, women's adoption, and women's uses of inputs are rarely reported." [32] Agricultural experts seldom recognize that most of Africa's smallholders are women. [33] While rightly contending that the effectiveness of development strategies hinges on reaching African smallholders, they make the costly error of ignoring the fact that the constraints facing women smallholders may be an important part of the problem. The disconnect is as appalling as it is frustrating. The key role that women play in procuring adequate supplies of food for their families on a sustainable basis shows that food security is a prime concern for them.

RESEARCH SETTING

The overall purpose of this research was to ascertain what criteria and constraints effected farmer's decisions about using organic and/ or inorganic fertilizer in an environment shaped by structural adjustment policies. In 1998, it could not have come at a more appropriate time. Fertilizer verification field trials had just been completed throughout Malawi with the goal of recommending fertilizer application rates based on soil type. [34] However, the economics of the situation could not be ignored and in the final analysis, based on the ratio of fertilizer prices to maize prices, the "most profitable recommendation for farmers in most areas of Malawi was to apply no fertilizer to their hybrid maize." [35] The recommendation was not put forth without serious consideration for what that would mean for resource poor farmers. For the near future, the prognosis was "grim".

This research was conducted in the Zomba district of southern Malawi during the months of May and June of 1997 as part of the Gender and Soil Fertility Project though the University of Florida's Soils Management CRSP. Zomba's topography varies from mountainous and hilly regions, located between Machinga and Zomba district in the southern area, to broad, flat plains in the upper Shire River and east to Lake Chilwa. The diverse topographical characteristics cause a wide range of climate diversity. As a result, temperature difference and rainfall distribution may vary considerably between neighboring sub-districts, in effect, creating different climates for farmers separated by just a few kilometers. These variations and differences are important to keep in mind: Zomba's variations in climate, soil and topography make it difficult to speak of Zomba in a singular, unified way. For example, Mtubwi in the northern area of Zomba and in the upper Shire valley is at a much lower elevation than Malosa that borders on the south of Mtubwi district. Yet Mtubwi in the rain shadow of the mountains is much drier than its immediate neighbor to the south.

The sample covered 8 sub-districts. A total of sixty farmers were interviewed broken down into three sub-groups based on gender and marital status and comprised 16 men in male headed households (MHHs), 23 married female farmers (MF), and 21 female-headed households (FHHs). Within each sub-district, I interviewed 6 farmers, 2 farmers from each sub-group, if possible.

A comment on the categories of MHH, MF, and FHH is necessary. These were deliberately chosen in order to see if marital status had any affect on decisions concerning fertilizer and hybrid maize. I could have broken farmers down into just male and female but that would have "muddied the waters" particularly in regards to women's decisions in female-headed

households. It is well recognized that the constraints FHHs face are much different than in MHH and they should be separated if the problem of household food security is to be properly addressed. Throughout the literature it is suggested that women in MHHs are more likely to concede to the husband for crucial decisions. Separation of married women (MF) from FHHs was done with the expectation that the married women's decisions, strongly influenced by their husbands, would closely resemble the decisions of male farmers [36] .

DECISION TREE MODELING

As the purpose of this research was to identify criteria and constraints facing farmers in Zomba in regard to use of inorganic fertilizer and planting hybrid or local maize, it seemed appropriate that decision tree modeling be used. The advantage of using decision tree models is that they are testable, cognitive models useful in describing specific criteria and constraints. [37] Decision trees are maps guiding the observer along the way as informants / experts go about choosing between a set of alternatives located at the top of the tree (denoted by { }). [38] The tree is composed of separate decision criteria (denoted by < >) that are arranged in a logical path that leads to a specific outcome (denoted by [ ]), e.g., [Use chemical fertilizer; don't]. Once constructed, the decision tree model can be tested for accuracy in prediction of the choices made by another sample of decision makers from the same group. [39] Should the prediction accuracy of the model be 85% or better, then it is judged to be an adequate model of individual decision processes of members of that group. [40]

The researcher may then identify the main factors limiting adoption or use of one of the alternatives, e.g., chemical fertilizer. These limiting factors are the criteria on the path leading to negative outcomes, e.g., [Don't use chemical fertilizer]. In this way, decision trees highlight criteria policy makers might use to encourage adoption of some intervention, e.g., fertilizer, by the target population. When results of testing a decision tree model are disaggregated by gender, as they are in this paper, then policy makers can clearly identify the main factors limiting adoption and use of the intervention by women as well as men. When results are disaggregated by marital status and gender, as they are here, then policy makers can see if there are more factors limiting adoption by FHHs than men and women in MHHs, or if some factors are more limiting to FHHs than to MHHs.

CONSTRAINTS TO USING CHEMICAL FERTILIZER

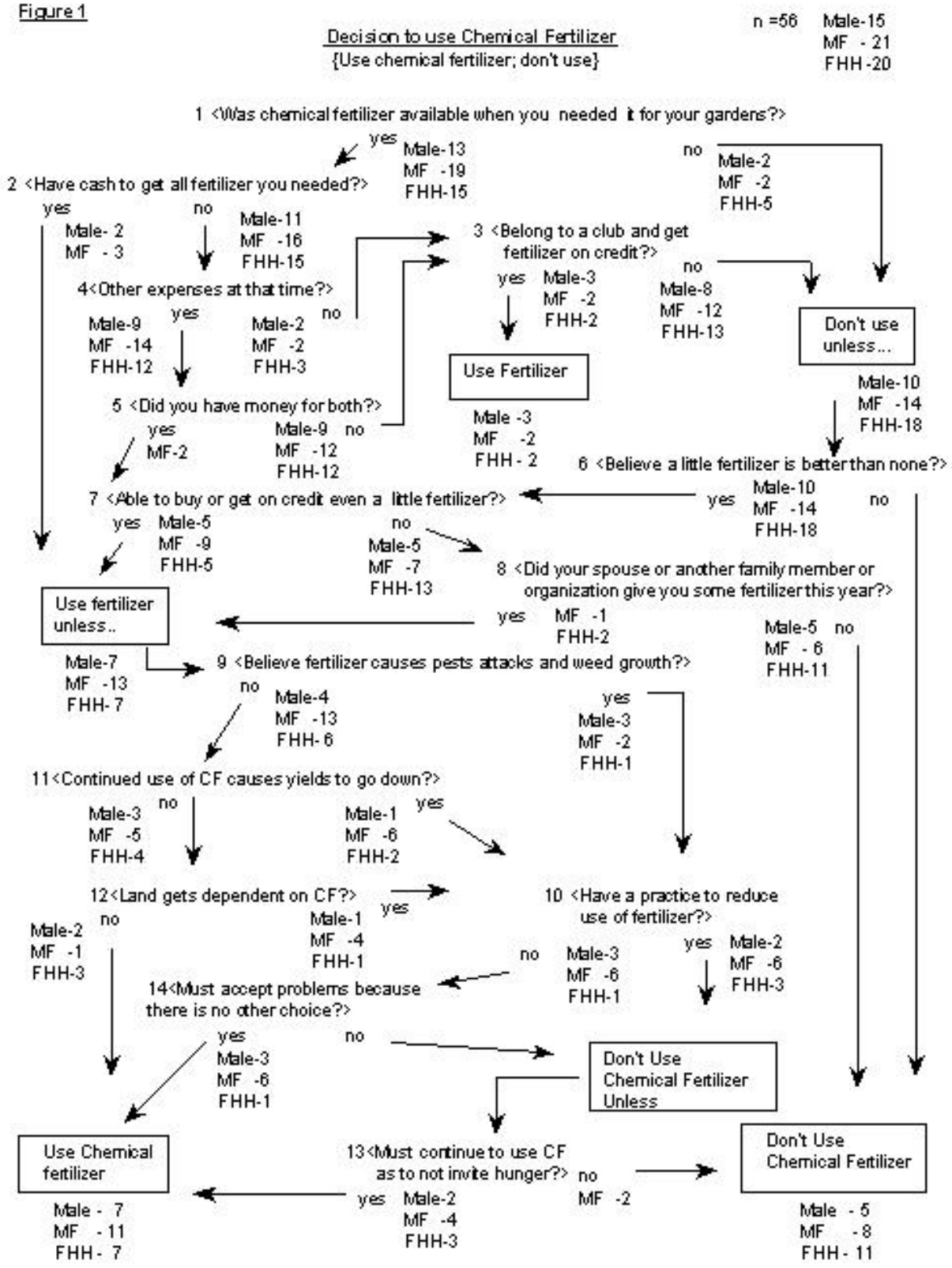
In the 1995/96 season, 80% of all informants used some chemical fertilizer on their maize. One year later, 1996/97, that number declined to 65% of all informants. The largest decline occurred within FHHs with a drop from 74% to 52% of all informants using some chemical fertilizer. Male informants (Male) and Married Female (MF) informants dropped 12% and 13% respectively. Over the same two seasons, there was a decline of 27% in the amount of fertilizer applied. The reasons most cited were the high price of fertilizer and the farmer's lack of cash. Not surprisingly, FHHs showed the greatest decrease in the amount used (34%). Married female informants reduced the amount used by 22% and male informants decreased the amount used by 26%.

As can be seen in Figure 1, for 89% of the informants, not having enough cash to obtain *all* the chemical fertilizer they needed was the main limiting factor (criterion 2). This is far from surprising in light of the rise in the price of fertilizer and the devastating effects devaluation of the Malawi Kwacha has had on most rural households. A very high percentage of male and married female farmers (87% and 86% respectively) did not have the cash to buy all the fertilizer they needed; while 100% of FHHs lacked the money to buy all the fertilizer they needed. Clearly, these figures suggest FHHs are "the poorest of the poor."

The importance of credit in the decision to use chemical fertilizer is evident from criterion 3 that separates the farmers who belong to farmers' clubs and get credit for fertilizer from those who don't; the former are sent to the outcome [Use fertilizer]. They are few, however. Criterion 6 confirms farmers' beliefs that chemical fertilizer is essential for good yields, while criterion 7 "cuts" farmers into those who are able to purchase or get credit for some fertilizer versus those who are not. In this case, it is the combination of marital status and gender that limits use of fertilizer: only 20% of FHHs were able to apply some fertilizer, compared to 50% of married women (MF) and 60% of male farmers (Male). Of those who could not apply some fertilizer, very few received free fertilizer from any source.

Of 13 FHHs who could not obtain some fertilizer, two (12%) received some fertilizer for free. One received it from her father because "she is a widow" and another received it from her mother. Of 7 married women, only one received free fertilizer, however, no male farmer received any fertilizer for free. Thus this decision tree suggests that three factors - lack of cash, not belonging to an active club and not having a source for free fertilizer - were the major reasons for keeping 55% of FHHs and 33% of married women and male farmers from using fertilizer.

Figure 1


Decision to use Chemical Fertilizer
{Use chemical fertilizer; don't use}
n =56 Male-15 MF - 21 FHH -20
1 <Was chemical fertilizer available when you needed it for your gardens?>
yes Male-13 MF -19 FHH-15
no Male-2 MF -2 FHH-5
2 <Have cash to get all fertilizer you needed?>
yes Male- 2 MF - 3
no Male-11 MF -16 FHH-15
3 <Belong to a club and get fertilizer on credit?>
yes Male-3 MF -2 FHH-2
no Male-8 MF -12 FHH-13
Don't use unless...
4<Other expenses at that time?>
yes Male-9 MF -14 FHH-12
no Male-2 MF -2 FHH-3
Use Fertilizer
Male -3 MF -2 FHH - 2
5 <Did you have money for both?>
yes MF-2
no Male-9 MF -12 FHH-12
Male-10 MF -14 FHH-18
6 <Believe a little fertilizer is better than none?>
yes Male-10 MF -14 FHH-18
no
7 <Able to buy or get on credit even a little fertilizer?>
yes Male-5 MF -9 FHH-5
no Male-5 MF -7 FHH-13
8 <Did your spouse or another family member or organization give you some fertilizer this year?>
yes MF -1 FHH-2
Use fertilizer unless..
Male-7 MF -13 FHH- 7
9 <Believe fertilizer causes pests attacks and weed growth?>
no Male-4 MF -13 FHH- 6
yes Male-3 MF -2 FHH-1
Male-5 no MF - 6 FHH-11
11<Continued use of CF causes yields to go down?>
no Male-3 MF -5 FHH-4
yes Male-1 MF -6 FHH-2
12<Land gets dependent on CF?>
yes
no Male-2 MF -1 FHH-3
Male-1 MF -4 FHH-1
10 <Have a practice to reduce use of fertilizer?>
yes Male-2 MF -6 FHH-3
no Male-3 MF -6 FHH-1
14<Must accept problems because there is no other choice?>
yes Male-3 MF -6 FHH-1
no
Don't Use Chemical Fertilizer Unless
Use Chemical fertilizer
Male - 7 MF - 11 FHH - 7
13<Must continue to use CF as to not invite hunger?>
yes Male-2 MF -4 FHH-3
no MF -2
Don't Use Chemical Fertilizer
Male - 5 MF - 8 FHH - 11

Other criteria on the tree deserve attention. Some farmers have doubts about the continued use of fertilizer; some believe it causes pest attacks and weed growth (criterion 9). Others believe they must continue to use fertilizer, once they start, because the land gets dependent on chemical fertilizer (criterion 12). If they don't continue to use it, their yields might go down (criterion 11). Some farmers thus develop strategies or practices to reduce their fertilizer use (e.g., complementary use of manures, legumes, crop rotations) (criterion 10); farmers without such a practice feel they must continue its use so as not to "invite hunger" (criterion 13). Even though 21 of 28 (75%) farmers feel chemical fertilizer has its drawbacks, and just over half of this group know of a practice that could reduce the use of chemical fertilizer, 82% believe chemical fertilizer forestalls hunger. The 48% of farmers who do not have a practice to reduce their fertilizer use believe they have no other choice but to use chemical fertilizer (criterion 14).

This belief should not be underestimated as it has important implications for researchers trying to develop substitutes for chemical fertilizer. Organic alternatives to chemical fertilizer are available in the form of intercropping with grain legumes, adopting agroforestry innovations, and using animal manures. But few farmers are doing any of these *as a replacement for inorganic fertilizer*. This research shows that farmers desire chemical fertilizer because they see it as the best defense against a poor harvest. It also shows that few, if any, have access to enough animal manure to make a difference. Finally, the research shows that farmers are intercropping with grain legumes. What needs to be asked is whether they are improving the soil fertility with the grain legumes to such a degree that they do not need as much or even any chemical fertilizer. Intuitively, it would seem that the extensive intercropping of grain legumes over the years would have increased soil fertility to such a level that two things would be occurring simultaneously: an increase in maize yields along with a decrease in the need for chemical fertilizer. Because that is not happening, we need to investigate the reasons why.

As shown in the paper by Gladwin, Peterson, and Uttaro in this special issue, most Zomba farmers either lack knowledge of trees and shrubs that might improve their soil; or being aware of their imputed benefits, fully understand the management of them. Large amounts of time, effort and money have been invested in discovering ways to improve Malawi's soil fertility with green manures and other new soil improvement technologies. Over time this research should disseminate out to farmers throughout Malawi and it is hoped that Malawi's rate of declining soil fertility will slow down and even be reversed.

There are reasons to be concerned that even if the research is disseminated throughout the country, it may not have as great an effect as initially hoped. One of several factors is farmer practice and management of green manures that, in spite of research efforts, will mean a future where the majority of farmers in Malawi continue to experience declining soil fertility and increasing food insecurity. It is vital to understand what green manure is planted, why it is planted, and how it is managed and used in the garden. This is key and directly ties into whether chemical fertilizer remains a necessary input or not for adequate yields. If the green manure is used according to the protocols of the research, the need for chemical fertilizer should be greatly diminished, if not completely eliminated. Conversely, any deviation from the protocols that lessen its effect should correspond to a need for some chemical fertilizer.

Every farmer interviewed was intercropping the maize garden with crops such as pumpkin, pigeon pea, cowpea, and groundnuts. Grain legumes are the most prominent with

pigeon pea ubiquitous throughout the Zomba RDP and all 60 farmers in my survey had it in their garden. A smaller yet substantial number (28 or 47%) planted mucuna. Although both mucuna and pigeon pea offer great potential as a green manure, the farmers are not treating them as such. The important question from a soil fertility perspective is how the farmer views a grain legume because that is going to determine how it is managed and ultimately whether it addresses soil fertility.

Research has shown mucuna and pigeon pea it to be beneficial intercrops and a significant number of surveyed farmers believe each is beneficial for their soil (Table 1 and Table 2 below). [41] However, according to agronomic research and personal interviews with agronomists, addition of enough nitrogen to significantly benefit the plants requires plant biomass to be turned under and incorporated into the soil before the pods and seeds form and mature - *a practice not a single informant in the survey engages in*. Timing, in this regard, is essential. After seed formation and the growing period, the plant virtually stops nitrogen fixation and transportation, concentrating nitrogen in the seeds while significantly reducing the amount of nitrogen in the leaves. [42]

Farmers in Zomba are intercropping primarily for food –not for soil improvement; a reasonable, rational and understandable purpose. Small land holdings combined with lower yields due to declining fertility places food as the first priority. In this sample of farmers, 95% rank pigeon pea as a food crop first (Table 1 below). The second priority is to sell the pea. Trailing far behind was the goal to improve the soil and of the 3% who ranked soil improvement as a first priority, not one turned the leaves under before seed formation. They even said that they like to eat and sell pigeon pea.

This should come as no surprise because pigeon pea is almost never used as a green manure crop (i.e. turned over before maturity). Other characteristics of pigeon pea, such as its slow initial growth and temporal complementarity with maize, make it an ideal intercrop to grow for seed. Additionally, the plant resembles more of a small tree than a short plant that would be easier to incorporate. One should therefore not expect any survey informants to turn pigeon pea under while green.

That being said, by treating pigeon pea as a food/cash crop, farmers are removing most of the nitrogen in the seedpod. Any senescing leaves that are brown contain much less nitrogen. Unless the farmer returns to the field and incorporates the dry leaves into the soil they remain on the soil surface throughout the dry season. [43]

Table 1: Farmers Ranking of Reasons for Planting Pigeon Pea

n = 60 % in ( )	Believe PP Improves Soil	Plant Pigeon Pea	Prioritize Plant to Eat			Prioritize Plant to Sell			Prioritize Plant to Improve Soil		
			1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Male	15	16	14	2	0	1	9	0	1	4	9

n=16	(94)	(100)	(87)	(13)		(6)	(56)		(6)	(25)	(56)
Married Female n=23	18 (78)	23 (100)	23 (100)	0	0	0	17 (74)	2 (13)	0	5 (22)	13 (56)
Female Headed Household n=21	15 (71)	21 (100)	20 (95)	1 (5)	0	0	15 (71)	4 (19)	1 (5)	5 (24)	12 (57)
All	48 (80)	60 (100)	57 (95)	3 (5)	0	1 (2)	41 (68)	6 (10)	2 (3)	9 15)	34 (57)

Mucuna, on the other hand, is a legume species better suited for green manuring and therefore, how the farmers view it will be more revealing. Mucuna is not as popular as pigeon pea and those who did not grow it cited its tendency to "take up too much room" and that it "creeps" as the main reasons for not planting it. These farmers feel mucuna is not an easy plant to manage and threatens any maize in the immediate vicinity. Even so, 77% of all farmers believe mucuna improves the soil (Table 2).

Slightly less than half of those interviewed (47%) planted mucuna, feeling that the benefits of mucuna outweighed the negatives. But soil fertility is not the primary reason why they plant it. It is not even the second reason. Like pigeon pea, 82% of the farmers who planted mucuna planted it as a food crop first. To sell was ranked second by 18% and only one farmer gave soil improvement first priority. Interestingly, when asked if he liked to eat or sell the beans, he said yes.

Table 2: Farmers Ranking of Reasons for Planting Mucuna

n= 60 % in ( )	Believe Mucuna Improves Soil	Plant Mucuna	Prioritize Plant to Eat (% of those who planted)			Prioritize Plant to Sell (% of those who planted)			Prioritize Plant to Improve Soil (% of those who planted)		
			1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Male	13	9	8	1	0	0	4	3	1	3	4

n=16	(81)	(56)	(89)	(11)			(44)	(33)	(11)	(33)	(44)
Married Female n=23	20 (87)	10 (43)	10 (100)	0	0	0	8 (80)	1 (10)	0	2 (20)	8 (80)
Female Headed Household n=21	13 (62)	9 (43)	5 (55)	4 (44)	0	5 (55)	4 (44)	1 (11)	0	1 (11)	7 (77)
All n=60	46 (77)	28 (47)	23 (82)	5 (18)	0	5 (18)	16 (57)	5 (18)	1 (4)	6 (21)	19 (68)

The same practices emerge with mucuna as with pigeon pea. When asked if they incorporate the leaves into the soil while still green and before the seed pod forms, not one farmer answered yes. Mucuna is grown for seed and as such, it is treated as primarily a food crop. Farmers are removing the seeds form the fields leaving the dry leaves on the soil surface.

Research has shown that leaf residue adds nutrients as well as biomass to the soil. The question is whether it is enough to compensate for the nutrients taken up by the following maize crop. Does the leaf residue create a net gain of nitrogen in the soil? Or is the outcome less optimal by simply restoring nutrients that would occur without legume intercropping? Again, this depends on what the farmer does. How the residue is managed determines its soil fertility benefit. For example, incorporating the dry leaves of pigeon pea by themselves will lead to a small net increase in soil nitrogen (1-2% N) in the short term. However, should farmers turn the leaves into the new ridges with the maize stover, then the stover binds the nitrogen, resulting in no nitrogen benefit for the following maize crop [44]. Unfortunately, this is a very common practice in Malawi.

An even more serious threat is the widespread practice of burning to clear fields during the dry season. In this case any nitrogen remaining in the dry leaves is lost in the fire. From a soil fertility standpoint, this practice is devastating. Since land is scarce in southern Malawi, gardens tend to border each other. When burning takes place the fire usually spreads to other farmer's gardens thus denying them of any benefits from the leaf residue.

It is risky to assume that intercropping maize with a grain legume will eventually lead to a greater soil fertility reducing the need for fertilizer. Under sowing dry leaves with the stover and/or clearing the land with fire are two very common practices that seriously jeopardizes the benefits obtained from growing pigeon pea as a food crop. Even the assumption that dry leaves add biomass to the soil is highly questionable in fields cleared with fire.

If farmers choose to plant a green manure as a food source, it will be managed in a way that truncates its imputed potentiality. Moreover, what farmers do after harvesting the seed

will further effect soil fertility and that in turn dictates whether chemical fertilizer is needed and how much. These practices directly influence the length of a household's hunger season. Planting legumes for food addresses an immediate concern. Planting a legume as a green manure to improve soil fertility for the next year's harvest addresses a more distant concern. Prolonging hunger now is not an option.

In light of these challenges, the need for chemical fertilizer remains high in Malawi. Of the 60 informants, 57 believe chemical fertilizer as indispensable for improved yields, whether they are currently using it or not. Without it, they feel they are "inviting" hunger. Of all 60 informants, 54 (84%) believed they must use chemical fertilizer in order avoid hunger, regardless of any problems they identify with it. [45]

THE DECISION TO USE SMALL BAGS OF FERTILIZER

Clearly, chemical fertilizer is highly desired by farmers in Zomba. However, only a few farmers are able to purchase the amount of chemical fertilizer they think is necessary for optimal yields. The steep rise in the price of chemical fertilizer is attributed to the removal of fertilizer subsidies and even more so, the devaluation of the kwacha over the last five years. More and more farmers are finding that the cost of a 50 kg bag of chemical fertilizer is simply out of their reach. Asked if even a little fertilizer was better than no fertilizer at all, it was not surprising that every informant answered yes. The next best scenario then would be obtaining less than adequate amounts of fertilizer.

One innovation that was being introduced at the time in some parts of Malawi is repackaging fertilizer in smaller quantities than 50 kg bags. For example, in Dowa, in the central region of Malawi, VEZA/HODEZA offers fertilizer in smaller than 50 kg bags. Small bags of fertilizer, it was hoped, would provide some fertilizer to poor farmers whose purchasing power had been drastically eroded. Farmers who do not have the cash for a 50 kg bag might purchase a smaller quantity of fertilizer – a quantity they could afford. [46]

Moreover, it is anticipated that the use of small bags of fertilizer by FHHs would be one way to improve food production on their very small landholdings. Cash was the main constraint stated by all farmers who do not apply any fertilizer or manure on their maize (n = 18). But when asked if they had the cash for at least a small bag of fertilizer, although eight farmers said yes (44%) the result is less encouraging for FHH. At issue is whether or not poorer FHHs would be able to afford even a small bag of fertilizer. Table 3 shows that seven out of 10 FHHs not using fertilizer or manure now say they would also not be able to afford a small bag of fertilizer. (These results are replicated by D'Arcy in Dowa, central Malawi. [47])

Table 3: Number of Farmers Not Using Any Fertilizer or Manure Likely to Buy Small Bags

Have Cash For Small Bag of Fertilizer?	Yes	No
Male (n=4)	2	2
Married Female (n=4)	3	1
FHH (n=10)	3	7

All (n=18)	8	10

The second concern hoped to address matters of weight and transport, particularly important for FHHs. Transporting fertilizer is a factor in its use and smaller bags would be easier to carry, not only from the store or club, but also to the field. [48] It was argued that lighter weights would not only be an incentive to buy the smaller bags of fertilizer but for some farmers whose health is deteriorating - and in Malawi, there are many farmers in poor health - it may be one of the more important ones. However, the problem of FHHs not having available cash for small bags lessens the saliency of the benefit of smaller weight for them.

Other issues surface in the model of the decision to use small bags of fertilizer, seen in figure 2, which lists reasons why almost all (59 of 60) informants choose not to use small bags of fertilizer. Only one informant is able to continue to stage-2 criteria, for brevity not presented here. [49] Criteria in figure 2 say that farmers will switch to smaller bags of fertilizer if they need more than a 50 kg bag for their crops and cannot afford to buy another one (criteria 1,3), or they need less than 50 kg and cannot afford to buy even one 50-kg bag (criteria 2), or (and this is true for the majority) they are not able to share or split a 50 kg bag with someone (criterion 5).

Surprisingly, a large percentage of farmers (70%) responded positively when asked if they can share the cost of a 50 kg bag of fertilizer with family, friends, or neighbors. Indeed, if this is the case, then the ability to share a 50 kg bag is a significant factor limiting the demand and use of smaller bags, which are more expensive per kilogram of fertilizer received. However, the way the criterion was phrased might have been misleading. To ask "Are you able to share the cost?" is not the same as asking "Do you share the cost of a bag?" The phrasing of the question is unclear such that responses are ambiguous.

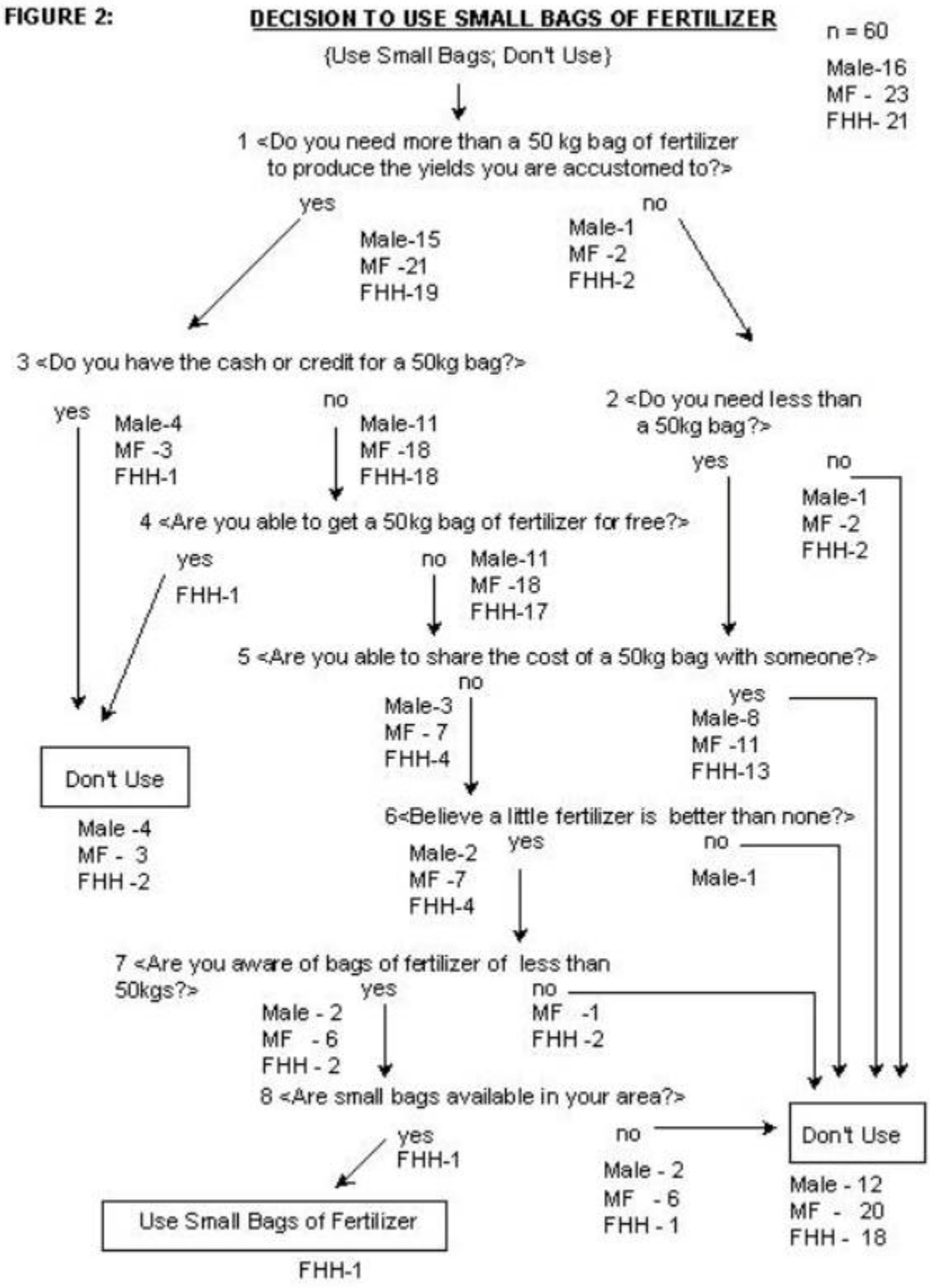


FIGURE 2:
DECISION TO USE SMALL BAGS OF FERTILIZER
{Use Small Bags; Don't Use}
n = 60
Male-16
MF - 23
FHH- 21
1 <Do you need more than a 50 kg bag of fertilizer to produce the yields you are accustomed to?>
yes
Male-15
MF -21
FHH-19
no
Male-1
MF -2
FHH-2
3 <Do you have the cash or credit for a 50kg bag?>
yes
Male-4
MF -3
FHH-1
no
Male-11
MF -18
FHH-18
2 <Do you need less than a 50kg bag?>
yes
no
Male-1
MF -2
FHH-2
4 <Are you able to get a 50kg bag of fertilizer for free?>
yes
FHH-1
no
Male-11
MF -18
FHH-17
5 <Are you able to share the cost of a 50kg bag with someone?>
no
Male-3
MF - 7
FHH-4
yes
Male-8
MF -11
FHH-13
Don't Use
Male -4
MF - 3
FHH -2
6<Believe a little fertilizer is better than none?>
yes
Male-2
MF -7
FHH-4
no
Male-1
7 <Are you aware of bags of fertilizer of less than 50kgs?>
yes
Male - 2
MF - 6
FHH - 2
no
MF -1
FHH -2
8 <Are small bags available in your area?>
yes
FHH-1
Use Small Bags of Fertilizer
FHH-1
no
Male - 2
MF - 6
FHH - 1
Don't Use
Male - 12
MF - 20
FHH - 18

Unfortunately, there simply are not enough data here to support the conclusion that farmers are sharing the cost of 50-kg bags of fertilizer with family and neighbors. Out of 60 informants, only five (8%) specifically mentioned that they either received fertilizer from a family member or gave some to a family member. Only one informant said she was sharing the cost of a bag with a neighbor. Other data seems to speak against current sharing. Within the last three years, fourteen farmers (23%) were using fertilizer and stopped due to its high cost. Not one of these informants is now receiving fertilizer from a family member, friend or neighbor; yet 11 of the 14 said they could share the cost of a bag with someone.

The option of farmers' obtaining fertilizer repackaged in a small bag does not look promising. There are two obstacles - one serious - inhibiting the use of small bags. First, the less serious obstacle is availability. During the 1996/97 growing season finding small bags of fertilizer in Zomba was difficult. In fact, they were almost non-existent. There was, however, a noticeable increase in availability of small bags in the 1997/98 season in major market centers such as Mayaka, Jali, and urban centers of Blantyre, Lilongwe and Zomba. Managers in a few other market centers informed me that they expected to have smaller bags of fertilizer arriving before planting season. In smaller trading centers and other rural centers small bags remained unavailable. Nevertheless, fertilizer in small bags was appearing in places where they were absent the year before.

A greater obstacle to obtaining fertilizer in small bags is the higher price per kg of the smaller bags. In 1998, in those markets where small bags of fertilizer were available, they were not selling. Researching this phenomena, additional explanations offered by farmers were discovered including the persistent lack of money, cost of small bags, transport costs incurred traveling to a market center to buy a small bag and that smaller bags had a the higher cost per kg. If there was no economic justification for using fertilizer on maize at the price of a 50 kg bag, it was an even more compelling reason not to use it in a 5 – 10 – or 25 kg bag. [50] These last two reasons introduced additional constraints in the decision to use small bags of fertilizer that were unfortunately not included in the decision tree and unforeseen by policy planners when repackaging fertilizer in small bags was being developed.

In sum, it seems unlikely that small bags of fertilizer will contribute to any lessening of food shortages at the household level, at least not until small bags become more available and the price per kg becomes more reasonable. In the interim, more research needs to be done on increasing access to small quantities of fertilizer. [51] Even if small bags of fertilizer become available, this research suggests that household incomes need to increase for a significant proportion of these farmers to afford even the small bags.

It also appears unlikely that sharing a 50 kg bag is a solution, at least at the moment. This option may be constrained by lack of trust between neighbors and friends who would be expected to share 50-kg bags, as social capital, ravaged during the later half of the Banda years, has further declined in the post-structural adjustment era.

THE DECISION TO PLANT HYBRID MAIZE

One of the most important decisions farmers have to make is whether to plant hybrid maize versus local maize, or both. Hybrid maize is well received by farmers because it addresses both food security and cash needs of the household economy. It addresses food

security in two highly significant ways: higher yields and early maturation. Considerably higher yields come with a cost, as expensive inorganic fertilizer has to be applied. In some situations, due to soil and climatic conditions, hybrid yields may not be any larger than local maize particularly if unfertilized. Around Nsanje, for example, in the lower Shire Valley, fertilizer is not used. In a nationwide survey carried out in 1997/98, a random sample of fifty farmers in twelve villages in the lower Shire showed that not one respondent used inorganic fertilizer. The reason consistently stated is the soil's natural fertility due to the almost annually flooding when the Shire River overflows its banks leaving behind nutrient rich silt. It is the river's parting gift, compensation for causing harm and ruin to so many homes.

The soils in Zomba are not revitalized as in the Lower Shire. The soils of the farmers surveyed require amendments to boost yields adequately. As the discussion above regarding the decision to use inorganic fertilizer shows, the farmers in this survey feel that inorganic fertilizer is vital to averting the hungry season. [52] The relationship between fertilizer use and hybrid yields is also convincing. Asked to choose between animal manure and chemical fertilizer, fertilizer was overwhelmingly preferred for higher yields (Table 4).

Table 4: Farmers choice between animal manure and chemical fertilizer for best hybrid yields

What do you think will cause your hybrid maize to have the best yields: animal manure, chemical fertilizer or both?			
Respondents n=60	Animal Manure	Chemical Fertilizer	Both
Male n=16	1 6%	14 88%	1 6%
Married Female n=23	1 4%	22 96%	0
Female Headed Household n=21	1 5%	18 85%	2 10%

Early maturity is the other attribute that makes hybrid maize preferable over local maize. Malawi's rainfall has been erratic during the last decade and climatic change has affected the timing and duration of the rainy season. Rainy seasons ending prematurely causes local maize to dry up in the fields before ears have formed spelling doom to a family relying on it. Smallholder farmers cannot risk the household food supply on local maize just because they prefer its taste, or pounds better or even stores better. The vast majority of farmers view the earlier maturing hybrid as an important defense against hunger. They may see hybrid maize,

with all its constraints, as one of the best strategies to employ in order to greatly minimize the risk associated with local maize. Even in the fertile lower Shire, hybrid is overwhelmingly desired for this reason.

The decision tree shows a complex web of factors that lead farmers to choose one of two outcomes, [Plant hybrid maize] or [Plant local maize] (figure 3). Access and availability of inorganic fertilizer is one of several pivotal factors influencing that choice. The others that carry much weight with farmers are access to seed and fear of crop loss with local maize.

The criteria and constraints identified by respondents came from four varieties of hybrid maize, which they had experience with: MH – 17 and18 and NSCM – 41and 51. Of the 29 farmers who planted hybrid in 1996/97, only 7 planted NSCM – 41, the rest planted either MH-17 or MH-18. At the time of this research, there were other varieties of semi-flints being introduced that addressed some of the constraints identified by farmers but only one farmer – a male who was educated through Form 2 and had a junior certificate – mentioned one of the new semi flints (Chitute) in the survey. Even so, he planted MH-18 and NSCM-41. It is possible the new semi flints were known but not available in the stores. It is also possible that knowledge of these new varieties was very limited at the time. As these new varieties become known, some of the constraints they were developed to address such as storage difficulties will disappear. Other constraints, such as price of seed, are less likely to change.

At the top of the tree in figure 3 are criteria asking whether hybrid maize tastes better than local (criterion 1), pounds better (criterion 2) and/or yields better (criterion 3). Eighteen percent of all informants believe hybrid maize tastes better than local maize and of those 91% prefer local because it pounds better. Although 86% believe hybrid has higher yields and 74% believe it is easier to sell than local maize (criterion 5), hybrid does not store well (criterion 4) –t he greatest constraint to planting hybrid maize at this point of the decision tree. Of those who believed hybrid has better yields, 93% stated that it does not store as well as local. (One informant lost her entire hybrid harvest to weevils the year before.) All other things being equal, the storage constraint alone would account for a large number of farmers not planting hybrid.

Nevertheless, farmers who plant hybrid maize do so for two good reasons. The first is to sell it for income. Seventy four percent believe hybrid is easier to sell than local. Hybrid's earlier maturity and greater yields provide the family with a welcome opportunity to gain access to cash. The second reason is to shorten the hungry season. Both are compellingly sound reasons to grow hybrid maize.

There is a problem that surrounds the income decision and it is as much a result of the disadvantaged situation farmers are in as it is with hybrid's storage problem. Because farmers believe that hybrid does not store well and due to their usually cash strapped circumstances, they tend to supply the market at the same time, depressing prices in the process. The little cash they receive cannot, under current price ratio, pay for production cost of fertilized hybrid and is far less than what they will be paying for maize during the hunger season. This is an ongoing scenario repeated every year representing another diminishing choice to poor households in need of an immediate influx of cash. [53]

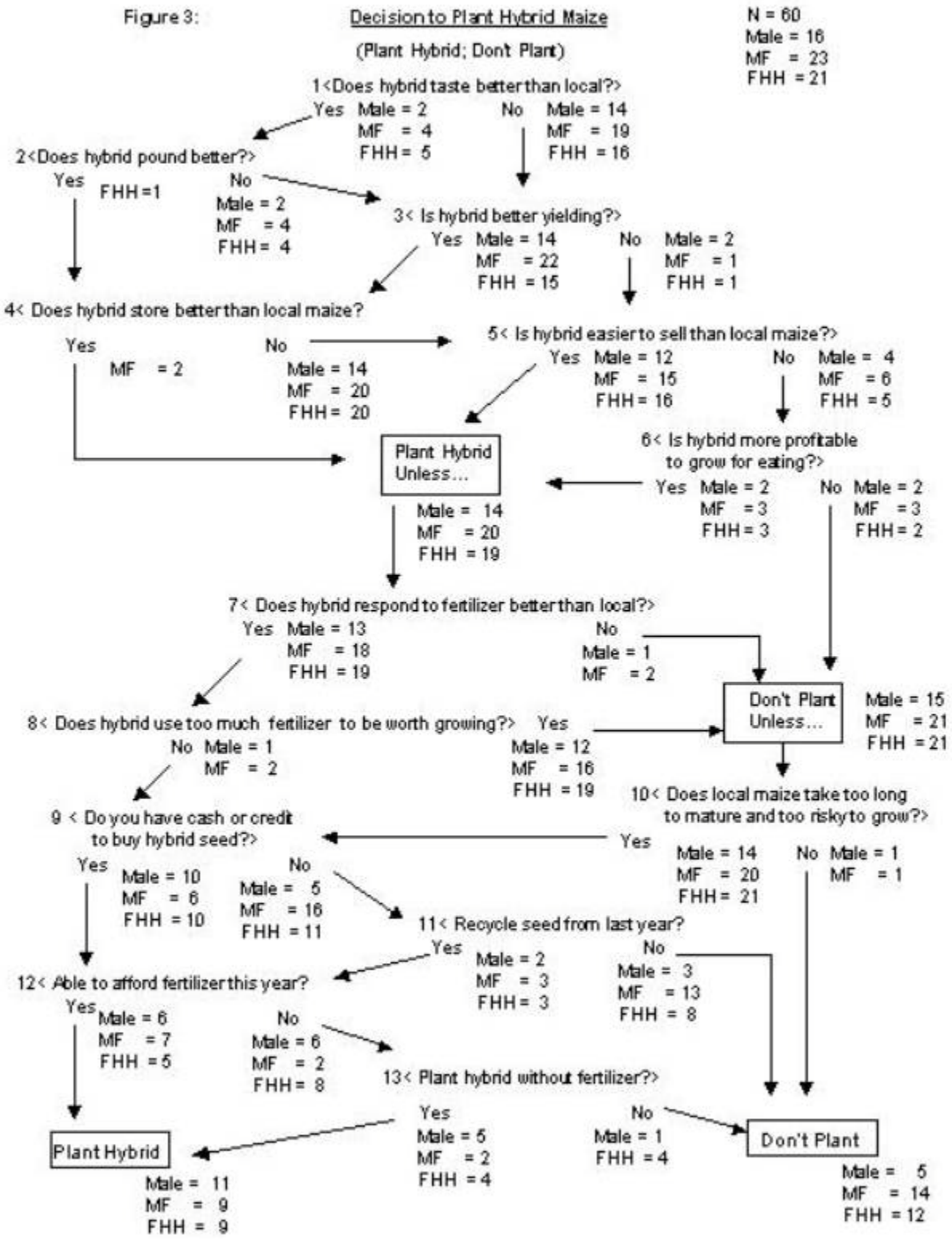


Figure 3:
Decision to Plant Hybrid Maize
(Plant Hybrid; Don't Plant)
N = 60
Male = 16
MF = 23
FHH = 21
1<Does hybrid taste better than local?>
Yes Male = 2
MF = 4
FHH = 5
No Male = 14
MF = 19
FHH = 16
2<Does hybrid pound better?>
Yes FHH = 1
No
Male = 2
MF = 4
FHH = 4
3< Is hybrid better yielding?>
Yes Male = 14
MF = 22
FHH = 15
No Male = 2
MF = 1
FHH = 1
4< Does hybrid store better than local maize?
Yes MF = 2
No
Male = 14
MF = 20
FHH = 20
5< Is hybrid easier to sell than local maize?>
Yes Male = 12
MF = 15
FHH = 16
No Male = 4
MF = 6
FHH = 5
Plant Hybrid Unless...
Male = 14
MF = 20
FHH = 19
6< Is hybrid more profitable to grow for eating?>
Yes Male = 2
MF = 3
FHH = 3
No Male = 2
MF = 3
FHH = 2
7< Does hybrid respond to fertilizer better than local?>
Yes Male = 13
MF = 18
FHH = 19
No
Male = 1
MF = 2
Don't Plant Unless...
Male = 15
MF = 21
FHH = 21
8< Does hybrid use too much fertilizer to be worth growing?>
No Male = 1
MF = 2
Yes
Male = 12
MF = 16
FHH = 19
10< Does local maize take too long to mature and too risky to grow?>
Yes
Male = 14
MF = 20
FHH = 21
No Male = 1
MF = 1
9 < Do you have cash or credit to buy hybrid seed?>
Yes
Male = 10
MF = 6
FHH = 10
No
Male = 5
MF = 16
FHH = 11
11< Recycle seed from last year?
Yes
Male = 2
MF = 3
FHH = 3
No
Male = 3
MF = 13
FHH = 8
12< Able to afford fertilizer this year?
Yes
Male = 6
MF = 7
FHH = 5
No
Male = 6
MF = 2
FHH = 8
13< Plant hybrid without fertilizer?>
Yes
Male = 5
MF = 2
FHH = 4
No
Male = 1
FHH = 4
Plant Hybrid
Male = 11
MF = 9
FHH = 9
Don't Plant
Male = 5
MF = 14
FHH = 12

Other criteria further down the tree appear to support farmers' preferences for local maize. The belief that hybrid uses too much fertilizer to be worth growing is supported by an overwhelming 93% of respondents (criterion 8) . In light of this research, this would appear to be a constraint that would sound the death knell for planting hybrid maize. However, as substantial as this constraint is, any negatives associated with hybrid maize are far outweighed by one negative fact concerning local maize: local maize takes too long to mature. When asked if local maize is therefore too risky to grow, 96% farmers agreed - strong evidence that the risk associated with local maize is too high to plant only local maize.

Even if it needs fertilizer, planting hybrid offers a strategy to farmers to mitigate the risks associated with local maize and its longer growing season. Hybrid maize seed was developed and marketed for exactly that reason. Its early maturity and greater yields means that farmers, particularly those with small land holdings, are able to improve household food security. The benefits of increased yields come with a price, however, and that price is fertilizer.

The high price of fertilizer is not the only constraint to planting hybrid. The price of hybrid seed also represents a serious constraint to farmers. As the tree shows, farmers prefer hybrid even after saying it uses too much fertilizer to be worth growing due to the risks associated with growing only local maize. The price of the seed, however, is a constraint to 55% of the respondents (criterion 9) but represents less of a constraint to male farmers (66% can afford the seed) whereas 55% of FHH and 72% of married women cannot. There is, however, an alternative and that is to plant recycled seed (criterion 11) but only 25% have the opportunity; the others have no choice but to plant only local maize, assuming all the inherent risks. Again women farmers, whether in FHH (73%) or in male headed households (81%), are less likely to have access to even recycled seeds than male farmers (60%).

In the end, 53% are able to afford fertilizer for hybrid (criterion 12). For the others who cannot afford fertilizer, 69% will plant hybrid unfertilized (criterion 13) rather than plant just local, clearly demonstrating their fear of the risks to their households if they do not plant some hybrid maize.

From a gender perspective, it is clear that women in FHHs and in MHHs are feeling the constraints of fertilizer and seed prices more than men. In previous constraints, all three sub-groups show little difference in preferences and beliefs. Yet separation between the genders begins at the cash-for-seed criterion and continues with criteria further down the tree. In the end, 69% of male farmers are able to plant hybrid maize but only 39% married women and 43% of FHH can.

The decision tree tells only part of the story. Even as hybrid maize greatly reduces the risks of a long hungry season, fewer hectares were being planted with hybrid and more with local as a result of less farmers planting hybrid maize (Table 5).

Table 5: Number and Percent of Farmers Who Planted Hybrid Maize.

	1995/96	Percent	1996/97	Percent	Percent Change
ALL	40	67	29	48	- 19

n=60					
Male N=16	13	81	11	69	- 12
Married Female N=23	12	52	9	39	- 13
FHH N=21	15	71	9	43	- 28

These numbers contrast with earlier research that found the acceptance of hybrid maize among smallholder farmers, particularly women, as problematic. [54] The percentage of farmers growing hybrid prior to 1996/97 contradicts any notion of acceptance being problematic. Farmers in the survey are fully aware of the benefits of hybrid in spite of personal preferences towards local in areas such as taste, pounding and even the critical shortcoming of hybrids notorious storage problem. Evidently these preferences pale in comparison to the two main benefits of early maturity and higher yields that farmers view as critical for addressing food security. The decline in planting hybrid is better explained by other factors, namely the increased price of fertilizer and hybrid maize seed.

According to farmer responses in the questionnaire, 19% fewer farmers planted hybrid maize in 1996/97 than the previous year with the largest percentage drop occurring with FHH. 34% of those who planted hybrid in 1996/97 did not use fertilizer compared to 30% in the previous year. Overall, 1996/97 saw a drop of 11% of farmers planting fertilized hybrid compared to the previous year (Table 6). Breaking it down further, 29% of FHH, 38% of male farmers and 30% of married women used fertilizer on their hybrid in 1996/97 compared to 43% FHH, 50% male and 39% married women the year before. With the price of seed a major constraint to farmers, it would not make sense to spend scarce cash on hybrid seed and then not fertilize it particularly when, unfertilized, the yield of hybrid is not much different than that of local.

Table 6: Change in Number and Percentage of Farmers Who Planted Fertilized Hybrid Maize

	1995/96	Percent	1996/97	Percent	Percent Change
All n=60	26	43	19	32	- 11
Male	8	50	6	38	- 12

n=16					
Married Female n=23	9	39	7	30	- 9
FHH n=21	9	43	6	29	- 14

One explanation might be the fact that under certain climatic and soil conditions, unfertilized hybrid still has a better response than local maize. Since this research took place in Zomba, it is likely that the variations in climate conditions were not that great. Regarding variations in soil conditions, that unfortunately remains a question that this research was not capable of determining. It remains a possibility that some farmers who did not fertilize their hybrid, have better soil conditions. However, relying on data provided by farmers and mentioned above, it seems safe to assume variations in soil conditions is not that wide. Considering that this group of respondents overwhelmingly felt that their soil needed fertilizer, planting unfertilized hybrid would seem to be a waste of scarce money, unless the risks of planting only local are also considered. Examined under that light, planting unfertilized hybrid maize makes better sense, even with the lower yields. Not only is the number of farmers planting unfertilized hybrid increasing, the amount of fertilizer applied to hybrid is also decreasing as shown in Table 7 below.

Table 7: Change In Total Fertilizer In kgs Applied to Hybrid Maize by Farmers Who Planted Hybrid Both Years.

	Hybrid 95/96	Hybrid 96/97	Percent change
Male n = 11	755	450	- 40%
Married Female n = 9	1350	740	- 45%
FHH n = 9	1202	680	- 43%

Furthermore, the total amount of hectares planted in hybrid is declining as well as shown in Table 8. Here we see the most dramatic decrease is with FHH. In the course of one year, total hectares of hybrid maize planted by FHH in the Zomba RDP decreased by 57%. Male and Married Female farmers showed nearly similar decreases, with a decline of 20% and 23% respectively.

Table 8: Change in Hectares Planted with Hybrid

	Hybrid 95/96	Hybrid 96/97	Percent change
Male	7.22	5.8	-20
Married Female	10.92	8.42	-23
FHH	8.88	3.8	- 57

Conclusion

The focus of this paper was to analyze the criteria and constraints farmers, both women and men, use in making decisions that have a direct bearing upon household food security. With a gendered perspective, it makes the invisible woman visible, shedding light on those factors that affect her and her family's situation either positively or negatively. The series of figures in this paper show women farmers, whether as FHHs or women within male headed households, as well as men use decision processes to minimize the risks associated with local maize while trying to gain the benefits of hybrid maize in a larger environment of escalating fertilizer and seed prices.

Because other variables (i.e. weather, labor put into the gardens, pest attacks, etc) significantly affect yields, it is impossible to draw any solid conclusions about how the decisions made by the informants affected their yields. What can be said is that women farmers are making as complicated a set of decisions as men are – decisions that directly affect their household food security.

It also can be said that marital status of a woman does make a difference in terms of choices. As a group, married women are more likely to have access to some fertilizer than a FHH by a margin of 62% vs 45%. The variation between male farmers and married females is slight with 67% of male farmers able to afford some fertilizer. Moreover, even if the percentage of farmers that are able to pay for all the fertilizer they need is small (9%), marital status is a factor. No FHH was able to obtain all the fertilizer needed.

Other conclusions that can be drawn from the research is that the farmers in Zomba want fertilizer and in an overwhelming number. They have seen what results from not using fertilizer and fear that without it, they and their families will face hunger. Since 91% of farmers cannot acquire the amount they need, then the next best choice would be to acquire some amount of fertilizer. This research, however, also examines the potential impact of small bags

of fertilizer, if they were to be freely available in local shops and markets. Results here describe why almost no one buys them now; while they also suggest that FHHs, who would benefit the most from their introduction, would probably not have the cash to buy them. Once again, gender and marital status make a difference. FHH are much less likely to obtain even smaller quantities of fertilizer, either with cash or credit, than married females or males. The bottom line is that 55% of FHH did not use any fertilizer on their crops compared to 38% of married females and 33% of male farmers.

The promise of using green manures to supplement or replace the need for inorganic fertilizer is unlikely. Survey respondents are not intercropping with legumes as green manures but with legumes as food and income crops. In this statistical sample, it is universal. Moreover, farmer practices of undersowing the dry leaves with the maize stover or clearing fields with fire are greatly reducing any benefits from planting the legumes.

The decision tree model to plant hybrid maize shows that it is a complicated, *multi-dimensional* decision process involving farmer minimization of the risk of a short rainy season, providing an earlier source for income, and shortening the hungry season by yielding more and maturing earlier. These factors, however, need to be seen in relation to the risk-taking that planting local maize assumes. Planting local maize places the household at much greater risk in terms of food production. However, it requires little if any inputs and this saves the household money. Is it a trade off? Lower yields and no cash means the hungry season will start earlier and hurt much more. However, as this research shows, the advantages offered by hybrid maize are increasingly becoming out of reach for more farmers due to two constraints: the un-affordability of fertilizer and the un-affordability of seed. There is nothing new here and this evidence only corroborates earlier research [55] .

Further, the model clearly shows the linkage between fertilizer use and cultivation of hybrid maize is strong; but due to the multi-dimensionality of the decision, it alone does not explain why farmers prefer to plant hybrid maize. Interestingly, every farmer who had some cash or grant for fertilizer grew hybrid maize; but a significant proportion of farmers (47%) said even if they could not afford fertilizer for hybrid, they would plant hybrid maize, *if they could afford the seed*.

None of these developments bode well for Malawi. The upshot of all this is evident in the current tragedy the people of Malawi are facing. The harvest of 2002 has been dismal with a shortfall estimated to be around 600,000 metric tons. That is the amount Malawi will have to import in order to stave off the starvation seven million people face as their maize runs out. Although much of the suffering has been blamed on flooding followed by drought, that is misleading. It is true that the rainfall season was sporadic and there were floods in parts of the country. But the drought had a more devastating impact on local maize, which more Malawians planted.

"The weather part is very small, because the floods and dry spells were localized," says Ellard Malindi, Malawi's secretary for agriculture and irrigation. "Most of it was due to the lack of inputs [of fertilizer and seeds]." Corn production during that period, from 1998 to 2001, fell to 1.4 million metric tons from 2.4 million. [56]

The fact that farmers are planting less hybrid and more local maize has serious repercussions for household food security. In 2002, it was devastating. For farmers who do not

grow a cash crop such as tobacco, it is particularly salient. For many households, particularly FHHs, it is more in the nature of a desperate measure because of diminishing choices.

Notes

1. Up until recent years, the corporation enjoyed a monopoly on the purchase of virtually all marketable peasant produce. It was established by the government to control prices on smallholder produce with the intent of raising revenue for the government. ADMARC would buy crops from the peasants at very low prices and sell them at higher prices on the world market to earn large profits. Between 1983 and 1987 profit margins on crop trading averaged 32 percent of net sales. In some years the profit margin has been as high as 42 percent. The rich farmers, on the other hand, never fell under the control of ADMARC. Instead, they had direct access to the world market through the auction floors. It was also the only institution that supplied inputs to peasant farmers. . In 1996, the government, under pressure to liberalize its economy, passed the Privatization Act, which was to divest the government of much of its assets and enhance the role of the private sector in agriculture. In accordance with the Privatization Act, the government prepared for the commercialization and privatization of ADMARC by end-March 1999, with implementation to begin not long after. By the start of the 1999/2000 crop season, the government was to be no longer be involved in direct procurement, import, or sale of maize, and ADMARC was to operate on purely commercial terms. However, by 1998, it was clear that the government and ADMARC were dragging their feet on implementing the program resulting in much confusion. One result is that some ADMARCs in distant rural communities have virtually become non-entities, unable to purchase produce from farmers while the private traders have not shown up to replace ADMARC's presence. The upshot is that in many communities, smallholder farmers have no access to the market.
2. This year ADMARC failed to buy sizeable quantities of maize from the farmers resulting in low stocks. USAID lists three reasons for this failure: "(a) the general drop in maize production, resulting in a net maize deficit in the country; (b) its late entry into the maize market after the private traders had already bought most of the maize from the farmers; and (c) ADMARC's low producer price, only about half of what the private traders were offering." When ADMARC decided to adjust its purchase price upward it did so very late after the harvest. (USAID/FEWS NET Nov-Dec 2001Monthly Report). Also adding upward pressure on prices is the fact that the Government of Malawi (GOM) made a controversial decision to sell its strategic reserve of maize purportedly at the behest of the IMF in order to raise money for debt payment and government operation expenditures. The act itself appears to contradict the very purpose of the strategic grain reserve, which had government commitment to maintain it as a means to even out maize availability between years of drought. The IMF has denied advising the GOM or the National Food Reserve Agency to sell off the strategic maize reserve. It is not clear what happened to all the proceeds from the sale.
3. In 2001/02 the food security situation was estimated to be "tight" with possibilities of starvation reported in a number of districts especially in the South and Central regions.

In the north, the situation is slightly better as people with money are able to buy cheaper maize from local sources as well neighboring Tanzania. Severe flooding in parts of Malawi in the first half of 2001 exacerbated the situation (SADC Food Security Quarterly Bulletin, October, 2001). To add to the suffering, drought during the height of the growing season decimated crops in early 2002. Estimates range between 3 to 7 million people or more face starvation.

4. Owens, Patricia 1999. *When Maize and Tobacco are Not Enough: A Church Study of Malawi's Agro-Economy*. 2nd Edition. Peggy Owens, ed. CLAIM, Blantyre. P.20
5. International Food Policy Research Institute. 1997. "Food Gap Widening in Developing Countries: One in Four Children Worldwide Will Be Malnourished in 2020".
6. Since the mid-1990s, fertilizer prices have risen sharply while a series of currency devaluations and high inflation rates have severely eroded household purchasing power. The upshot being that most smallholder farmers have been unable to afford adequate amounts of fertilizer, if any at all.
7. Reports are coming out placing a share of the blame for the potential famine Malawi is facing on the decline in the use of fertilizer on hybrid maize and the decline in the planting of hybrid. It is believed that the drought would have been less severe if fertilizer and hybrid seed were made available to all Malawi's smallholder farmers this past year as the Starter Pack Program did in the previous three years. See "Man-Made Food Crisis Grips Southern Africa" Christian Science Monitor, May 15, 2002.
8. Gladwin, Christina, Anne M. Thomson, Jennifer S. Peterson, and Andrea S. Anderson. 1998. "Addressing Food Security In Africa Via Multiple Livelihood Strategies Of Women Farmers" p.2.
9. Shapouri and Rosen, 1999, p.1
10. ibid.
11. It is estimated that in Malawi, 65% of the population lives below the poverty line and on less than $2 per day or MK134 (USAID/FEWS, 2001). Using the current ADMARC official price for maize at MK17 per kg (and not the market price of MK25 per kg, an increase in production of just three bags of maize would have a value of MK2550 for the household. Of course, how the increase in production comes about is not addressed in this calculation. At the time of the research, using inorganic fertilizer on hybrid maize was not recommended due to the high producer fertilizer to maize price ratio. However, at current prices, it may beginning to make sense to use fertilizer on maize.
12. Staatz, J., 1990. "Food Security and Agricultural Policy" in T.R. Frankenberger et al. Proceedings of the Agricultural-Nutrition Linkage Workshop, Volume I, USAID, Arlington.
13. World Bank. 1990. *Symposium on Household Food Security and the Role of Women.* Harare, January 21-24, 1990.
14. Gladwin, Christina,et al. 2001. "Addressing Food Security In Africa Via Multiple Livelihood Strategies Of Women Farmers" Adedeji, Adebayo, 1989. "Interaction Between Structuralism, Structural Adjustment and Food Security Policies in Development Policy Management", ECDPM Occasional Paper, Maastricht. Von Braun.

1991. "A Policy Agenda for Famine Prevention in Africa" Food Policy Report, International Food Policy Research Institute.

15. In 1985, food security was defined as access by all people at all times to sufficient food, in terms of quality, quantity and diversity, for an active and healthy life without risk of loss of such access. See Reutlinger, S. 1985. "Food Security and Poverty in LDCs" Finance and Development, vol. 22, no. 4, pp 7 – 11. ; United Nations, 1988. Towards Sustainable Food Security: Critical Issues, Report by the Secretariat, World Food Council, Fourteenth Ministerial Session, Nicosia, Cyprus, 23 – 26 May.; World Bank, 1986. *Poverty and Hunger: Issues and Options for Food Security in Developing Countries*, World Bank Policy Study, Washington, D.C.
16. World Bank/World Food Program.1991 *Food Aid in Africa: An Agenda for the 1990s* p.14.
17. UNICEF, 1990. "Strategy for Improved Nutrition of Children and Women in Developing Countries", UNICEF Policy Review, New York P.2. Alamgir, Mohiuddin and Arora, Poonam. 1991 *Providing Food Security For All* London: International Fund for Agricultural Development (IFAD)/Intermediate Technology Press.
18. UNICEF, Namibia, 1991. *A Situation Analysis of Children and Women in Namibia*. UNICEF, Namibia.
19. Gladwin, et al. 2001 argues that simply increasing production of subsistence crops may be ineffective. Current thinking about food security, that it is an issue of household income and poverty and not just inadequate aggregate food production, challenges programs which encourage women to just grow more food crops to improve their food security. Instead, government should look for ways to improve returns to farmers' resources in a broader context, which may include expanded opportunities for non-farm micro enterprises and agricultural labor. See Gladwin, Christina,et al. 1998. "Addressing Food Security In Africa Via Multiple Livelihood Strategies Of Women Farmers", and Subcommittee on Nutrition of the United Nations/International Food Policy Research Institute (SCN/IFPRI). 1999. Fourth Report on the World Nutrition Situation. SCN/IFPRI, Washington, D.C.
20. Unfortunately, they typically sell it when the market price is lowest reaping a much smaller benefit then if they waited until demand spiked the price upwards. Thus, poor households get caught in a dismal cycle of selling when prices are depressed and then re-entering the market to buy when demand drives the price much higher. Scarce money goes toward buying maize and not much else. Should the cash run out before the next harvest, then hunger is assured, starvation possible, good health rare and chronic malnutrition persists.
21. Dixon estimates that women make up on average 46% of the of agricultural labor force in Africa but only if subsistence production is included as economic activity, along with other factors. See Dixon, R. 1982. "Women in Agriculture: Counting the Labor Force in Developing Countries". *Population Development Review* 8, pp. 558-559.
22. The rationale given for this lack of attention to women's contribution is that male farmers are more productive than farms of female-headed households. The weakness of this line of reasoning lies in the very issue discussed here and that is ignoring gender obscures the constraints that hinder women's productive capabilities. For more

discussion see Quisumbing, Agnes R. 1996. "Male-female differences in agricultural productivity: methodological issues and empirical evidence." *Economic Development and Cultural Change* 24(10): 1579-96; Due, J., and C. Gladwin. 1991. "Impacts of Structural Adjustment Programs on African Women Farmers and Female-Headed Households". *American Journal of Agricultural Economics* 73:1431-1439.

23. Gladwin et al. 2001. "Addressing Food Security In Africa Via Multiple Livelihood Strategies Of Women Farmers" p.4.
24. UNIMA Center for Social Research and SARDC-WIDSAA, 1997. *Beyond Inequalities: Women in Malawi*, UNIMA/SARDC, Zomba and Harare.
25. ibid.
26. ibid.
27. ibid.
28. World Bank, 1995. *Malawi: Human Resources and Poverty: Profile and Priorities for Action*, Washington, D.C.; Government of Malawi and UNICEF, 1993. *Situation Analysis of Poverty in Malawi*, Government of Malawi\UNICEF, Lilongwe. pp. 22, 77.
29. UNIMA Center for Social Research and SARDC-WIDSAA, 1997. *Beyond Inequalities: Women in Malawi*, UNIMA/SARDC, Zomba and Harare.
30. Goheen 1991.
31. Gladwin, Christina, Ken L. Buhr, Abe Goldman, Clifton Hiebsch, Peter E. Hildebrand, Gerald Kidder, Max Langham, Donna Lee, Peter Nkedi-Kizza, and Deirdre Williams, 2001."Gender and Soil Fertility in Africa",p.3 – 4.
32. Gladwin et al. 2001.
33. Dixon, R. 1982. "Women in Agriculture: Counting the Labor Force in Developing Countries", *Population Development Review* 8:558-559; Gladwin, C.H., and D. McMillan. 1989. "Is A Turnaround In Africa Possible Without Helping African Women To Farm?", *Economic Development and Cultural Change* 37:279-316.
34. Benson, Todd. !997. The 1995/96 Fertilizer Verification Trial – Malawi: Economic Analysis of Results For Policy Discussion. Report by Action Group I, Maize Productivity Task Force. Ministry of Agriculture and Livestock Development, Government of Malawi, Lilongwe. p.1.
35. Benson, !997, p.7.
36. Admittedly, there has to be variations of gender relations in married households and I am not saying here that all married women have an equally subservient role to their husbands. For example, in some households, there may be much more consultation between husband and wife than in others. But how much occurs is very difficult to determine. All that we can safely say is that a woman in a FHH does make all the decisions and a man in a MHH has the final decision – we just do not have any idea how much of his wife's influence is incorporated in that decision.
37. Williams, Deirdre. 1996. "Gender and Soil Fertility Decisions: Initial Report, Maseno, Kenya". Paper submitted to the Institute of Food and Agricultural Sciences, University of Florida, Gainesville. p.2
38. Gladwin, Christina. 1989. *Ethnographic Decision Tree Modeling*. California, Sage Publications

39. ibid p.15.
40. ibid p.16.
41. According to well – documented research substantiated in field trials, pigeon pea grown as an intercrop with maize improves the soil by dropping leaves as it matures. Additionally, its deep roots draw up minerals that have leeched far beyond the reach of the roots of grain crops such as maize. Pigeon pea transports these minerals back to the surface, making them available for shallow rooted crops.
42. Legumes are nitrogen fixing but that does not mean the legume is distributing nitrogen (N) throughout the immediate soil vicinity. Sarrantino explains it quite clearly. "While it is tempting to think of legume nodules as little fertilizer factories pumping N into the surrounding soil, that isn't what happens. The fixed N is almost immediately shunted up into the stems and leaves of the growing legume to form proteins, chlorophyll and other N-containing compounds. The fixed nitrogen will not become available to the next crop until the legume decomposes. Consequently, if the aboveground part of the legume is removed for animal fodder, the majority of the fixed nitrogen also leaves the field. What about the legume roots? Under conditions favoring optimal N fixation, a good rule of thumb is to think of the nitrogen left in the plant roots (15 to 30 percent of plant N) as being roughly equivalent to the amount the legume removed directly from the soil, and the amount in the stems and leaves as being equivalent to what was fixed.
43. Annual legumes that are allowed to flower and mature will transport a large portion of their biomass nitrogen into the seeds or beans. Also, once the legume has stopped actively growing, it will shut down the N-fixing symbiosis. In annual legumes this occurs at the time of flowering; no additional N gain will occur after that point. Unless you want a legume to reseed itself, it's generally a good idea to kill a legume cover crop in the early- to mid-blossom stage. You'll have obtained maximum legume N and need not delay planting of the following cash crop any further, aside from any period you may want for residue decomposition as part of your seedbed preparation."
44. What legume is grown also matters. For instance, not one of the farmers in my survey who planted groundnuts returned the leaves to the field. The nuts were separated from the plant and the leaves were used as fodder, either for their goats or for their neighbors. Interestingly, the farmers in the surveyed said that they knew the leaves would benefit the soil. However, they chose not to return them to the field but use as fodder for goats. I offer this as an example of the disconnect between what the farmers believe and the actual practice they engage in. Even if turning the still green leaves into the soil after harvest only slightly benefits the soil, farmers in this survey were choosing not to do so, whether with groundnuts or pigeon pea.
45. See Sakala, W.D., G. Cadisch and K.E. Giller. 2000.
46. This was brought out even more so in another section of the questionnaire. Asking them about buying fertilizer on credit, 66% said they were afraid of credit so much they would rather not join a club – for many farmers the only way to get enough fertilizer was on credit. Male farmers were less fearful, with 50% saying so whereas 70% of MF and 76% of FHH feared credit. But when asked if they feared hunger more than credit if they did not obtain fertilizer, only one farmer – a married woman – said no.

47. The potential of even small quantities of fertilizer on yields was substantiated with the Starter Pack program begun in 1998. The package entailed giving 10 kgs of fertilizer along with hybrid seed – enough for 0.1 ha - and pulses to every household. The harvest was a near record and many attributed this to the program.
48. D'Arcy 1998.
49. Gladwin et al. 1997.
50. Uttaro 1998.
51. In July, 1998 the cost per kg for 23-21-0 + 4S in a 50 kg bag was MK15. Packaged in a 5 kg bag the price was MK 25 per kg or a 66% premium. The premium was justified due to packaging and the ever-offered transport costs although it is hard to see how. Two 25 kg bags take up as much room on a truck as one 50 kg bag. Other factors such as material and labor should result in only a slight increase.
52. I conducted a short duration experiment around Malosa in July, 1998 where I sold fertilizer by the kg in rural trading centers. I wanted to see if farmers would purchase fertilizer by what they could afford rather than at a set amount. The price per kg was 33% higher than the price per kg in a 50 kg bag in order to cover costs and provide a slight profit. The response was extraordinary and by the second week, people were waiting for the "mzungu" to arrive with fertilizer. What made it even more encouraging was that the experiment was taking place during the height of the dry season with at least 4 months before the beginning of the planting season. It also was extremely encouraging that many of the customers were women. The down side was that the experiment, as such, lasted only three weeks and farmers were begging us to keep coming particularly as the planting season approached.
53. Further evidence is provided by responses to the question "Does your soil need chemical fertilizer for good yields?". 94% of male farmers, 91% of Married women farmers and 100% of Female Headed Households replied in the affirmative.
54. The sale of the strategic grain reserve by the government of Malawi in 2001 was also injurious to small holder farmers in that it flooded the market with grain just as farmers were trying to sell their maize, further depressing producer prices. In 2002, facing starvation, millions of smallholders now have no cash to buy food.
55. See Arizo-Nino, E. 1991. *Women Farmers and Agricultural Policies in Malawi*. Report for USAID/PPC/WID.
56. Pauline Peters, conducting research in the Zomba area, found 47% of the sample growing hybrid to be the lowest percentage since 1990/91. The reasons given were high cost of seed and fertilizer. See "Maize, Food and Tobacco in Zomba: Situation Report, 1996" by Pauline Peters, Harvard Institute for International Development, August, 1996.
57. "Man-made Food Crisis Grips Southern Africa." Nicole Itano, *Christian Science Monitor*, May 15, 2002.

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