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Famine Mitigation Strategy Paper

ENABLING RESILIENCE AND ENHANCING ASSETS

Famine Mitigation from a Seeds and Tools Perspective

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Foreword

The Famine Mitigation Strategy Papers have been developed as part of an effort by the United States Agency for International Development, Office of U.S. Foreign Disaster Assistance, Prevention, Mitigation and Preparedness Division to assist famine response agencies and personnel in developing and designing effective interventions to respond to extreme food insecurity and famine situations. In preparing these papers, input was solicited from a broad range of specialists from the international donor community, the academic community, governmental and non-governmental agencies, and independent specialists in the field. These papers provide policy makers, program planners, and project managers with basic background information and a range of approaches for developing programs and projects in the areas of early warning and response systems, rapid assessment methodologies, seeds and tools interventions, livestock interventions, water resources development, market interventions, food/cash for work programs, and in providing assistance under conflict situations.

It is becoming readily apparent that the most effective response strategies are those that identify deteriorating situations and initiate appropriate responses early on in an emerging or incipient famine process. Strategies that respond not just to the immediate symptoms of the emergency, but also to the underlying causes of this vulnerability provide the needed and often missing link between ongoing development, emergency relief, and recovery efforts. Many of the papers produced under this effort differ from traditional relief oriented approaches in that they bring a developmental approach to the provision and implementation of relief assistance.

In an era of declining emergency resources and increasing potential and actual food insecurity situations, it is imperative that we explore and test approaches that are more cost effective, provide rapid and positive impacts, strengthen and enhance local capabilities, and provide some level of sustainability once the initial resources are exhausted. Greater emphasis will also be placed on more effective monitoring of both the short term and the longer term impact of these types of interventions. We hope that these papers can serve, in part, as catalysts in the further development of policies, programs, and projects that better respond to the needs of those most vulnerable to the famine process.

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Executive Summary

Famine-prone agroecosystems have a number of common characteristics which form the foundation for famine mitigation. A number of studies indicate that famine-prone regions are agroecosystems in which local coping strategies are depleting crucial assets. In order to design sustainable interventions for a particular area, a local and participatory agroecosystems appraisal is necessary. Such appraisals will examining four aspects of such systems which have been neglected in traditional analyses of famine: irregularity of climate and soils, informal social organization, compound farming systems, and 'wild' or fallow lands.

The most effective interventions will assist households in enhancing assets which most increase the resilience of their coping strategies. This paper identifies six such assets: seed (and vegetative propagules), local storage capacity, locally manufactured tools, soil, water catchment structures and local transportation infrastructure. Of these, the most cost-effective and rapid interventions will emphasize seed and vegetative propagules.

Crop varieties with varying maturities, drought tolerances, growth habits and nutritional contents provide the smallholder with the assets he needs to respond to the environmental uncertainty characteristic of semi-arid areas. Seed type and viability can be rapidly assessed, making possible tightly targeted seed interventions. Local seed storage is a widely recognized need and welcomed by community members. On-farm seed multiplication relies on indigenous knowledge regarding roguing and isolation and has been successfully promoted by various PVOs and NGOs. Private seed companies have the capacity to provide foundation seed of local varieties where partnerships between NGOs and seed companies can be established. Seed and vegetative propagule interventions also provide junctures for increasing forage availability and soil improvement through increasing vegetative cover and organic matter content.

Interventions in food storage provide assets which enable smallholders to more effectively employ a variety of coping strategies. Indigenous compound farming systems provide various means of enhancing available resources. The most obvious affect water catchment and soil organic matter and emphasize integration of nutrient pumping by perennials and nutrient cycling with livestock.

The ability of certain household coping strategies to moderate the impacts of famine means that relief will be necessary in most famine mitigation interventions for the poorest to benefit. In countries such as Mozambique, Ethiopia, Somalia, Sudan and Angola, this both constrains and provides impetus for cash and food for work schemes. From the perspective presented in this paper, the determining criteria for judging C/FFW projects (beyond nutritional improvement) is enhancement of crucial assets--such as local storage capacity, local transport, soils, water catchment local tool manufacture and, especially, local social organization.

The purpose of this paper is to discuss the issues, concepts and practical considerations which apply to the development of interventions in each of the above areas. We also propose a procedure for rapid assessment of specific parameters of famine-prone agricultural systems. This paper provides an orienting viewpoint which, with those location-specific data, can be used to establish specific interventions for sustainable famine mitigation.

Preface

If your goal is to prevent famine and decrease dependence on relief in a famine-prone region, the first task is to understand the constraints in that agroecosystem. To accomplish this task, the first step is a local participatory agroecosystem analysis. Participants will include local community members and leaders, the most effective local NGO managers and systems-oriented specialists in seeds and tools, livestock and water. A variety of communities and NGOs are sampled within a region to provide for multiple hypothesis testing.

Such a multidisciplinary appraisal is the most efficient way to combine local expertise with objective and comprehensive technical proficiency. In addition to determining constraints, these participants establish the key criteria for judging interventions in that region. This is the foundation upon which successful interventions are built.

In this paper we have presented the principles, successful strategies and issues you need to examine in your agroecosystem analysis. We hope you can explore all the strategies and issues we include here. If not, at least remember two basic consistencies across famine-prone regions of sub-Saharan Africa.

1. *Smallholder assets* determine a households susceptibility to famine. Aspects to be considered include: how much food is in storage, what is the quality of soils, are healthy, productive perennials growing in the compound, are water catchment structures in good repair, are livestock healthy and integrated with crops, are needed seed available and viable, and, are hand tools available and in good repair?

2. The best *single* means of increasing these assets is through seed and shoots. A wide variety of seed must be available to match the variability in rainfall and soil conditions. These must be locally adapted seed varieties and include lines which provide forage, improve soils and provide soil cover. The best way to accomplish this is through partnerships between individual NGOs and private seed enterprises and companies to distribute and multiply such seed and shoots in each famine-prone area.

Local food storage, water catchment and soil improvement can work with seed interventions to increase the resilience of local coping strategies.

The goal of this paper is to help improve the design of sustainable famine mitigation interventions. We've provided as many references as possible so that readers can explore any of the key issues. If you have experiences which can help create better famine mitigation with seeds and tools, please contact the Famine Mitigation Activity or either of us.

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ENABLING RESILIENCE AND ENHANCING ASSETS: Famine Mitigation from a Seeds and Tools Perspective

1.0 INTRODUCTION

Famine is a concern for certain populations in every developing country in the world. Even in countries with justly lauded food security programs, such as India, Botswana and Zimbabwe, famine has been avoided not because the tendency toward famine has been mitigated, but rather because relief has been institutionalized. Institutionalization of relief is also unfolding in several countries which are among the world's most at-risk, including Mozambique, Ethiopia, Somalia, Sudan and Angola. Continuing with the present systems means that the likelihood of severe famine, given a widespread and prolonged dislocation in the relief distribution system, intensifies every year.

In contrast, sustainable famine mitigation interventions focus on asset and resource enhancing approaches that build resilience into local coping strategies. Famine-avoidance schemes, such as the institutionalization of relief, undermine sustainability. To create interventions which promote sustainable local agricultural systems, we must understand the agroecosystems of famine-prone areas.

1.1 Famine-prone Agroecosystems

Though low average rainfall is common in famine-prone areas, low rainfall itself does not predispose an area to famine. As many have shown, drought is also not a sufficient predisposing cause. However, the unpredictability of rainfall, combined with low mean rainfall, invariably predisposes an agroecozone to both famine and desertification. Inhabitants of such areas must be prepared to employ their productive assets and coping strategies for different agroclimatic conditions each growing season.

Uncertainty is the way of life in these environments. There is no equilibrium state, no meaningful average yields, no average rainfall. So we cannot speak of any ability of these ecosystems to return to a normal equilibrium state. Instead we must track resilience. Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb change. Our goal in famine mitigation is not just to keep each famine we detect from happening, but to reduce vulnerability through increasing the resilience of at-risk populations.

Multiple coping strategies designed to fit variable agroclimatic conditions provide sustainable systems in semi-arid areas with highly variable rainfall onset and duration.

Seed are a key resource since, in addition to being compact and easy to transport relative to other famine mitigation inputs, they are the most basic asset needed by farmers to employ multiple coping strategies: genetic variability. A primary adaptive strategy of farmers is to adjust the mix of species and varieties used in their fields and gardens to actual and expected rainfall.

However, poor seed storage and/or several years of a particular rainfall pattern can result in the seed of the particular type needed during a given season (due to limited long-term seed viability in storage) to be unavailable.

An early assessment of the viability of present seed stocks is crucial to determining seed appropriate seed interventions. If seed retain normal viability, which is easily determined by simple germination tests, maintaining that quality will constitute a key intervention. Seed storage improvements, particularly at the local level, are crucial across the widest variety of communities in famine-prone areas.

Seed are becoming even more potentially valuable as supportive assets for multiple coping strategies due to the new sorghum and millet varieties produced each year. New varieties are available (e.g., ICRISAT's SV1 and SV2 sorghums and RPMV1 millet) which increase yield in a variety of semi-arid agroecological zones. The number and local adaptability of such varieties are likely to increase since the IARCs as a group continue to devote over 50% of their research budgets to plant breeding.

The problem with realizing this potential is two fold. First, there is little on-farm testing. Yet, in many areas, investigating new lines is a matter of course to smallholders. When asked why they had planted a variety, "'for experiment' was never seen as an odd answer" to the Sahelian farmers studied by Richards (1986). Capitalizing on this penchant for experimentation by distributing packets of pure, but genetically diverse, short season seed to farmers may be the best means of increasing smallholders' resistance to famine.

When on-farm testing has been successful, local seed multiplication is a key intervention. Imported seed are too expensive in most famine-prone areas and subsidized importation will leave no sustainable long-term effects unless local multiplication capacity is present. A variety of PVOs and NGOs have perfected on-farm seed multiplication interventions.

Two key problems in seed distribution systems are quality control and transportation bottlenecks. Both can be avoided with interventions focusing on the development of skilled local seed storage.

Labor is a major constraint to many new interventions, especially those involving changes in management techniques. Changes in inputs such as seed do not involve increases in labor since better adapted seed actually can require less labor than the less vigorous lines they replace.

1.2 Nested Agroecosystems: Compounds and Bush

A second aspect of sub-Saharan African agroecosystems is also frequently unappreciated. Nearly every sub-Saharan Africa agricultural system actually combines two nearly independent systems. One is a compound system, the other is comprised of bush plots. The compound farm system features "a distinct area adjacent to the house where continuity is physically and socio-economically safeguarded." The system is characterized by secure land tenure, continuity over time, diversity of labor activities, and inclusion of small ruminants and poultry. Compound farm systems include all gardening activities, some animal husbandry and all cereal production in areas which can be secured by the household from outsiders. Compound farming systems have been labeled the most sustainable agricultural systems in Africa by many observers.

This compound farming system is contrasted with the extensive cultivation of staple crops, usually by men, at some distance from the family's residence. These "bush fields" are often traditionally characterized by shifting cultivation, though the fallow period is being drastically reduced. There has traditionally been little concern about managing soil fertility through manure or crop rotations, nor with water management to control erosion and runoff.

The repeated use of extensive bush farming techniques invariably leads to degradation of the assets most basic to famine mitigation: soil and water. But associated with those same extensive systems are compound farming systems where soil and water resource-enhancing techniques adapted to the agroecological conditions of that particular famine-prone region are regularly employed. Attention to plant microenvironments modulates rainfall variability and provides a sustainable model ready to be replicated in every society in sub-Saharan Africa.

Three key characteristics of compound systems will be crucial to the intensification of farming systems: integration of various crop species, integration of crops and livestock, and replication of processes to regenerate soils as fallow periods do now. Integration of crop species, using techniques such as intercropping, can be reinforced with seed interventions that provide seed packs which include all species planted (e.g., cowpea and pearl millet, or groundnuts, guinea corn and early millet--depending on the local agroecosystem) which should have compatible maturities and growth habits.

The potential for intensification also depends on individual skill improvements which is only engendered in an atmosphere of empowerment. Food and Cash for Work projects, if used to build skills rather than as make work, can be the key vehicles for such interventions.

1.3 Social Aspects of Agroecosystems

The formal and informal groups which assist all farmers in coping with highly variable environmental conditions comprise a component of agroecosystems which is rarely examined, but no society has ever moved from food insecurity to food security without strong local organization of farmers. Many governments have been reluctant to promote farmer organizations due their inability to keep such organizations out of the political arena.

In many respects, the crucial group for famine mitigation in sub-Saharan Africa are the landholders. Interventions through strong local groups can improve their ability to produce sustainably, in ways that enhance their assets so they need not mine their land but can afford to improve it as a productive asset. The ecological degradation accompanying famine can be halted only by those who work the land.

Access to these groups can be gained through certain PVOs and NGOs that work with them. Knowledge is spreading about how to reform informal work groups into the type of social organizations which can promote village-level agricultural innovation.

Sedentary groups considerably outnumber nomadic and semi-nomadic people in the semi-arid zone. Further, as the ineluctable intensification of agriculture continues, more and more pastoralists will start settling into agricultural coping strategies.

"It is at the level of the village that most food is produced and at which the majority of the African population seek security and protection against food shortages. When there is a food deficit, it tends to begin in the villages and households that are most vulnerable and spread over a wider geographical area."

One fact is clear: rural areas, where food is grown and where aid supplies are most difficult to distribute are the most badly hit by famines. Part of the reason this is so is because policies have been developed around a restricted concept of urban consumers and rural producers. This has resulted in the development of unidirectional distribution systems, from rural to urban areas, where rural producers sell grain to a central marketing board. Grain is transported to central silos and processed in urban areas. Even the highest production levels in this system cannot cover inadequate production in rural areas. Policy changes oriented to increasing rural household food security could help, however, urban-oriented governments are notoriously slow to implement such policies. While trying to increase the capacity for market flow between rural areas, interventions with more likelihood of success are those which modulate the flow into urban areas and provide a buffer for local needs.

Consistent with several recent studies, the best means of creating such a buffer is through enabling household coping strategies that build up assets which can be utilized or liquidated during times of stress. A close examination of famine survivor strategies indicates that asset enhancement and preservation is a common value. Additionally, it provides a means for focusing more on building alternatives and less on just avoiding famine.

Improved grain storage interventions can help all populations affected by famine. For example, since "few pastoral systems can sustain themselves without the acquisition of cereals from farming communities," food storage interventions focused on farming communities are also a means of mitigating the severity of famine on pastoralists. A number of studies have shown that famine survivors' primary goal is "more grain in storage."

Grain storage is not only a key coping response of households, it also permits other coping responses to occur. Household and village level storage and processing are not only interventions which provide more food where it is most needed to mitigate famine, but, as the missing link in the harvesting-threshing-storage-distribution system, they provide inroads to solutions to market fragmentation.

"In truth, all societies subject to the danger of famine have always been forced to organize themselves around their grain reserves." (Sigaut, 1988)

Interventions involving hiring villagers to inspect food stores will reinforce indigenous knowledge and protect food resources. These interventions can be implemented at any stage in the onset of famine. Storage and seed interventions can be mutually reinforcing since grain storage characteristics are highly heritable.

Food and cash for work projects which manufacture storage containers from local materials provide useful skills and immediately increase food storage capacity and, therefore, resistance to famine. Such food and cash for work projects can then leave behind productive enterprises.

Local tool manufacture (plow-tips, yokes, hand-tools) facilitated by FFW and CFW, if tied to improving skills of local woodworkers, can also create more sustainable famine mitigation enterprises.

Individual household food sufficiency is often best predicted by management skills of female household heads. The care and skill of women in storing, rationing and distributing food often determines whether the household's children are seasonally or permanently malnourished. Famine mitigation attempts best target women in the intervention area of food storage.

1.4 Wild Agroecosystems

A fourth agroecosystem component which is often overlooked is vegetation in fallow and "wild" areas. In addition to being sources of roots and other less palatable famine foods, plants in fallow areas are often hunger breakers. The succulent early growth of perennials and early annuals following the first rains can provide the nutrient-packed nourishment crucial to early planting labor. The traditional practice of preserving such species in fallow areas, largely by women, can be replicated in famine mitigation interventions introducing perennial species which fill the same niche into compound plots. These species, if properly chosen can also serve as nutrient pumps, fix nitrogen and reduce evapotranspiration and soil moisture loss.

1.5 A Fresh Approach

The two major historical approaches to famine (focusing on national food stocks and entitlements) both ignore the most cost-effective route to famine mitigation. Households facing famine are extremely active in attempting to escape the processes pulling them toward destitution and mass migration. Beyond agronomic strategies, a host of other asset-based responses (including mobilization of social networks, storage and processing and use of semi-feral foods) are employed. This apassivity is most startling in the evidence that during some of Africa's most terrible famines, famine victims have chosen not to consume food in order to try to preserve their livestock and plant their fields. In fact, it is exactly these sorts of coping strategies which provide the basis for sustainable famine mitigation.

2.0 PRINCIPLES OF FAMINE MITIGATION

2.1 Avoiding Famine versus Famine Mitigation

Through its Famine Codes and subsequent Drought and Good Weather Codes (Sinha *et al.*, 1987), India has received justified international acclaim for avoiding famine, but in 1985 an estimated 200 million Indian citizens were hungry and dependent on relief for a large portion of their food intake (Jayne *et al.*, 1990). Botswana has likewise received acclaim for its famine avoidance program, but over a third of its citizens receive relief food at some time during the year (Moremi, 1987). Standard approaches to food insecurity have tended to institutionalize relief, rather than mitigating famine.

Zimbabwe is the first and only country where official government ministries have publicized and sought a solution for the fact that successful famine avoidance has resulted in a deepening reliance on relief as a way of life for residents of drought-prone areas. As Stack and Chopak (1990) note, in recent years Zimbabwe has consistently realized aggregate grain surpluses, thus ensuring national food security[1]. Yet every year large volumes of relief food stocks are distributed. A large percentage of children are malnourished and households have insecure food supply for large parts of the year.

The reason there is no famine in India, Botswana and Zimbabwe, according to these data, is not because the tendency toward famine has been mitigated, but rather because relief has been institutionalized (Ndegwa, 1989). And India, Botswana and Zimbabwe are the success cases in famine avoidance. In fact chronic hunger and food deficits are still present and structural food insecurity is growing in each of these countries.

Such countries as Mozambique, Angola, Ethiopia, Somalia and Sudan have fewer resources and much less food security. But the same solution (institutionalization of relief) is unfolding in each of these countries. The inherent tendency of relief food programs to become income support programs (Pinstrup-Anderson, 1989) is supported by recent evidence from Mozambique (Alderman, Sahn and Arulpragasam, 1991).

Gutu, Lambert and Maxwell (1991) also point out the ominous implications of the fact that Ethiopian food shortfalls have been met by increasing food imports (doubling since 1980 and now accounting for 20% of total consumption). Atwood likewise notes that Botswana's avoidance of famine has succeeded due to huge foreign exchange reserves and liberal importation of food. Reliance on food imports to avoid famine depends on uninterrupted foreign supply lines and lasts only so long as the foreign exchange reserves and foreign subsidies to overproduction.

Mortimore (1989) shows that many of the worst famines (such as in India in 1913-1914) occurred when cash was available to buy food, but the food was simply not available. Today this is not the case. Food is widely available for purchase on international markets, though increasing pressure to reduce agricultural subsidies in the U.S. and the EEC may well cut supplies.

Feeding starving people is the laudable goal of famine relief programs. This goal justifies straightforward implementation of easily quantifiable relief distribution efforts. However, the tendency toward institutionalization of relief leaves societies more in a more precarious position. As food habits change, local production is undermined and dependency increases. Continuing this approach means that the likelihood of severe famine resulting from any widespread and prolonged dislocation in the relief distribution system intensifies every year.

2.2 Famine Mitigation and Relief Food Distribution

Famine mitigation interventions can rarely be undertaken without an existing need for relief. When in famine onset interventions can take place is often a function of when donors authorize and fund activities. Usually this occurs long after many households' productive resources have been depleted. Donor agencies' notorious slowness in responding is partly due to the fact that Early

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[1] Recent harvests in Zimbabwe have, however, been less bountiful. Zimbabwe may even have to import grain to meet export contracts in 1992 according to the Economist Intelligence Unit (1991) and FEWS Bulletin (1992).

Warning Systems (EWS) report the first signs of problems as much as two months after farmers' first realization (Perrier, 1992). By the time donors can mobilize to use this information, local resources are extremely diminished.

As summarized by Campbell (1990), any type of centralized intervention will necessarily occur late in the famine onset cycle. In fact, extra-community response to famine rarely occurs before villages and households initially affected are in dire straits (Matiza, Zinyama and Campbell, 1989). Thus, major donor response to famine will likely come most often after relief is necessary for some in the area. Famine mitigation efforts using such "major donor famine response" resources will need to be able to smoothly mesh relief with famine mitigation efforts. Famine mitigation interventions must also mesh with traditional relief efforts such as food distribution.

Relief can be accomplished during dire food emergencies in ways that enhance farmer's assets and coping skills, build cost effectively on local capacity and avoid relief institutionalization. The key is to find productive local groups with skilled leaders and put appropriate resources at their disposal.

Anderson and Woodrow (1991) noted that one of the most successful famine mitigation efforts in 1984-85 in Ethiopia was that of Save the Children. While other relief agencies were using helicopters to fly food into refugee camps, Save the Children used local knowledge of trails, local stone-building skills and local pack animals to maintain and enhance constructive social structures while improving the fcod marketing infrastructure and enabling families to avoid the disease-ridden feeding camps.

2.3 Transforming Perspectives on Famine

A sustainable approach to famine mitigation which avoids institutionalization of relief requires a new perspective on famine.

Part of the problem in reorienting efforts to reduce famine is the misdirected focus of nearly all definitions of famine. These definitions all agree that the disastrous endpoint of all too many recent famines is the death of thousands resulting from hunger and destitution so widespread it leads to mass migrations to feeding camps. Certainly, these are the events famine mitigation seeks to prevent.

But, avoiding hunger-induced mass migration begs the question of what famine mitigation should most profitably be. What is needed is not a definition, but a framework which looks at famine-prone areas as agroecosystems in order to identify the intervening variables famine mitigation interventions must influence. A beginning is provided by viewing famine from the perspective of the victim, for whom:

> *"the beginning of famine (is) the adoption of abnormal non-sustainable survival techniques which eat into the resource and capital base which the victim would normally try to preserve." Walker (1989)*[2]

Households employing non-sustainable survival techniques (which, by definition, eat into their assets) progressively become more susceptible to famine. When a major system perturbation, such as a drought, flood, war or market disruption occurs, these are the first households to succumb.

When they begin to migrate to other areas, these areas are put under stress and households in these areas made more vulnerable to famine (Matiza *et al.*, 1989). Any area, at any particular time, will have households employing varying intensities of asset-depleting strategies. Sustainable agricultural systems will have a minimum of households forced to employ asset-depleting strategies. Systems tending toward famine will have maximum numbers of households depleting assets through non-sustainable survival strategies[3].

A perspective which focuses on household assets and strategies for enhancing them sheds a new light on the common approaches to avoiding famine.

2.3.1 National Food Stocks and Household Command of Food

Developing a productive framework for improving famine mitigation has historically been hindered by the over-emphasis on national food stocks. Food security is not achieved simply through overflowing national food stocks. In many countries, huge food surpluses exist in-country or are readily accessible as food aid, yet starvation and chronic hunger are widespread.

In Zimbabwe, for instance, tremendous production growth has occurred in recent years among smallholders and full grain silos exist concurrent with considerable periodic and chronic hunger. A recent report noted that in Zimbabwe, 30% of children under 5 are chronically malnourished (Chisvo *et al.*, 1991). Many other countries face a similar conundrum. A large national surplus in India in 1985 enabled major shipments from India to Africa while 200 million were hungry in India itself (Jayne *et al.*, 1990).

Malawi received international acclaim for being food secure in the early 1980s based on a visible, marketed grain surplus. At the same time --then little noticed, but now of major governmental concern-- hunger and malnutrition were reaching crisis proportions in hunger-prone areas of the country (Msukwa, 1990). In Tanzania, during years of bumper crops (1988-89) one region, Rukwa, still had 80% of households food insecure (Kavishe, 1991).

The combination of bumper crops coupled with food insecurity (labeled by some the food insecurity paradox) bedevils the heart of famine mitigation efforts. The paradox dissolves when one contrasts the food available nationally to food available to households. Sen (1981) was one of

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[2] An approach such as Walker's, interestingly, could be construed to apply to any agricultural system which is unsustainable--not just to famine situations. This, however, is not seen as conceptually invalid by theorists such as Sen (1980) and practitioners such as de Waal (1990) who contend from very different perspectives that famine and poverty are conceptually and empirically tightly linked.

[3] Successful famine mitigation interventions in an agricultural system, then, always promote increasing sustainability of that system.

the first to contend that increasing food supplies will not necessarily decrease the effect of famine on particular populations. He defined the food which a person receives as dependent on his endowments (land, labor and other resources) and his *"exchange entitlement mapping (the function that specifies the set of alternative commodity bundles that the person can command respectively for each endowment bundle)"* (Sen, 1981).

Aggregate food supply, in and of itself, has little bearing on a household's food security except insofar as it influences the household's exchange entitlement mapping (or E-mapping). Simply put, unless households have the means of getting the food they need, all other factors are irrelevant to famine.

Subsequent distorted versions of what has come to be called "entitlement theory" have been applied in various countries to ensure that each population group receives its fixed "entitlement."[4] Atwood (1991) thoroughly explores the devastating effect of applying this approach while underestimating the importance of available food stocks in Ethiopia and Mali.

Countries recently successful at avoiding famine (such as Botswana in 1981-84 (Holm and Morgan (1985) and Kenya in 1984-85 (Cohen and Lewis, 1987) were attentive to changed E-mapping of people whose crops or agricultural employment had failed to provide access to enough income to provide needed food. But they also paid attention to the national food supply balance sheet to ensure there was enough food in the country to meet anticipated need.

Practitioners in Ethiopia have taken this lesson to heart and are focused squarely on food supply (as reflected in balance sheets) as a key factor determining ability to mitigate famine (Gutu, Lambert and Maxwell, 1990). The insights of Sen insure that we not neglect the household's command or lack of command of enough of this food to meet their needs.

Recent presentations of the theory (Dreze and Sen, 1989; and Dreze, 1991) have emphasized the linkage of entitlement to cash for work programs. The basic idea is that those with the lowest entitlement to food can be induced to work for wages that will not attract those with a higher ability to obtain food. However, McGregor (1990) shows that

> *"by consuming their endowments, poor peasants can undercut the wages of the poorest. It is the latter who perish because the minimum wage they can work for is above the market clearing rate."*

This is especially pronounced in sub-Saharan Africa where much of the famine-prone population produces a large amount of the food they consume. They are able to work for less than is required to feed them because they have some food stored from past production and can farm to produce part of their needs.

Food or Cash for Work (F/CFW) is often ineffective for the poorest when smallholders are a significant portion of the population. The self-selection crucial to CFW is so effective in India due to the large numbers of landless laborers. In sub-Saharan Africa, the poorest cannot survive on

[4] This attempt to reestablish a never-existing equilibrium will be discussed later under agroecosystem analysis.

wage rates attractive to smallholders. This is not to say that CFW cannot be effective in these conditions. Atwood (1991) notes that a relatively small population, free trade and unconstrained foreign exchange can create possibilities for F/CFW, but, as Eicher observed in Southern Africa,

> *"with the exception of diamond-rich Botswana, no SADCC country has the foreign exchange earnings and administrative capacity to finance, mount and sustain a national food for work programme, school feeding programme, etc." (Eicher, 1991)*

Many entitlement approaches ignore the ability of famine survivors to change their E-mappings. Entitlement is seen as something fixed which is provided to passive recipients. de Waal (1990, 1991), especially, has noted the non-passive nature of famine survivors. This *"fighting spirit"* is the key to improving the skills of survivors; to experimentation, which is a key to resilience; and to the multiple coping strategies (whether agricultural, social, wild foods, storage or markets) which enable survival.

This fighting spirit leads to coping strategies which make entitlement approaches inadequate. For example, households facing famine voluntarily reduce food intake to preserve assets. de Waal (1990) found in Darfur in 1984/5 that,

> *"at the nadir of the famine people were spending only a proportion (sometimes as little as a tenth) of their income on food. Although they were hungry and many people around them were dying, nevertheless they could buy food; instead they were spending their money on maintaining their animals, buying seed for their farms, hiring labour, etc. . . .They chose not to sell assets whenever possible, and to spend much of their money on preserving assets."*

Though such behavior is inconsistent with entitlement approaches, a perspective which emphasizes asset enhancement as a key to famine mitigation does encompass such behavior. Further, if Sen's "endowments" and "E-mappings" are subsumed under household assets and coping strategies, respectively, then a household's command of food depends on its assets (endowments) and the coping strategies (exchange entitlement mappings) which enhance those assets.

A more widely useful and complete perspective on famine mitigation is one which focuses on enabling coping strategies which enhance or expand the household asset base.

2.3.2 Household Assets

Decline in asset value is an indicator that coping strategies are not working. The emphasis on assets by famine victims leads us to further consider how assets fit in a framework for developing famine mitigations. Most researchers distinguish between three types of assets: productive assets, stores and social claims. Productive assets include such elements as seeds, tools and draft animals. Stores include grain, processed food and non-breeding animals. Social claims include membership obligations, past favors and family ties.

A number of other assets do not fit so neatly into the three categories. Storage facilities and processing facilities could fit under productive assets, though they could warrant another category. Pastoralists' animals constitute both their main productive asset and main food stores. Foraging ruminants harvest sparse plants and convert them into useful products and store them for pastoral households. Fallow areas which provide "wild foods" are also assets and must be included in the famine mitigation framework since they are the basis for a crucial coping strategy. Likewise, soil and water-catchment structures are productive assets, though they cannot be liquidated. For famine mitigation, however, productive soils and efficient water catchment are among the most basic assets.

The standard approach to analysis of assets (e.g., Campbell *et al.*, 1989) holds that, in famine-prone areas, farmers build up assets and then liquidate them in time of need. However, some assets can't be converted at all, others can't be converted during famines, and farmers avoid converting still others because they are worth very little or because their loss will reduce the household's future effectiveness. Some assets are preserved and enhanced even if it means increased hunger.

The change in the value of assets is fundamental to famine mitigation, in part because changes in value are correlated across commodities. When grain prices are up, livestock prices are usually down. Without adequate coping strategies, farmers often must sell at a low price. With better coping strategies, farmers sell earlier at higher prices and maintain assets through times of low prices.

Building up assets. One feature applies to all assets: farmers anticipate famine and prepare for it by increasing the amount of stored assets and by increasing their capacity to maintain productive assets (Campbell *et al.*, 1989). In contrast, famine perspectives which focus on relief are very consumption-oriented. The key questions they ask are: how much food do people need and are they getting it. If they are not, the implied solution is to organize a means of getting food to them. Likewise, entitlement approaches are very income-oriented (Stack and Chopak, 1990). If enough food is not available for a segment of the population, these approaches contend that sector's income must be raised to permit purchase of food. Other similar approaches are more subtle. Rohrbach *et al.* (1980) cite semi-arid enterprise budgets to show that farmers will be unlikely to invest in productive enterprises which require much labor.

Labor migration appears to be the solution to many who have adopted these income-oriented approaches. However, the families who are most destitute are those who have a family member who has migrated and is not sending remittances back home (Campbell *et al.*, 1989).

Income-based approaches do not recognize that rural people's aim during famine is to preserve, so far as possible, their way of life (especially the productive assets which make this way of life possible). A number of researchers have discovered that social collapse and migration occur *"when they no longer believe that it is possible to preserve any such way of life"* (de Waal, 1990). This can occur due to ecological degradation, when other assets are totally lost (stolen, sold or destroyed), or when the supply of wild foods is exhausted or unsafe to collect. All these events represent a depletion of the asset base.

An asset based approach to famine-mitigation should focus on the maintenance of productive enterprises, versus creating working for wages and entitlement. Coping strategies are integrated with assets if we accept the fact that famine occurs only when no coping strategies are left (de

Waal, 1990). Since coping strategies collapse only as the assets on which they depend disappear, famine mitigation depends on building up the assets on which coping strategies depend.

2.3.3 Participation

How can these assets be built up in famine-prone areas? Farmer input is key. Indigenous knowledge is an information bank which, with farmers' active participation, can direct changes toward famine mitigation. Since constraints will be different in every situation, change agents must rely on farmer involvement in both identifying constraints and adapting technology. As Nagy *et al.* (1990) note:

> *"Previous attempts to introduce apparently promising technologies based on research that had not directly involved the farmer and that had not benefitted from farmer-feedback have been largely unsuccessful."*

But focusing on input from farmers is not enough: experimentation by farmers and ownership of the process by farmers are both required. Sustainable modification of coping strategies depends on empowerment, or else the skills of the farmer are latent and not applied. A famine survivor must be viewed as an experimenter, an innovator, a risk-bearer, and not as an object of impersonal forces he can't control.

Most researchers give at least lip service to the concept of participation, knowing that involvement in the research process leads to a sense of ownership of the results and more commitment to the findings (Philippi, 1991). But those seeking interventions often have a hesitancy to involve farmers too much. Participation then becomes limited to asking farmers what their problems are, instead of involving them in all stages of project design and implementation. Participation often becomes a means to a better "research product" (e.g., Cohen and Uphoff, 1980). Consequently,

> *"(a) debate exists between those who view participatory research from a pragmatic viewpoint and those who emphasize its importance as a method to facilitate the liberation of oppressed people." (Campbell, 1987)*

Fujisaka (1989) notes neither the "farmer first" or "expert knows best" approaches are optimal. Both experts and local people have unique areas of expertise which collectively provide a better basis for development than either alone.

Resolution of this debate lies in two facts: veto (which farmers ultimately have) and empowerment (helping them realize they have the veto even while the change agent is there). Especially in famine mitigation research, farmers have unique knowledge about the workings of their system. The more actively involved they are in research, the sooner we will have successful famine mitigation interventions. Indigenous coping strategies are the foundation for coping strategies which enhance assets

In summary, a famine mitigation prerequisite is determining coping strategies with cognizance of the assets those coping strategies depend on. But whose coping strategies do we facilitate?

To mitigate famine, one must determine where famines begin. In sub-Saharan Africa, famine hits the rural food producer first. Governments respond to the more visible poor in cities while the rural poor suffer in silent ignominy (Campbell, 1990). Many semi-arid rural areas therefore have a chronic, but hidden food deficit (Jayne *et al.*, 1990). Such problems might be entirely dismissed by urban elites, except that in extremely dire situations, this food deficit spreads to other areas along with mass migrations and even begins to affect the cities (Matiza *et al.*, 1989).

Within rural areas, certain populations are affected sooner and more severely. Nomadic pastoralists have a higher incidence of starvation during famine conditions (Kumar, 1987). But the sedentary far outnumber the nomadic in sub-Saharan Africa. The landless, who are also among the first to feel effects of food shortage, are also a relatively small proportion of the population in African famine-prone areas. Landholding farmers comprise the largest percentage of people in famine-prone rural areas in sub-Saharan Africa.

Interventions focused on improving the coping strategies of farmers are also the key to food production and conserving resources. Interventions focused on pastoralists or the landless will be unlikely to have as much impact on food production. Improving farmers' coping strategies provide the most effective means of mitigating famine.

What is the test of a successful coping strategy? Measurable indicators of household food security are difficult to come by. The dynamic nature of rural households is often underestimated. The majority in some agroecosystems near urban employment opportunities, are in a constant state of flux.

Food security is most concretely measured by relating food consumption to food stored. Often the only measure of food security is food on hand and number of people in a household at a particular time. But if we view stored food as one type of asset and accept that increasing assets leads to increasing household food security, then the key question becomes what effect particular coping strategies have on the asset base of the household. Relevant indicators, then, are any that reflect a change in the asset base.

2.3.4 The Context of Ongoing Indigenous Coping Strategies

Any famine mitigation intervention will take place in a context of ongoing indigenous coping strategies. A variety of sources can account for the presence of a particular strategy, but the origin (whether farmers, PVOs, extension, IARCs, pilgrims) is irrelevant, only whether the intervention is being used by farmers without outside coercion or incentive.

Given that household asset enhancement is the goal for selecting among the existing coping strategies, a number of characteristics of successful strategies become apparent. These strategies are based on local resources, local knowledge, and local organization (Anderson and Woodrow, 1991). They are flexible, do not overburden labor capacity, and reliance on external inputs is minimized.

Even if assets are increased by a strategy, that strategy may not be reliable or sustainable (eg. cutting firewood). If a strategy depends on an external source of funds for its success, the strategy can drain assets when the external source changes. On this dimension, cash cropping, labor migration and use of food relief are identical. All depend for existence on increasing dependence of a particular rural community with national and international sources of funds (Campbell, 1990).

Each can require investments which cannot be recouped if the source of funds becomes less reliable.

Since soil and water resources are among the most productive assets a smallholder has, the degree to which a strategy degrades the natural resource base must always be a criterion for evaluating the efficacy of a strategy.

2.3.5 Capacity Building and Resilience

Uncertainty is the way of life in semi-arid environments. There is no equilibrium state, no meaningful average yields, or average rainfall, so we cannot speak of any ability of these ecosystems to return to a normal equilibrium state. Instead we must track resilience. Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb change. A goal of famine mitigation should not just be to keep potential famines from happening, but to increase the resilience of at-risk populations.

Increasing the resilience of indigenous coping strategies will mitigate famine. The resilience of any particular strategy depends on the ability of smallholders to predict and respond to change. Successful coping strategies can never be separated from the skill of smallholders:

> *"Skills acquisition may be the most important capacity-building activity. Through the Tin Aicha program, in building the school, cooperative and dispensary, many people learned the skills of mason, carpenter, well-digger, etc. The program also introduced new skills in agriculture. In the subsequent periods of drought and famine, a number of families survived, not due to the institutions of Tin Aicha, but due to these skills." (Mali, American Friends Service Committee--Anderson and Woodrow, 1989)*

A focus on asset-enhancement should not lead to interventions focused just on asset supply, but should integrate training with supply of the input. The Ethiopian Red Cross distributed a hundred thousand tools, but trained only 86 farmers during the 1984-85 famine (Anderson and Woodrow, 1989). An asset, without a skill or coping strategy which makes use of it, is good only for resale, not for asset enhancement. If the asset is provided on credit without needed training, the only likely result is the creation of an additional debt burden on the recipient.

Conversely, training in improved strategies, without the needed inputs or assets to employ them, just produces frustration. However, when combined with needed inputs, training converts turns traditional relief responses into proactive development by asset enhancement through improving local coping strategies.

One way of characterizing the resiliency of different coping strategies is to examine their reversibility (Campbell, 1990). Strategies that destroy assets are not reversible. Eroded topsoil, consumption of seed, or destruction of breeding stock are all indicators of non-reversible, non-resilient strategies. Strategies that enhance assets have effects which are completely reversible.

2.4 Famine Mitigation and Agroecosystem Principles

Establishing specific interventions requires applying the coping strategy/asset perspective to famine-prone ecosystems since a basic principle of famine mitigation is that successful famine mitigation interventions will fit local agroecological systems.

However, there is little standardization of methods for classifying agroecological regions. While it is common to find methods of classification based on altitude and rainfall, many authors have used other criteria such as geographic zone, cropping system, or natural vegetation classification schemes. In Ethiopia, for example, Caldwell (1991) notes that two approaches refer to Ethiopia's agroecological zones as eleven distinct climatic and geographic regions. A third uses elevation and rainfall to divide Ethiopia into eleven zones. A fourth follows the third scheme but with fewer subdivisions within each major zone. Several others refer to still fewer divisions.

Furthermore, we can't identify all the possible agroecological conditions--every farm, even every field, must be treated differently in terms of soil preparation, planting, harvest--in every aspect of crop cultivation due to its agroecological peculiarities. In some systems, within field variation is crucial (e.g., in bean cowpea intercropping systems).

Agroecological conditions vary by year and within year resulting in such phenomena as routine fluctuations with 10 fold differences in extremes in yield (Botswana; Borton and York, 1987). Baumer (1991) contends that studies of semi-arid areas need a minimum of 15 years to sample all relevant climatic conditions.

This daunting complexity can be overcome by one simple method: rely on the farmer. Agroecosystems, in fact, cannot be defined independently of farmer actions.

> *"From the researcher's perspective a fundamental difference between ecosystems and agroecosystems is that the former functions as a result of internal checks and balances. Thus ecologists are able to create conceptual constructs, which they call 'ecosystems.' Agroecosystems, on the other hand, are not simply there; they are created in the physical sense by human intervention." (Lowrance et al.*, 1984)

The particular coping strategies to be employed must be determined by the farmer due to the complex set of interacting variables only he knows in detail for his farm. These include topography, soils, weather, climate, running water, moisture in the ground, plant species and their pests, technology of farm tools, experience with local availability of labor and capital and the interaction of these variables. For example, farmers often plant millet on well-drained sandy hills, while sorghum and corn, being tolerant of waterlogging are planted on clayey, wetland soils. In a drought year, though, millet is moved to the wetter soils and sorghum and maize planted rarely and then only where water catchment structures permit (Campbell, 1990).

Thus, famine mitigation interventions should not profitably focus on a particular coping response--the decision of which coping response to use must necessarily be the farmers'. Farmers know the intricacies of their agroecosystems. Each farmer provides the final test of whether an intervention will work in their particular system. But appropriate interventions can increase, through training and inputs, the farmer's library of responses. Successful interventions will enable coping strategies matching the broadest possible range of agroecological zones.

To do so, interventions must take into account the agroecological considerations which cut across all famine-prone agroecosystems. Four such considerations which are often overlooked in examinations of famine-prone areas, but which provide important criteria on which to judge interventions include:

The interventions effects on reducing the influence of rainfall variability.
The interventions effects on enabling smallholders to expand compound farming systems.
The degree to which interventions make use of existing farmer groups.
The interventions effect on conserving wild and fallow lands.

2.4.1 Resilience when Rainfall is Variable

Low rainfall is not a sufficient predisposing cause for famine or even low food production. Given trends in rainfall toward lower averages in east and southern Africa (Sutherland *et al.*, 1991), famine mitigation certainly must select and design land management strategies to more sustainably cope with this trend. But low rainfall itself is and has been associated with a number of very productive agroecosystems.

Drought is also not a sufficient cause of famine. For example, Webb *et al.* (1991) have shown in Ethiopia that there is not a strong correlation between drought years and subsequent food shortages. Since drought is a longer than anticipated period of low rainfall, coping strategies are successful which have flexibility in response to lower rainfall.

A number of factors influence the effectiveness of any particular level of rainfall. Rates of evapotranspiration can be as high as 1600-2200 mm in some famine-prone agroecosystems (Deuson and Day, 1990). Other factors such as crop water requirements, soil infiltration, soil water storage capacity (including soil organic matter), water catchment infrastructure, irrigation infrastructure--all influence productive value of a particular amount of rainfall. In many famine-prone areas, these factors result in only 10-15% of rainfall being used by vegetation (van Keulen and Breman, 1990). Even that 10-15% is often not used efficiently due to inadequate nutrients. Even extremely low rainfall, efficiently used, can result in high production.

The overriding misconception of many researchers is that average rainfall has predictive value in semi-arid areas. This is illustrated by an example from Wright *et al.* (1991). With various assumptions about average water-holding capacity, average length of rainy period and average rainfall, Wright *et al.* recommended 90 day maize with a relay crop of cowpea for a site in semi-arid West Africa. But such systems have been tried and regularly fail. Average rainfall does not take into account whether moisture is sufficient during certain crucial periods. Maize, more than any other grain crop, is crippled by shortage of moisture at flowering and grain fill. Furthermore, at any level of rain below the average (which happens half the time), maize production is tenuous. Taking solely averages, such systems should work. But they don't because average rainfall is meaningless without taking variability into account.

If variability is an inherent characteristic of the system, then any attempt to match an average set of conditions, or equilibrium state, will result in about half the seasons with less rainfall than needed for production and another half where all possible resources are not used. In fact, even calculating the scope of variation has been difficult in many agroecosystems due to the fact that fifteen years of study is often necessary to sample the entire variety of rainfall patterns in semi-arid areas (Baumer, 1991).

Standardized, unresponsive coping strategies can only be successful if they use a small portion of the resources available in the best years. Otherwise they will fail in most years. Unresponsive coping strategies often lead to degradation of the very resources they depend on. Desertification, pest epidemics, salinization of soils, erosion under monocropping are among the results.

The sustainability of systems when rainfall is highly variable depends on the resilience of the coping strategies.

> *"The traditional economies of semi-arid areas depended on production systems flexible enough to accommodate all but the most extreme variations in the production environment without severe hardship to the population." Campbell (1990)*

Multiple coping strategies must be available to fit variable agroclimatic conditions in order to mitigate famine.

2.4.2 Compound Farming Systems

A second aspect of sub-Saharan agroecosystems has also been neglected in studies of famine-prone areas. Nearly every smallholder farming system is actually two systems nested together: the compound and the bush systems.

The concept of "compound farming system" is used by such researchers as Hahn (1990) and Okigbo (1990) to describe systems which incorporate, but expand far beyond, household vegetable gardens. A compound farm system features a distinct area adjacent to the house where continuity is physically and socioeconomically safeguarded. The system is characterized by secure land tenure, continuity over time, diversity of labor activities and inclusion of small ruminants and poultry. It is used as a depository for capital goods--buildings, livestock and storage of materials. Compound farm systems thus include all gardening activities, some animal husbandry and some cereal production in areas which can be secured by the household from outsiders.

Nearly every ethnic group has distinctive names for the types of farming delineated by the term compound system. The Nuba in Sudan refer to the compound farm as the *jubraka*. Women traditionally manage maize, short-season sorghum, groundnuts, cowpeas and a wide variety of vegetables in the *jubraka* and land tenure is relatively permanent (Speece,1989). In other Sahelian regions, various sorghums, maize, tobacco, melons, calabashes and other vegetables are grown in *jubraka*-type systems.

This compound farming system is contrasted with the extensive cultivation of staple crops, usually by men, at some distance from the family's residence. These "bush fields" are traditionally characterized by shifting cultivation--though the fallow period is being drastically reduced. There has traditionally been little concern about managing soil fertility through manure or crop rotations, nor with water management to control erosion and runoff (Vierich and Stoop, 1990). Land rights for bush fields are more apt to consist of use-right tenure or usufruct which tend to lapse when cultivation is abandoned.

In Ethiopia, among the Wollo, even the two types of farmland used by these systems are given different names (Caldwell, 1991). *Guaro* is land around the homestead where house is located. The land of bush fields is *ersha*. Major annual crops for home consumption and some of the perennial crops, such as coffee, are grown on *guaro* land. These are considered to be most fertile and productive. *Guaro* receives more inputs (ash and dung) and labor. *Ersha* lands are quite fragmented.

Since every cropping system in sub-Saharan Africa is actually two systems which interact but are often very distinct, investigation of interventions should not be divided along commodity lines since each system incorporates many of the same species. Instead interventions must address the unique internal logic of each system in order to be successful.

The contrast between the two systems is not always quite as sharp as some authors suggest, but several key differences make the compound strategies most appropriate for FM examination based on asset-enhancement through multiple coping strategies. Compound systems include various means of enhancing available resources. The most obvious are water catchment and increasing soil organic matter. The integration of crops and livestock in compound systems also makes far better use of nutrients and, in some systems, makes manure into a valuable, saleable asset. The incorporation of deep-rooted perennials (which serve as nutrient pumps) helps in soil improvement as do replication of fallow processes through such methods as mound farming (Stormgaard, 1990). As long as necessary seed are available, compound systems appear stable and productive. Compound systems are almost the only way to maintain land tenure in semi-arid areas.

Barker and Chapman (1990) note that compound farming is common throughout Africa and contend it is the most sustainable means of food production in Africa. Their summary term describing the strategy of compound systems is intensification. Famine-prone areas have two choices, continue application of extensive techniques and watch resources degrade or apply intensive techniques and see agriculture develop. Intensification has a local model in the compound farming systems nested within traditional farming systems.

One reason that compounds have been largely ignored in analysis of agroecosystems in famine-prone areas may be that, due to certain similarities, compound systems may have been identified with the gardens of Western culture--which are only secondary sources of food. Another may be that women are key strategists in compound gardens and the mostly male agricultural establishment makes little contact with women agriculturalists.

The cultivation by women of compound systems is especially germane to famine mitigation since women take the first actions in response to famine and act more intensely in early stages than men (e.g., in Mandara mountains of northern Cameroon, Campbell and Trechter, 1982).

2.4.3 Social Aspects of Agroecosystems

The formal and informal groups which assist all farmers in coping with highly variable environmental conditions comprise a level of agroecosystems which is rarely examined. When famine is in the offing, social cohesion sometimes gives way (Campbell, 1990) and sometimes doesn't (de Waal, 1990). When social cohesion is strong, the effects of famine on the group are routinely less.

In fact, no region has ever moved from household food insecurity to household food security without strong local organization of farmers. One of the best examples from the famine mitigation literature is Se Servir de al Saison Seche en Savane et au Sahel (SIX-S) which built on the "kombi-naam" traditional associations of young people active during the rainy season undertaking projects for the community. Six-S built on this informal organization to develop granaries and cereal banks in several Sahelian countries including Mali, Senegal and Burkina Faso (Anderson and Woodrow, 1989).

Michael Bratton (1987) in **Denying Famine a Future** notes the characteristics of a solid, constructive local group. We can also refer to findings from one good PVO manager after another, specifically Gerry Salole of Save the Children in Ethiopia and Zimbabwe, Luc Le-Chuan of World Vision in Senegal (see Worstell, 1991).

A constructive local group is one where the group culture is self-reliance with commitment to consensual decision-making on group matters, dedication to careful work, a desire to work together regularly, an interest in exploring new practices and knowing everyone can learn from everyone else. These five pillars are what good development worker looks for or encourages. But the proof is in results; the best groups have accomplished some cooperative activity. There is a tremendously successful example from Somalia of these "cultural change" principles being put in place at the Sheikh Bananey Cooperative (Anderson and Woodrow, 1989).

Small innovation-oriented groups provide the most fertile milieu for interventions. In fact, no famine mitigation project will be sustainable without solid local groups, no matter how good the project design. If such groups do not exist, they can be developed from productivity-oriented groups which exist in nearly every agroecosystem. The "jiggae" help each other work land and obtain inputs in Wollo. Among the Kaweluarea of Kenya "miethya" whose women members help each other in farm work, storage and marketing (Kamau *et al.*, 1989). Various similar informal work groups are documented in all southern African societies and in nearly every African culture (Salole, 1991a). For speed, efficiency and sustainability, famine mitigation projects should work with these existing groups rather than create new ones.

Famine mitigation requires implementing organizations which will search for the right sort of local organizations within each population. These implementing organizations are ones in which:

-local knowledge systems are deemed important,
-senior staff have a long-term commitment to future activities,
-and which are independent of, but plugged into, local power structures.

PVOs/NGOs and churches seem to have been able to nurture small farmer groups better than other institutions. The ability to inculcate a strong "ideology" may help members of a cohesive group better cope with famine situations (e.g., Bratton, 1987 and Anderson and Woodrow, 1991).

Staff of organizations successful in nurturing groups have a number of common characteristics (Worstell, 1991). One common approach is working with already existing formal and informal groups, such as existing work groups, rather than attempting to create their own groups. Staff especially seek out productivity-oriented groups. For famine mitigation efforts, good local staff are the "grammaticians" (Salole, 1991b) who serve as a bridge between technical experts in seeds or food storage and the coping strategies, assets and social structure of famine-prone populations.

The actual management of successful famine mitigation projects, however, is best accomplished by local residents themselves. All too many projects, hire a different sort of manager, as Peter Walker (1988) of Action Aid notes,

> *"(Sudanese University graduates and city dwellers) found it difficult to relate to, and share, the aspirations of those they were supposed to be in partnership with. . . . These urban 'enlightened' men saw development as a process of rejecting their traditional values and way of life in favour of an urban, educated existence."*

Examples are legion with the most extreme examples (cited by Jedlicka, 1977) of outreach workers who wore only suits and ties and refused to eat or talk directly with peasants.

Participatory approaches enlisting farmers in the research/development process often refer to "farmers as actors of change" (Murphy, 1990). The solid group and farmer-as-actor are not contradictory. The solid farmer group is dynamic and the dynamism is due to the experimentation and hard work of individual farmers. Farmers can thus quickly outgrow the change agent and researcher.

Often the main reason strong local farmer groups are not encouraged is governmental fear. Most governments have been afraid to promote farmer organizations due to fear of their inability to keep such organizations out of the political arena.

One qualification to the above comments is important. In most famine-prone situations, ultimate responsibility for food production is lodged at the household level. The ability of farmer groups to facilitate innovation and mobilize shared labor has led to interventions focusing on communal food production. Such community gardens rarely last longer than the funding source.

Farmer groups perform functions which better enable households mitigate famine. But these social systems do not usurp functions of the household subsystems. Effective intervention at the group level can facilitate, but not replace, household coping strategies.

The basic reason we must include social aspects of agroecosystems in famine mitigation analysis is that establishing local groups is a key survival strategy for all rural people (Salole, 1991a).

> *"Put simply, one cannot go far wrong if one is building on institutions which have been dreamed up, erected, modified, maintained, improved upon and put up with by the societies themselves without outside pressure or assistance. It is hard to conceive of any working development activity or process which does not rely ultimately on strong and vigorous activities which people choose themselves."*

As Philip Raikes (1988) notes, we should never underestimate the effectiveness and stability of social networks in determining resistance to food shortage.

2.4.4 Wild Foods and Fallow Lands in Famine Mitigation

Collecting food from uncultivated areas is an extremely widespread coping response in famine-prone areas of sub-Saharan Africa. Sixty-eight species are used for wild food during famine times in N. Nigeria (Watts, 1988), and hundreds of species are used in various regions in Ethiopia (Caldwell, 1991).

Wild foods are especially useful in the season after rains have come but before crops have come in. Leaves of numerous perennial species show a flush of growth following rains which is often more palatable than vegetation occurring at any other time. The niche of hunger-breaking first-flush foods can be partly filled with cultivated perennial crops which produce a quick flush of nutrient-rich growth at first rains, during the hungry season.

Wild foods are especially important for pastoralists and their herds. For specific coping strategies see, for example, Messer's (1985) description of famine strategies of the Samburu in N. Kenya. Some wild foods, such as *Acacia* pods, are collected by pastoralists for their animals, though this source is minor compared to consumption through grazing.

The decrease of fallow lands across Africa means less forage and decreased availability of food from nondomesticated plants as well as a reduction in nutrient-rich non-depleted soils. As fallow lands decrease, coping strategies must begin to compensate for effects of fallow lands on availability of wild foods and soil fertility regeneration. Fallow and 'wild' aspects of agroecosystems provide a valuable asset for coping responses.

2.4.5 Agroecosystems Constraints

The above agroecosystem considerations, combined with a focus on enabling multiple coping strategies which enhance the assets of smallholders, comprise a new perspective on famine mitigation. But how does this perspective change the view of standard lists of constraints to food security?

Three constraints--inadequate storage and poor transportation facilities, low investment in agriculture and high consumer prices relative to income--according to Maleka *et al.* (1991) are generally recognized and accepted as the key causes of food insecurity. Only one of these three directly addresses enhancing household assets--storage. All others are very centralized and only indirectly assist coping strategies.

This listing reveals the typical implicit assumption of many food security researchers that production will always be low in these areas and relief will have to be shipped in. We point out that sustainable famine mitigation efforts have only achieved their gains by increasing smallholder productivity--the alternative is institutionalized relief.

A major review of sustainable technology introductions in the Sahel during the 1980's notes:

> *"Without improvement in soil fertility and better means of capturing and storing water in the soil, significant productivity gains cannot occur." (Deuson and Day, 1991)*

Significantly, the methods of compound farming systems attack exactly these constraints. These techniques for water catchment and increasing organic matter also apply to an even more comprehensive discussion of constraints to increasing food production in sub-Saharan Africa:

> *"Poor soil fertility, high rainfall losses due to surface runoff, highly variable inter- and intra-year rainfall and labour shortages in the critical planting and weeding periods are the major constraints to increased cereal production in the subsistence-oriented farming systems on the Central Plateau of Burkina Faso." (Nagy et al., 1990)*

This analysis of constraints supports the framework sketched in previous sections. The importance of matching agroecosystems' variable rainfall to the variety of crops which best fit each type underscores the need for appropriate seed with the seed storage and multiplication required. Labor shortages during the growing season point to the lack of stored food during this season. Labor shortages may be met by increasing the capacity of present workers through increased availability of stored food during the hungry season.

But neither of the above summaries of constraints addresses *effective* productivity. Tying such analyses to household command of food is critical. Effective productivity refers to how much of produced food is actually consumed by rural households. Food storage is the key constraint not mentioned by traditional analyses from a strictly production perspective.

Traditional analyses also seek to find the one cropping system which is most appropriate, ignoring the extremely variable agroecosystems and the multiple coping responses they implicitly call for. The closest most studies come to such a systems level analysis is by stating that production technology is poorly suited to low-rainfall areas. Again the determining characteristic of variable rainfall is ignored in the attempt to discover a single coping strategy. The problem, according to traditional analyses, is to replace the existing strategy, rather than facilitate multiple strategies. This inadequate conceptualization of local agroclimatic variability may well reflect the origin of most agricultural research in areas with more reliable rainfall. In any case, lack of attention to rainfall variability by researchers is remarkably consistent with the inexperience of newly settled farmers. This points again to the need for indigenous input into famine mitigation design.

Traditional production-oriented constraint analyses, such as the above, also neglect wild foods and especially the wild lands and fallow areas required to maintain these sources of food.

Constraint analyses which neglect production often fail in the opposite direction of the above analyses. Jayne *et al.* (1990) note that the lack of grain distribution from surplus areas to deficit areas constrains famine mitigation and therefore recommend that policies regulating grain movement and ownership be changed. But, as discussed in section 3.3, many of these policies have already been changed in, for example, Zimbabwe and Mozambique, but their effects last as local officials and local merchants continue to benefit by maintaining the previous policies. Such market policy changes routinely fail to have positive effects on household level coping strategies.

Furthermore, if such policy changes cannot effect change in a country like Zimbabwe, where transportation systems are relatively developed, other countries can expect even fewer results from such interventions. The urban bias of nearly every country will further limit effective policy changes when they conflict with the goal of low food prices.

Given the importance of enhancing assets and developing interventions which facilitate multiple coping strategies, two technical areas fall out as crucial: food storage and seed availability. Food storage permits any strategy which results in increased local food production to contribute to famine mitigation. Seed availability increases the ability of farmers to use a number of different coping strategies matched to agroecological conditions of any particular season. Food storage and seed availability head the list of constraints from the perspective of asset enhancement and multiple coping strategies.

2.5 Food Storage Principles

Establishing and maintaining food at low moisture content is the basic principle of food storage in tropical areas. One reason moisture control is so crucial is because it is so weather-dependent. Open sided cribs allow grain to dry when humidity is low, but permit grain to take up moisture during wet weather. Ventilation is extremely beneficial in dry weather for maintaining quality of grain in storage. But in the rainy season, storage sealed against humid air is needed.

Cool air holds less moisture and decreases biological respiration resulting in fewer storage losses. Some traditional systems of grain storage have involved moving grain to higher altitudes for storage. But of the two bywords of good storage, cool and dry, often the only one open to intervention is dryness. However, the fact that deterioration of grain in storage is much less pronounced in cool, dry weather than in hot, humid weather must be taken into account in implementing food storage interventions, particularly in extremely bimodal climates.

> *"...moisture may be the most important factor determining whether, and to what extent, grain will be liable to deterioration during storage." (National Academy of Sciences, 1978)*

A key to drying is pace. The pace of drying must not be so slow that fungi and insect infestations can build up, but not so rapid the food goes "into case" with the surface drying and sealing moisture in inner layers.

Once grain is dry enough, sealing in impervious containers, if available, will result in sustained, secure grain storage. Underground pit stores are traditional methods for storing large amounts of grain. They can be cost-effective methods for obtaining conditions where grain is cool, dry and sealed from insect and fungal infestation. Inspection opportunities are reduced, however, so grain must be well-dried and free of infestation before storage.

Keeping the food dry will eliminate most fungal and bacterial infestation problems. Regular inspection to insure grain stays dry may be sufficient to preserve nearly all grain of species such as teff (*Eragrostis abyssinica*) with minuscule grains and a hard seed coat. However, nearly all other tropical stored foods are much more susceptible to insects than teff.

Insect problems which are not solved by keeping grain dry require application of other principles. A major one is to make inhospitable the microenvironment where insects multiply. One traditional means is by filling spaces between grains to reduce breeding areas for insects and to abrade insect cuticles leading to desiccation.

Biological "insecticides" are often very effective, but depend on alteration of the ecology of a particular species. The techniques are thus highly location-specific, providing another essential reason for understanding local adaptive strategies.

One key consistency among all successful storage strategies is attention to hygiene--cleaning bins and containers thoroughly prior to storage.

2.5.1 Rodent, Bird Control and Theft

In examining losses to rats and mice, the Centre for Overseas Pest Research concluded that:

> *"the single one fact which emerges most clearly from the survey is the widespread ignorance of the magnitude of the rodent problem, and of means to control it." (Hopf et al., 1976)*

Widespread resistance of rodents to rodenticides in the developing world makes structural impediments the most promising rodent control means. A number of interventions which both increase awareness and alleviate the problems of rodents are noted in the following chapters.

Bird losses can be especially crucial with millets and sorghum when grain is either left in the field to dry or dried on roofs. Interventions which keep grain away from birds can be a valuable post-harvest loss reducer. If field bird losses are a problem, finger millet (*Eleusine coracana*) has far fewer losses than other millets and sorghum.

Many villagers store less grain than they could because of fear of theft, according to several researchers (Messer, 1989 and Sigaut, 1988). Social and physical interventions which reduce theft can increase farmers' willingness to store more grain.

2.5.2 Legumes: Special Considerations

Grain legumes (such as beans, cowpeas, etc.) have much higher storage losses than cereals. Much of this is due to their tendency toward field infestation by insects (especially bruchid beetles). Eggs are laid on the maturing pods and though only a small percentage of the harvest is infested, the nucleus is provided for severe losses in storage. Losses are reported as high as 50%. Interventions with populations which rely on legumes should focus on reduction of insect infestation before placing in storage.

2.5.3 Traditional Varieties' Resistance

Successful traditional storage methods may be disrupted if other varieties are introduced with different grain characteristics. Traditional varieties often have a harder endosperm and reduced seed moisture content and are, thus, less prone to insect and pathogen attack. Introducing other varieties may well require changes in traditional drying and storage methods.

2.5.4 Root Crops

Most storage problems in root crops are related to the physical characteristics of the crops. Roots and tubers are living, actively metabolizing organs that continue to respire and transpire at much higher rates than grains. Unlike the food grains, they are high in moisture content and are essentially perishable commodities susceptible to mechanical damage, physiological breakdown and attack by fungi and bacteria.

Traditional practices recognize this fact and leave cassava in the ground until needed. This method reduces mechanical damage (which hastens infestation), maintains dormancy and provides cool storage. However, quality declines when such storage is prolonged. Once harvested, the roots are either used immediately or processed into dried products with longer storage life. If not used immediately or processed, root crops should be stored in conditions which either reduce respiration (by cool storage) or allow for it (by good air circulation).

2.5.5 Sub-populations and Food Storage

Food storage with refugees is often easier to effect than with other populations, especially if food is distributed daily. Distributing impervious, sealable containers may provide long-term, sustainable interventions.

Food and cash for work projects which manufacture such containers from local materials provide useful skills and immediately increase food storage capacity and, therefore, resistance to famine.

Nomads' capacity for food storage is limited so processing which reduces food weight is key. Their herds are their food stores. Interventions to improve herd health and survival will be key to food availability.

Traditional coping strategies related to preservation and storage of foodstuffs are invariably the responsibility of women (Dei, 1990). The care and skill of women in storing, rationing and distributing food often determines whether the household's children are seasonally or permanently malnourished (Messer, 1989). Men often construct storage structures, but actual storage practices are performed by women. Interventions focused on storage, must then be directed at women.

2.5.6 Community Cereal Banks

Cereal banks' chief problems relate to administration which does not distribute stored grain equitably to all sectors of the population or does not enforce payback. Perspicacious selection and training of administering community groups avoids these problems.

2.6 Seed Quality and Availability Principles

Seed represent the most compact and easily transportable of all inputs which might be useful in mitigating famine. If initial assessments indicate that a pre-famine area is experiencing seed deficits, seed interventions can be extremely cost effective.

An early assessment applicable to RRA and crucial to determining seed interventions is the viability of present seed stocks. If seed retain normal viability, easily determined by simple germination tests, maintaining that quality will be a key intervention.

2.6.1 Seed Storage

Many of the interventions noted above for grain storage are also applicable in seed storage. The principles are the same, chiefly, keep it cool and keep it dry. But, seed are a bit trickier than grain, especially in the drying process.

One perspective seems to be consistent among several successful NGO seed program managers. They stress to farmer groups that seed are living organisms. Seed are in a dormant state but the germ is highly perishable. Interventions in grain storage can provide farmer groups with the basic principles needed in seed storage, except that seed stores must preserve life in addition to food value. If this perspective can be transferred to managers, seed interventions are much more effective.

Drying. Unless harvest falls during a period with no rainfall and relative humidities lower than about 60 percent, the moisture level of seed will need to be reduced to insure seed viability. If seed moisture remains above 14-16%, seed germination rates decline rapidly due to biological heating even if infestations are absent. Each species must be considered separately. At 19% moisture, most seed have a storage life of days (Douglas, 1980). Interventions based on detection and modification of high seed moisture content are the most basic of seed interventions.

However, even at 14% moisture, temperatures of 20-25 C will reduce survival for most seed to only a few weeks. Some vegetable species lose viability in weeks unless stored below 15 C. If these types are to be used, costly central storage may be required.

Drying of seed must be done much more carefully than grain drying. Slower drying and insuring that seed are not overdried are fundamental. Insuring seed is dried out of the direct sun will usually significantly increase germination rates.

Household storage. Household storage is assisted by provision of impervious, sealable containers with proper training in seed storage. Household storage makes seed most readily available at planting time, but also makes seed available for eating during famine conditions. Whether household storage will best maintain seed stocks depends on how depleted food stocks become. Stored seed becomes more and more attractive as food as hunger increases. Interventions which provide relief food, while moving seed out of household storage for multiplication, are crucial at this stage.

Community seed-banks. The one consistency across several communities in one famine mitigation study was that improved community seed storage is crucial. Seed storage in these drought-afflicted communities of Northern Kenya was in the office of the chief or other local offices (Anyango, 1989). Interventions to provide alternative storage areas would be eagerly welcomed by these communities. They already have community-wide seed storage, they are just lacking facilities to keep the seed at high quality levels. The principles governing successful storage facilities have been discussed under grain storage.

Regional/national seed-banks. The more centralized seed storage becomes, the more likely one bad decision will diminish seed availability for an entire region. Centralized storage can also create problems in achieving timely distribution.

Advantages of centralized storage include efficiencies of scale and better trained people at the regional or national level. Douglas (1980) and a number of other publications are excellent sources for useful information on establishing national seed storage. Whether regional or national seed storage has a high probability of success depends on governmental efficiency and stability. Only a local appraisal at the time of famine mitigation can provide the needed assessment.

Extra-country seed sources. Though encountering many of the problems mentioned above (especially propounded in distribution), relying on seed of crucial varieties stored outside the country may be an intervention appropriate for international PVOs working with private seed companies. Private seed companies have an increasing ability to supply varieties appropriate to famine-prone areas. This seed is too expensive for routine use by farmers so lines used should permit local multiplication.

If private or other extra-country sources are used, once a crucial variety is known to be in short supply inside the country, the best strategy is to import the variety and move it into local storage as soon as possible.

2.6.2 Selection and Availability

A primary adaptive strategy of farmers in variable rainfall conditions is adjustment of the mix of species and varieties used in their fields and gardens. Watts (1987) reported that over 70% of farmers used polyvarietal crop substitution of drought-resistant millets and sorghums to mitigate the effect of drought. In his northern Nigeria study area, farmers often had a subtle knowledge of crop types (particularly millets) in relation to moisture tolerances, soil requirements and maturation rates. As is typical of manual cultivators in drought-prone areas, these Hausa farmers respond to rainfall patterns by altering the species and varieties they plant and by increasing intercropping with double and triple crop mixes.

For these farmers to be successful in overcoming drought in their famine-prone situations, a wide variety of seeds must be available. A key famine mitigation objective is to determine the seed varieties farmers know are most useful in drought situations, identify existing stocks of those varieties and make sure that those stocks are preserved and available to farmers at planting time.

Varieties. Often the principal traditional famine mitigation strategy is switching to short-season varieties. The best intervention is providing high quality stock of farmer-tested varieties. Preferably these varieties will be self-pollinating landraces adapted to similar climatic and cultural conditions. Often maize, though less drought resistant, is used during times of food scarcity because it quickly matures to the point where the grain is palatable. Though sorghum and millets are known by farmers to often have higher average yields in drought years, they aren't palatable when green and immature. As discussed further in section 3, the preference of many farmers for maize is not likely to be reversed, so a better route for long-term mitigation may well be to exploit the vast library of maize germplasm to improve its' adaptability (Blackie, 1990).

In many areas, however, shorter season millets and sorghum are very much in demand. Farmers in many study areas have been eager to experiment with short season varieties (e.g., Colson, 1979). In many areas, investigating new lines is a matter of course to smallholders. When asked why they had planted a variety, *"'for experiment' was never seen as an odd answer"* to the Sahelian farmers studied by Richards (1986).

Capitalizing on this penchant for experimentation by distributing packets of pure, but genetically diverse, short season seed to farmers may be the best means of increasing smallholders' resistance to famine.

Early maturity is one of many traits which confers drought-resistance. Early maturity enables the crop to escape drought; other types of drought-resistance are known as drought tolerance. These include maintaining water uptake, reducing transpiration, desiccation tolerance, enhanced osmoregulation, continued root growth while the above-ground portion is dormant and profuse branching or tillering to make up for portions of a stand lost to drought. Varieties to be included in any seed intervention should possess whichever of the traits have been shown to condition drought tolerance in that species in that region. For example, profuse branching has been shown to be especially important in Sudanese cowpea varieties (Muleba, Mwanke and Drabo, 1991).

Cooking and processing quality. One consideration is often given short shrift in choice of new varieties to promulgate to farmers: cooking and processing qualities. Examples of nonacceptance of high yielding varieties due to bad taste are legion. Other important processing qualities are ease of threshing, cooking time, palatability when served cold and nutritional composition of secondary parts. Richards (1986) found that varieties which tasted good when cold were especially valued by women since this saved cooking time during busy seasons.

In refugee camps, drought resistant seed are less an immediate need. However, assuming seed of these species will be saved for later use, the same characters noted above should be present.

Storage considerations of new varieties. Whenever a variety new to an area is being considered, keeping quality should be examined. Many new varieties have been selected solely for high yield and store very poorly. Traditional varieties in locally made stores often suffer minimal losses (Gibbon and Pain, 1985).

Germplasm preservation. Famine mitigation has a special responsibility in seed interventions because the chief centers of diversity for many food crops are in Africa. In fact, Ethiopia was the origin of cultivated sorghum and yearly new biotypes are reported from the highlands. The guinea and caudatum sorghums both have centers of diversity along the Ethiopia-Sudan border. Any famine mitigation interventions should not result in long-term degradation of these invaluable resources. Wherever possible, preservation of unusual types should be facilitated during seed selection and storage.

Considerations at the species level. Famine mitigation interventions should give special attention to provision of grain legume seed. Grain legumes not only are a valuable source of protein, they usually have a short maturity period (lending drought-tolerance), grow vigorously over a wide range of environments on poor soils without nitrogen fertilization and, furthermore, are nutritionally complementary to the starchy staples in the diets of most rural households (Collinson, 1987).

2.6.3 Seed Multiplication

On-farm. Farmers often have the basics skills related to roguing and plot isolation needed for seed multiplication. The basic areas for skill enhancement are in adequate storage, techniques for insect control in storage and good quality seed to begin multiplication of new or lost varieties.

Vegetatively propagated species. The main reason cassava is not used more often as a hunger breaker is due to the lack of shoots to plant when the first rains come (Watts, 1987). A useful famine mitigation strategy is to support nurseries of cassava in areas where cassava use is established and valued

2.6.4 Distribution

Two key problems in seed distribution systems are quality control and transportation bottlenecks. Both can be avoided with interventions focusing on skilled local seed storage.

Quality control can be approached on a national level either by market control or pre-market control. Market control allows any seed to be sold as long as it is truthfully labeled as to germination, weed seed content, etc. Pre-marketing control requires that all seed must be certified by a government agency before sale. Intervention at a policy level to encourage market control will make more seed of more varieties available.

Transportation bottlenecks are often the bane of any famine mitigation or relief activities. Though not solely a seed intervention, the resilience of input supply networks must be a topic for early assessment in famine mitigation reconnaissance surveys.

Breakdown in a national seed supply chain means seed is not available or arrives too late. Often late seed must still be paid for, especially if purchased on credit from a government agency or parastatal. On-farm seed multiplication efforts, combined with village and women's group communal storage facilities has created a resilient distribution system in Gambia for Save the Children. This should be closely examined for possible replication in other drought and food shortage-prone areas.

On-farm seed multiplication, however, is only successful if the work begins with high quality seed of pure varieties. Mitigation interventions certainly cannot depend on these being locally available. Private seed companies may be the best sources.

Elaboration on these principles and discussion of intervention methods is included in section 2.

2.7 Other Factors

2.7.1 Soil Enhancement

Increased organic matter is the basis for sustainable agriculture (Harwood, 1992) and absolutely vital to famine mitigation interventions seeking to increase soil fertility:

> *". . . virtually every technological recommendation for maintaining or improving soil fertility in the Sahel emphasizes the need to increase the organic content of soils . . ." (Delgado, 1991)*

In addition, soils with increased organic matter have increased moisture retention capability.

Light tilling and mulching preserve organic matter in soil. Tillage implements which minimize soil disturbance can accomplish this goal. Hand tools generally result in less soil disturbance.

2.7.2 Hand Tools

Hand tools are assets required for implementation of strategies for famine mitigation in nearly all agroecosystems. Whatever the level or scale of agriculture, tilling and weeding operations for the vast majority of smallholder farmers is done by locally made hand tools in the cultivation of field and garden crops.

Cultural and economic factors (Faggerson and Colley, 1983) which favor the continued use of hand tools include: a) very small fragmented farms with scattered fields of odd shape, b) partially cleared land left with trees, roots and stumps that interfere with animal or engine powered traction, c) a high density of population on arable land which forces the extensive land cultivation on marginal land, d) very low per capita income which make investment in new income increasing inputs difficult, and e) isolation and lack of intermediate modern sector rural employment opportunities.

Improving the availability of traditional tools and improved hand tool technology is paramount to enhancing the timely production and harvesting of garden crops. But proper design, use and maintenance is required to realize their benefits. Efficiency of hand tool operation is achieved when hand tools are adapted for speed with relatively little fatigue and light in weight for easy transport.

Sustainable local manufacture is assisted if hand tools are of simple design, made of materials which are readily available and can be used or adapted for other purposes.

The number of hand tools which can assist in intensive production (Rice *et al.*, 1986) include: cutlass or machete for clearing debris; hoes (long and short) for preparing beds and ridges, for burying organic residue and for weeding; rakes for leveling beds, trowels for transplanting seedlings and watering cans for watering transplanted seedlings and growing crops in beds.

Many advocate an even wider range of basic tools for full efficiency. These include hand forks, forked hoes, spade and pitch fork (Rice *et al.*, 1986).

However, the most cost-effective interventions will be tools which enable multiple coping strategies. The adaptable hoe (with changeable blades) is one example of this principle. Potentially it could reduce the cost of traditional tools by providing multiple garden operations in one tool. Blades can be made of different sizes and shapes. Manufacture is simpler in that only the blades need be made of tool steel. This type of construction simplifies hardening and tempering. The part attached to the wooden handle and joined to the various tool steel blade attachments can be mild steel (Blandford, 1989).

Since local systems for manufacture and repair of hand tools depends on local blacksmiths, upgrading blacksmithing will be important for supporting the use of appropriate new hand tools.

2.7.3 Intercropping

Crop mixtures, using alley cropping, intercropping and relay cropping, protect soil surfaces from erosion. Intercropping is the rule rather than the exception in semi-arid sub-Saharan Africa. The principle of coordinating plant density with relevant agroecosystem parameters (such as rainfall, nutrient availability, competition for sunlight and space for harvesting), when mastered, leaves few technical constraints tc intercropping (Deuson and Day, 1990).

Consistent with any approach using multiple crops to meet varying agroecosystem niches, intercropping is only effective when seed quality and availability are high.

2.7.4 Weaning Foods

Infant mortality and malnutrition are often the most severe consequences of inadequate coping strategies in famine onset periods. Infants are the most famine-susceptible members of any population. Interventions prior to weaning should focus on increasing mothers' health. After weaning, the processing of stored food to make nutritious weaning foods is an important intervention. Weaning foods often depend on maize or other cereals which cannot provide enough calories or nutrients to infants without as many as 6 or 7 daily feedings. Since this number of feedings is impossible, weaning food based on local legumes are a important intervention in famine mitigation. Weaning foods based on processing of local grains are a part of indigenous knowledge in many famine-prone areas, but have been little investigated.

2.7.5 Local Transportation

Any marketing or input supply interventions are facilitated by improved transportation.

Local transportation can be facilitated in the performance of relief activities to facilitate a sustainable distribution and marketing system for long-term famine mitigation. The Save the Children-Ethiopia example--using CFW to improve roads and 1500 local donkeys while other NGOs were flying in food with helicopters--was discussed above.

The traditional transportation sector is uniquely suited to the road and repair conditions of famine-prone rural areas. Modern mechanical transportation has a number of hidden costs including shipping and storing spare parts and supplies, cost of training mechanics and providing their salaries and skill upgrading. Pack animals are much more adaptable to rugged terrain and functional without imported parts.

The versatility and low maintenance costs of animal transportation can only be utilized if they can carry enough. Improved animal carts and wagons (along with organization of caravans if necessary) expand capacity.

Construction of carts and wagons and support for manufacture of wheels and harness and pack apparatus sit squarely on the traditional blacksmith sector.

2.7.6 Pest control

Sustainable pest control could increase production without increasing land under cultivation or soil degradation. Deuson and Day (1990) note 30-40 % preharvest losses to pests as typical in the Sahel. Improving grain storage can remove much of this loss.

Given lack of local skill in mixing and spraying, lack of degradation of most pesticides available and concomitant health risks and given the donor constraints on pesticide use, pre-storage pest control must concentrate on cultural techniques.

3.0 RESPONSES TO FAMINE

Famine mitigation only takes place is a context of ongoing indigenous responses. Some of these have been introduced by international PVOs, some by national or local NGOs, some by government agencies, some by village associations and others by farmers themselves. Original source of responses is irrelevant to this approach to indigenousness. The only consideration is whether the response is presently being used.

The starting point is knowing local strategies. Some of these indigenous responses will, with support, mitigate famine. Others will not be sufficient to cope with the on-going emergency and require supplementation with other strategies. Still others will prove to be maladaptive. When a society's understanding of and behavior in an environment utterly fails and when survival itself is threatened, a whole system change is in the offing (e.g., when pastoralists have moved to refugee camps, Knight, 1980). In these cases, famine mitigation is not possible and complete rehabilitation will be necessary.

When famine mitigation is appropriate, all improved strategies will necessarily build on existing response patterns. In a famine, by definition, some coping strategy has failed. The failure may not be at the household level, but beyond the household level. But effects will be at the household level. Further, any intervention at higher levels will not have effects on famine unless there are effects at the household level. So, enabling more effective household strategies is the one measurable goal which must be achieved before intervention at larger scales can be designed. Change agencies will most efficiently initially intervene at a level such that household food security changes can be easily ascribed to the interventions. The following discussion will therefore focus on strategies near the household level.

3.1 Indigenous Agricultural Knowledge Systems

If existing local coping strategies are the necessary foundation for any famine mitigation interventions, understanding indigenous agricultural knowledge systems is vital. Miriam Wells (1991), George Dei (1990), Robert Chambers (e.g., Chambers *et al.*, 1989) and C. G. Knight (1980) are a few authors who have shown in vastly different situations the radical differences in successful interventions which accompany different world views.

Responses to famines always build on indigenous knowledge systems. Examples are many. Understanding food shortages related to outbreaks of the variegated grasshopper (*Zonocerus variegatus*) is incomplete without knowing that grasshoppers are eaten on considerable scale in some areas, and even sold in the market place with women, children and poorer people the greatest beneficiaries (Brokensha *et al.*, 1980). Strategies involving pesticide use must consider that the insect is a food commodity in addition to being an agricultural pest. Only access to indigenous knowledge would reveal such local adaptations to food shortage.

3.2 Responses Specific to Local Agroecosystems

A number of locally specific studies have been conducted to determine the coping strategies which are actually employed to mitigate famine at the household level. Drought-resistant varieties, extra weeding and moisture-retaining cultural practices were the most common responses among the

Sukuma in Tanzania according to Bein (1980). In Tanzania, Mkunduge (1973) found borrowing, storage, use of substitute foods and migration to be most prevalent. In the Usambara mountains, Heijnen and Kates (1974) found 18 different drought adjustment coping strategies applied depending on agroecological situations. Jedrej (1985), in the Ingessena Hills of Sudan, found famine victims most likely to sell animals, produce handicrafts, work for wages, buy grain on credit, migrate, and gather wild foods, fruit, roots and tubers.

Rahmato (1988) in Wollo, Ethiopia, found enhanced survival chances in famine situations were due to: diversified food sources, adapted market strategies and social networks. Campbell *et al.* (1989) in Zimbabwe communal areas found that the goal of all coping strategies is more grain in storage.

In Nigeria, Watts (1988) reported nearly 3/4 of farmers stated that their main preparation against drought in the future would be producing and storing more food.

In contrast to some expectations, in many areas where there is a continued perception of drought by local farmers there has been a widespread replacement of sorghum with maize (e.g., Ethiopia, according to Webb *et al.* 1991). The share of total acreage planted to sorghum has fallen from 21% in 1980 to 13% in 1988 (Webb *et al.* 1991). The explanation seems to be that sorghum varieties in Ethiopia are highly susceptible to rainfall variability.

The multiple uses of crop plants may also be a factor. *"Elijam"*, a 3-month variety of sorghum used by the Somali ethnic group in Hararghe is considered by farmers to be drought-tolerant, but is disliked due to its short stalk length which provides less fodder for livestock (Caldwell, 1991). Maize, in contrast, produces plenty of fodder in addition to high grain yields.

Adesina and Sanders (1991) report that farmers in all three Sahelian zones have been introducing more intensive practices (manure and fertilizer use, irrigated gardens, moisture conservation practices) and earlier maturing varieties. In southern Africa, one unique indigenous coping response, which replicates the effect of fallow while permitting intensification, is "mound-cultivation" (Stromgaard, 1990).

Intercropping is a response which is used traditionally, but is expanded under drought stress. Mixing varieties row by row (so separate harvest is possible) enables farmers to grow late and early genotypes together and achieve greater productivity in environments with variable season length (Nageswara Rao *et al.*, 1990). Cowpea and millet are especially useful for intercropping in extremely dry areas if an early maturing but indeterminant and spreading cowpea is planted about two weeks after millet (Reddy *et al.*, 1990). A reduction in insect infestations will usually result upon intercropping. However, in a limited number of situations, insect pressure may increase, eg. midges increase when a cowpea and millet intercrop leads to a denser canopy (Leroi *et al.*, 1990).

Mixed sequential cropping is also a traditional response which is heightened during times of famine onset. Mixed sequential cropping can provide constant vegetative cover during the growing season, protecting soils and soil moisture. It is also a safeguard against total crop failure, particularly when the mixture is made up of crop varieties having different moisture and soil requirements and with different tolerances of drought, wind and pests (Dei, 1990:5).

Use of earlier maturing seed is a widespread coping response. In the driest conditions, only the most quickly maturing millet will consistently give a decent crop. In these situations, a variety of genotypes are not appropriate. Other than good quality seed of these early varieties, the key coping strategy is to concentrate on water catchment.

Traditional coping responses emphasize flexibility. Vierich and Stoop (1990), examining a number of traditional African production systems, found that coping responses emphasized flexibility. Farmers change choice of plant populations, fertilizer and crop management techniques based on rainfall expectations and these are revised as the season progresses. They cite examples from Niger, N. Nigeria, Burkina Faso. In Niger, one example is that farmers maintain seed stock of varieties of varying maturities and then make planting decisions based on rainfall expectations. Recognizing that either or both of groundnuts or peanuts may fail in any given year, farmers may spread risks between early millet--resowing, if necessary several times--and late-maturing guinea corn--which may fail completely, but brings a bonus if the rains end well.

Gender. An important gender difference is apparent in several studies of coping responses. Women may bear the initial responsibility of guiding the family through the crisis; they are aware of it earlier. Women are involved in food preparation on a daily basis and usually have day-to-day control of the family's food stores, they are likely to become more sensitive to any impending shortages earlier than their husbands and so respond earlier. In a study in chronic food deficit area of Zimbabwe (Matiza *et al.*, 1989), a little over one-half the female respondents reported that they faced food shortages annually, compared with 37% of the male respondents. But nearly three times as many men (16.4%) as women (3.5%) reported that they seldom experienced food shortages. Often, the shortage may even pass (following a good harvest) without the husband being fully away of it. Men only get involved if shortage persists and intensifies.

The primary on-going coping strategies employed by women related to gardens maintained as part of the compound farming system. The wide variety of plants grown in these compound systems counteract nutrient deficiencies which can develop with overreliance on a few staples. Further intensification of compound systems is a primary response of women early in the famine onset cycle (Pacey, 1982).

3.3 Trends in Coping Strategies

Trends in the evolution of coping strategies which are likely to influence famine mitigation attempts in the future have been examined by Downing (1988), who noted the following:

1. Decreased numbers of livestock and decreased wherewithal to maintain more,
2. Maize becoming more dominant, even in semiarid regions.
3. Increasing investment in soil conservation,
4. Increasing ineffectiveness of agricultural strategies during drought,
5. Increasing ineffectiveness of coping strategies, especially on-farm agricultural practices,
6. Decreased effectiveness of kin-based networks, requiring more reliance on individual household,
7. Expansion of the monetary economy, more diversification to off-farm income sources, more investment in education.

3.4 Interventions Impacting Several Coping Strategies

The interventions which impact a wide variety of these coping strategies will provide the most cost-effective famine mitigation. Availability of seed and food storage provide the foundations for the largest number of responses.

Food storage. Borrowing and other social coping responses prevalent in all cultures may be mostly subsumed under the category: receiving stored food from relatives. Campbell *et al.* (1989) found that the most important source of food in time of food deficit for 21% of their semi-arid southern African sample was relatives' stored food. In their sample, over half of those who stored food for household consumption gave some of it to relatives outside the household during times of scarcity.

Grain storage is not only a key coping response of households, it also permits other coping responses to occur. A variety of the coping responses are tied to rainfall variability. These can be broadly grouped in two strategies, (a) control of microclimate (ridging and cross-ridging, intensification of weeding and thinning, (b) the use of multiple crop varieties matched to rainfall conditions.

Any coping response which relies on increased production depends on availability of good quality seed. One summary observation from Sudan seems to apply to above data on coping responses: productive farmer famine survivors respond to threat to sustainability of livelihoods more than dearth of food (Walker, 1989). The key perishable input which maintains farmer livelihoods is seed.

3.5 Coping Responses and Asset Accumulation

Examining the above responses according to what asset makes the response effective, we find:

1. Borrowing from relatives is effective because they have grain stored,
2. Increased intercropping is effective because seed is available,
3. Short season varieties are effective if seed available,
4. Switching to millet and sorghum is effective if seed available.
5. More grain can be stored if adequate and skilled storage is available,
6. Buying grain from merchants is effective if grain available at good price. The integrated markets which facilitate good prices are a function of good local storage and good transportation.
7. Use of wild foods is effective if wild or fallow areas remain. Since protection of such wild areas with foraging permitted seems unlikely, the niche filled with wild foods will need to be filled with cultivated perennials and early annuals.

3.6 Food Storage Responses

Since a number of coping responses include food storage or depend on food storage, food storage strategies are explored in depth below.

"In truth, all societies subject to the danger of famine have always been forced to organize themselves around their grain reserves." (Sigaut, 1988)

Since the beginning of FEWS, food stores--especially grain--have been seen as crucial early warning indicator (May, 1986). McCorkle (1987) noted that depletion of food stored at the household level is the crucial event early in the onset of famine. If depletion could be delayed, the onset of famine is delayed or even averted. Responses related to food storage have their most impact in the hungry season. This period includes the season of greatest energy need--planting season--resulting in few crops planted and harvested and less in storage when planting season comes around again.

Zones of famine-prone areas with adequate storage facilities have been repeatedly shown to suffer less severe seasonal undernutrition (Sharman, 1970).

Awareness of the need for good food storage is extremely high in famine-prone areas (see, e.g., Anyango *et al.*, 1989; and Messer, 1989). In fact recognition of the likelihood of storage losses is one of the reasons smallholders sell their grain at harvest and buy foodgrain back later[5].

Traditional coping strategies to reduce stored food grain infestation include storing in sheaves, or if storing as grain, simply to shuffle or shovel the grain around periodically following removal of any seriously infested heads or portions. In any traditional method, disease and insect organisms will be present to some low degree.

Coping strategies directed at grain moisture attempt to follow the principle: store it dry and keep it dry. Partially effective responses include open sided cribs which allow grain to dry when humidity is low. Such methods also permit grain to take up moisture during wet weather. Ventilation is extremely beneficial in dry weather for maintaining quality of grain in storage. But in the rainy season, storage sealed against humid air is needed.

Since cooler air holds less moisture, moving grain to higher altitudes is an effective response in certain agroecosystems (e.g., Ethiopia, Kenya).

Drying is the most commonly used method of food preservation. Meat drying can insure that maximum value is obtained from animals at the time when market price may be falling and before they have lost weight. Strategies appropriate for on-farm and village level grain drying are summarized by Lindblad and Druben (1976). Most effective drying strategies they discuss include: pit oil barrel dryer, an improved maize drying and storage crib, a simple batch-type rice dryer, and a number of simple solar dryers.

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[5] Selling grain at harvest instead of storing has a number of other causes such as coping with cycles of indebtedness. Many also contend that the lure of consumer goods, especially if relief has been institutionalized, are often too strong. In rural Zimbabwe, for example, Mazansu (1991) notes that households who produce only six of the 12 bags of maize they need will still sell a few to purchase consumer goods, because they can rely on friends, neighbors or government relief to assist them when their own supplies run out.

In contrast to drying, many other processing procedures reduce the effectiveness of storage. Flour and meal are most easily infected. The natural seed coat is the best protection of grain, if it is left undisturbed.

Traditional underground pit stores can be effective since, if properly constructed, grain can be kept cool, dry and sealed from insect and fungal infestation. Inspection opportunities are reduced, however, so grain must be well dried and free of infestation before storage. In Ethiopia, underground pits are used for ensete and, by farmers in Bedeno (Hararghe highlands), for maize and sorghum. Using pits dug 2.5 to 4 meters deep, maize can be stored without loss up to six months and sorghum for several years with only about 20% loss (Caldwell, 1991). Weevil problems encountered with this practice are related to inadequate inspection and drying before storage.

Coping responses regarding fungal, bacterial and insect infestation include regular inspection and various drying strategies mentioned above. Other traditional strategies aim to alter the microenvironment in grain storage to create an environment inhospitable to pest infestation. These include mixing smaller seed, sand, ashes, limestone and dried animal dung to fill spaces between grains.

Specific methods include using ash of *Boscia* species--especially with millet. Millet stored on the head, in bulk with the addition of *Boscia* ash, is reported to keep free of infestation for up to 5-7 years (National Academy of Sciences, 1978). Ground-up leaves of *Andropogon* and *Combretum* have been shown in many situations to repel insects and even rodents. Powdered sun-dried guava and eucalyptus leaves are toxic to *Sitophilus* weevils (Egypt; Sharaby, 1989). These methods reduce breeding areas for insects and to abrade insect cuticles leading to desiccation.

Sigaut (1988) details a method of insect control which takes advantage of weevils' attraction to moisture. Small nests of damp straw are placed beside the grain, weevils move into the grain overnight. The next day the straw is collected and burned.

Fires under storage cribs can be used both to control insects by acting as a fumigant and to dry foodgrains. Burning chaff mixed with pepper is also a traditional fumigant.

Foregoing threshing until just before use, in sheaves, provides the most protection for many millet species from biological heating and weevils. An elaboration is to pound ears of millet directly into the granary so that the granary is filled with a tightly packed mixture of pounded ears. This method only works when stored sheaves are free of infected.

Coping strategies addressing rodent control for traditional structure mainly feature baffles (Hopf *et al.*, 1976). Village level responses include offering bounties for rat tails (Sudan, Save the Children; Davies, 1987).

Though not strictly a storage problem, bird damage after grain maturity has the same effect of reducing food available after production is complete. Bird control coping responses often mean switching species: finger millet (*Eleusine coracana*) has far fewer losses than other millets and sorghum. In some situations, switching varieties is also possible, for example to sorghums with reflexive heads. This trait is mimicked by farmers who bend down heads when still green.

An underestimated source of loss in storage is theft--though many report severe reductions in amount of food stored due to smallholders fear of theft. Simple locks, in combination with secure containers are the method of choice in most countries.

Grain legumes are especially liable to loss in storage. Losses of 50% are regularly reported. The importance of legume protein makes grain legume storage strategies vital. Given a high degree of genetic variation to storage pests in legumes, switching varieties in often a traditional response (Bliss, 1991). Other strategies include reducing moisture levels of grain and filling intergranular spaces with millet, sand or ash. Locally available terpenes and oils (including lemon and groundnut oils) are reported by Sigaut (1988) to be extremely effective in controlling legume grain losses in storage.

A general concern in grain storage is the increasing susceptibility of newer varieties. Traditional varieties were under strong selective pressure for survival in storage, but little or no consideration is to such qualities in breeding modern food grains (Gibbon and Pain, 1985). A typical coping strategy is to shift back to traditional varieties, until the infestation is under control.

3.7 Root Crop Storage Strategies

Root crop storage faces an entirely different set of problems from grain storage. One traditional method is to leave root crops (especially cassava) in the ground until needed. This method reduces mechanical damage (which hastens infestation), maintains dormancy and provides cool storage. However, quality declines when such storage is prolonged.

In contrast to grains, nearly every type of cassava processing results in a longer storage life--largely due to the fact that cassava does not have the protective seed coat of grains. Processed products created by drying, including chips, flour and granular meal, particularly increase the storage life of cassava.

Unprocessed cassava can be protected in storage by shading and aeration, along with discarding bruised tubers.

Curing sweet potatoes, yams and potatoes with high temperatures and humidities--then storage in significantly lower humidity and temperature are idiosyncratically beneficial for these species. Reburial is often a successful coping strategy with these species, but success seems to be largely due to curing.

3.8 Pastoralists and Food Storage

Animals are the traditional food storage mechanism for pastoralists. Fodder banks and fallow areas are the assets which underlie many coping strategies for maintaining animals during many famine conditions. Especially important are saving milk-producing small ruminants. Increasing reliance on drought-tolerance goat varieties are a very useful traditional strategy.

3.9 Gender Effects on Food Storage

The care and skill of women in storing, rationing and distributing food often determines whether the household's children are seasonally or permanently malnourished (Messer, 1989). Messer's article is replete with descriptions of coping strategies women in smallholder households use to prolong the availability of stored food.

3.10 Processing for Weaning and Infant Foods

Locally available grains can produce weaning foods suitable for famine mitigation. Various indigenous Ethiopian beans (Ashenafi and Busse, 1991) and a sorghum-cowpea mixture (Nout, 1991) have been successfully used as both weaning foods and as milk supplements.

3.11 Seed-related Coping Responses

Seed storage has much in common with grain storage, as noted in section 1, with the qualification that methods must keep the seed germ with a range which keeps it alive. Beyond the strategies detailed above under grain storage, a variety of extremely effective local techniques for seed storage have one similarity: keeping seed inside the house in the most well-protected place.

Compound plots and gardens provide *in situ* preservation of germplasm needed to employ multiple coping strategies. A combination of *in situ* preservation of varieties and seed storage is needed in most situation.

Security-maintenance is a key concern of most coping strategies related to seed storage. In northern Kenya, the office of the chief or other local offices (Anyango *et al.*, 1989) is the primary depository of seed.

Maintenance of seed purity. Traditional strategies make wide use of roguing and isolation procedures. When reliance on purchased seed becomes complete in an area, these techniques are often unknown. Local seed multiplication in such situations is tenuous.

New varieties. Regular experimentation with new varieties is a fact of life for nearly every farmer (e.g., Richards, 1986). Every farmer has a network of contacts with seed sources: extension, nomads, pilgrims, neighboring villages. Farmers are often more attuned to qualities deemed less important by professional breeders. In addition to storage qualities mentioned above, farmers maintain varieties for types of cooking and processing quality.

Plant habit is especially important to farmers. In addition to needing tall varieties to provide stover, farmers often maintain varieties for habits adapted to low rainfall conditions. Drought tolerance due to profuse branching has been shown to be especially important in Sudanese cowpea varieties (Muleba, Mwanke and Drabo, 1991).

Maintenance of rare biotypes. Rare cultivated lines are even more apt to be endangered than wild species because they cannot survive outside cultivation. Compound gardens are often the method used traditionally to keep such lines extant. Lines which are well-known and very useful may die out under several years of unfavorable growing conditions, but then be desperately needed when growing conditions change. Cowpea lines often disappear when several wet years occur in a row, only surviving by careful cultivation in compound gardens.

A species of early millet, *Digitaria exilis*, is widely used in famine-prone West African countries (where it is known as hungry rice) but is unknown in many ecologically similar areas.

Soil-enhancing species. Richards (1986) found two nitrogen-fixing, water-efficient cover crop species (*Pueraria phaseoloides* and *Calapogonium mucuonides*) to be especially well accepted in his Sahelian region.

3.12 Wild Foods

Use of nondomesticated species is an extremely widespread adaptive response in sub-Saharan Africa. Watts (1988) noted 68 species used for wild food in famine in N. Nigeria. Hundreds of species are used in various regions in Ethiopia (Caldwell, 1991).

However, use of wild food is usually not peculiar to famine. Rather, such foods just increase in percentage during times of food shortage (e.g. in Wollo, Rahmato, 1988). Increase in use of wild foods can be an very early indicator of famine, though it is often one of the first assets to disappear if conditions continue for 2 years or more.

Women often have a better knowledge of edible wild plants than men. Survey work by IFPRI (Caldwell, 1991) confirms that women usually assume more of the responsibility than men for collecting wild foods. Studies also indicate that women collect wild foods earliest during famine onset and are the key informants for rapid reconnaissance in food insecure households. Children often participate more often in collecting wild foods than men, although several communities sampled did not show this trend. In general it can be said that all members of a household assume some responsibility perhaps based on food type, difficulty of access, or other household arrangements.

Wild foods are especially useful in hungry season after rains have come but before crops have come in due to the tendency of young early shoots of perennials to be most palatable.

Wild foods are especially important to nomads and often even when other foods are plentiful. Messer (1985) reported that the Samburu in Kenya, just after the rains ended used *Grewia villosa*, *Cordia ovalis*, *Acalypha fruiticosa*) and during the rains, roots were gathered (such as *Commiphora sp.*) and leaves (*Cyphostemma maranguense*) boiled in order to balance a dairy diet. Nomads also use a number of wild foods for their cattle. Most are self-selected as forage, but some are collected, including *Acacia* pods.

3.13 Water Catchment

The asset most limiting production in famine-prone areas is water. All cultures which have adapted to semi-arid areas have developed water catchment systems which channel and conserve rainfall. Given adequate storage capacity and a large enough catchment area, semi-arid areas with good soil are often unsurpassed in production.

Water conservation and catchment is accomplished through the traditional practices of ridging and bunding (and the modern variant: tied-ridges). Intercropping strategies have also evolved to capture and better use the limited rainfall of semi-arid areas. Fallowing, mulches, vegetation banks and crop stubble retention were introduced to expand the range of potential moisture-conserving techniques, but have proven difficult to incorporate into many farming systems (e.g. Bay Region of Somalia, Eagleton *et al.*, 1991). Their value is conceptual; helping farmers explore the possibilities of moisture transfer across seasons. Water catchment is highly preferred by most farmers to large irrigation projects.

Rooftop and runoff are the two types of catchment which are most common. Rooftop catchment techniques are matched to housing type and local materials. Edwards *et al.* (1984) and Pacey (1986) cover these topics in detail. Application being difficult with traditional cylindrical houses, rooftop catchment is not traditional in east or southern Africa.

Rainfall catchment, however, is common in every semi-arid society and is accomplished with little or no material investment. Descriptions of the basic types of rainfall catchment follow.

A **terraced wadi** system involves growing crops in fields or terraces built directly in a small dry riverbed. The fields are created by building a series of stone walls horizontally across the wadi. A portion of floodwater is retained and excess water is allowed to cascade into successive fields below.

Various **diversion systems** channel water out of a large wadi whose torrential floods would destroy terrace walls. A dam is built into the wadi, just high enough to raise the water into a channel leading to long terraced fields built on adjacent floodplains.

A **conduit channel** system supplies runoff water from a sloping catchment area by means of conduit channels which run diagonally along the hillsides to groups of terraced cultivated fields, usually located in beds of wadis, depressions or floodplains.

Microcatchments provide each plant with its own water collection area. Ridges on the downslope side of the microcatchment can be very small and made entirely of earth.

Limans trap overland water flow in a large field by means of a multi-sided dam built in a floodplain, shallow depression or tributary wadi. Liman walls are much larger than those of a microcatchment, but can also be built of earth alone.

Contour catchments are low earthen walls built along contour lines of a slope with plants grown uphill of the wall. Contour catchments are ideal for areas too steep for other types of fields and provide the added advantage of controlling erosion from these hillsides.

Compound catchments divert rainwater from semi-hard roads, walking areas, etc., around the compound and then store it in wells, cisterns or clay covered waterholes. According to Nissen-Peterson (1982), if the catchment area around the compound is well-sloped and hard surfaced, a rural household can collect as much as three quarters of the annual rain. But if the area is relatively flat and has a more porous surface, only a quarter or less of the rain will be caught.

Water catchment can also be improved on a micro-level by creating soil conditions which favor the maximum absorption of rainfall and the prevention of loss of soil moisture. This is most effectively accomplished by maintaining soil cover to decrease sealing of the soil surface and reduce evaporation. "We create our own drought when we don't have ground cover" (Fee, 1992). Increasing soil organic matter and limiting compaction also will lead to increased absorption of rainfall.

3.14 Soil Assets

Soil is second only to water as the limiting factor for food production in semi-arid areas. And soil with a good structure will actually aid in conserving and storing water.

Soil related activities which either reduce soil erosion or improve soil quality contribute to the mitigation of drought induced famines. All successful soil erosion efforts cause water to move more slowly across the soil. The slower water moves, the less it can cut into the soil and the less ability it has to carry soil away. Common methods include: cover crops, contour plowing, terraces, contour hedgerows, intercropping, alley-cropping and living mulches.

Soil quality is enhanced by various strategies which have the common results of improving soil structure, adding organic matter and conserving nutrients. Common methods are crop rotation (especially with legumes), alley-cropping, intercropping, turning under crop residues, applying animal manures and maintaining soil cover. Compaction and continuous monocropping are the quickest routes to destruction of soil productive capacity.

The assets of soil and water catchment are not usually mentioned in discussion of the productive assets upon which coping responses are based. But any agronomic analysis of famine mitigation would contend they are the most basic. Improvement of each, however, requires substantial labor investment by and training of smallholders. Other interventions, such as seeds, hand tools and food storage may be easier to accomplish.

3.15 Coping Responses Integrating Livestock with Seeds and Tools

A number of interrelationships between farmers and pastoralists help each to cope with incipient famine. Many other interactions help to mitigate famine by providing food for animals and improving soils. The specific interactions are unique to each agroecosystem. Generally, in return for manure, farmers provide food to nomads and permit their animals to graze stubble and fallow lands. **Manure markets** are even fairly formal institutions in some cases.

On farms, **protein banks** are one strategy to keep cows alive in drought-induced famine. ***Desmondium intortum*** is one species used for that purpose in Southern Ethiopia (Larbi *et al.*, 1991).

3.16 Response of Non-victims

The above discussion has been largely about responses of potential famine victims. Usually the response of local non-victims, if any, is just to mask effects rather than halt causes.

Local governments. As Gray (1990) notes, all major food policy models for sub-Saharan Africa assume that the most basic government goals for food and agricultural policy are: low cost to budget; food for urbanites; and low, stable prices.

The experience of most NGOs (e.g., Walker, 1989) is that if the famine can be denied, local governments usually reassure other non-victims and cover-up any evidence. For example, any drop in price of livestock is just a "blip" in market. Governments usually react only to the final, mass starvation phase (Walker, 1989).

Highly unusual are the Indian FFW response (Sinha et al, 1987) and CFW in Botswana (Moremi, 1987). Less relief oriented famine mitigation interventions, such as requiring planting on ridges by the government of Malawi, are even more rare.

Non-governmental organizations. Most successful NGOs/PVOs have based all their strategies on local strategies mentioned above. In addition to those mentioned above, a strategy for food storage with refugees has involved distributing impervious, sealable containers. This seems to provide long-term, sustainable interventions for famine mitigation in many situations.

Osborn and Faye (1990) have observed that seed multiplication efforts by NGOs have been especially effective responses.

Various NGOs have been successful in facilitating transportation improvements which were sustained. In addition to the Save the Children experience in Ethiopia, AFSC focused on developing local transportation to haul in materials for a major building project among the Tin Aicha in Mali. The Tin Aicha have adapted their new transportation system to hauling agricultural products and consumer goods (Anderson and Woodrow, 1989). Village ox-cart cooperatives have proven to be an effective strategy for sustainable famine mitigation in Western Sudan (Speece, 1989).

4.0 ECONOMIC, SOCIAL, POLITICAL AND TECHNICAL CONSIDERATIONS

Successful coping and adaptive strategies change just as regularly as economic, social, political, technical and ecological conditions change. None are stable. No one can predict with certainty which coping responses will continue to be most effective in the future.

Since strategies do change as these considerations change, a central thesis of this paper that the best famine mitigation interventions enable resilience by facilitating multiple coping strategies. Since change agencies can't be sure any one particular strategy will continue to be the most effective, interventions which bolster a number of strategies are advisable.

Below are discussed a number of the major factors causing change in which strategies are most effective.

4.1 Economic Considerations

Governments typically encourage the flow of resources out of agriculture. Price distortion is the key factor leading to decline in agricultural growth according to a study of patterns in 28 developing countries with available data (Zhao *et al.* 1991).

As this continues in famine-prone countries, the range of practical drought-coping strategies has narrowed and shifted from agricultural strategies to increased involvement in the monetary economy (Downing, 1988). Some evidence indicates that rural households are increasingly less likely to be either peasant risk minimizers, or climatic opportunists attempting to make the best possible use of the good years. According to these analyses, rural households are just satisfied with existing production as long as it doesn't require increased investment. Their major coping strategy is searching for sources of off-farm income. Where this is the case, interventions such as improved seed would be most likely to be effective, since no new practice or increased labor is involved.

4.1.1 Efficacy of Market Policy Solutions

Since food moves from rural areas to cities, a simple solution put forward by many is just to halt the movement of food out of rural areas when famine appears imminent and supply relief to the cities (see e.g., Pausewang, 1989). However, such suggestions underestimate the dynamics forcing flow of food out of rural areas due to debt, desire and need for cash, inadequate stores and unskilled trading. Often, famine-prone areas are characterized by unidirectional distribution systems including urban processing of grain, central storage in urban areas and lack of good transport networks between rural areas. All these factors conspire to insure that food moves out of rural areas, even when famines are imminent.

The fallacy of "urban consumers and rural producers" is also germane. Twenty to forty per cent of rural households in the Sahel are net purchasers of cereals, according to a number of studies summarized by Delgado (1991). Grain comprised 40% of total household expenses in one region of Zimbabwe (Buhera) according to Chisvo *et al.* (1991) during a year of good rainfall. A very strong predictive relationship exists between household grain deficit and household food insecurity, according to Jayne *et al.* (1990). Further, when grain is sold to purchase meal, there is a further decline in real income (Blackie, 1984).

Policy changes which stop food from leaving rural areas will not address the problems of food-deficit households.

Price controls. Another possibility in market policy is often advocated by those who observe that people often starve even when abundant food is available in market. Food can be simply too expensive for most people to afford (Bass, 1986). Ignoring the fact that expensive food often reflects high costs of production, many seek to control prices through policy solutions. The effects of attempts at control of markets though policy depends first on the enforcement ability of each particular government. In many countries, market control has simply lead to dominance of trading by private markets, outside the control of government, which establish the only prices which affect economic decisions (e.g. in determining acreage planted in Niger, Brorsen and Adesina, 1990).

When market control is effective in controlling prices, it can produce either low grain prices (leading to low production--reducing famine mitigation possibilities) or high food-grain prices.

Effects of high food-grain prices. Many Europeans, especially in the NGO community, contend that higher cereals prices are key to revitalizing Sahelian smallholder agriculture (Delgado, 1991). The simplest version of the argument is: if cereal prices rise, more will be grown and more will be available.

However, more will be grown only if it costs less to grow than to import. Otherwise imports will just increase. *Import parity* is the world price plus the cost to import to a given location. Rice and wheat stay close to import parity. Millet fluctuates. Millet supply is price elastic and thus should increase if prices are higher. But, as noted above, 20-40% of rural households are net purchasers of cereals in many semi-arid areas (e.g., Mali, Senegal, Burkina Faso, Delgado, 1991). In general, people in semi-arid West Africa, for example, spend 70-90% of income on basic food staples. They are not self-sufficient. High prices hurt rural net grain purchasers--increasing the possibility of asset depletion and decrease the chances for intervention success.

> *"Short-run production increases, in response to price incentives, without land and water conservation measures, may result in systematic degradation of the physical environment in the long run." (Deuson and Day, 1990)*

Increasing the price of grain will, given present cultural techniques, mean incentives to grow cereals on more fragile lands. Increasing grain prices usually also leads to reduced animal prices. This often leads to decreased offtake of animals and so additional increases in land degradation.

In addition, government policy mandating high food-grain prices,

> *"can lead to rigid production systems that are unable to adjust rapidly to surpluses and discrimination against earning foreign exchange." (World Bank, 1990; cited in Eicher, 1991)*

Market control to insure high prices can result in no availability at any price. The fact of virtually no informal grain markets in Zimbabwe shows how centralized market control can be a factor in shortages in a country with a surplus of grain (Jayne and Chisvo, 1991).

Market decontrol is not even considered as a policy option in food deficit countries and when tried in food surplus countries, has led to disastrous results. Market decontrol as a part of IMF-led structural adjustment in Zambia in 1987 led to food riots which insured reinstatement of the prior system of administered pricing. A sweeping decontrol in Tanzania led in 1989-1990 to restriction of operations of private grain dealers for the same reason: lack of government control over food supplies and prices, especially in urban areas, was deemed politically dangerous (Amani and Kapunda, 1989).

The World Bank report mentioned above actually cautions that

> *"[a]llowing the market to be the sole determinant of this mix (of crops) runs the risk of undervaluing foods for the poor and food security in general, whereas high-income consumers and export markets are well-served." Eicher (1991)*

In contrast, others note that market decontrol can serve to meet demand, which may well be for more grain in food deficit rural areas (as in Zimbabwe, Jayne *et al.*, 1990).

Market development is a third possibility for interventions in market policy. Market fragmentation is a consistent feature of famine-prone countries Borton and York (1987) contend that degree of market integration explains why Ethiopia has famine and Bangladesh, nowadays, does not. When grain is not delivered to areas where it is needed, famine can result even when purchasing power exists to buy it. Even when famine does not result, market fragmentation leads to asset decline since food is much more expensive.

Market integration is facilitated by good storage and good transportation. Improvement in transportation, though unlikely to be developed in isolation, is crucial to making food more available through market mechanisms (Delgado, 1991). A drawback is the fact that bringing in food easier may just increase dependence on outside sources.

Another drawback is that storage is prerequisite to efficient use of improved transportation--especially in the rural areas most prone to famine. Small farmers and petty traders are risk avoiders, not profit maximizers and they tend not to move product when faced with uncertainty. Further, they can seldom finance the increased activity in the market required during times of food shortage (Speece, 1989). Secure storage would facilitate movement of product to where it is needed, take some risk out of the venture and help insure a quicker return--decreasing the amount of capital needed. Opportunities to capture above normal return to storage have been documented in many famine prone countries (e.g., Sudan, Idrisi *et al.*, 1990).

Policy changes outlive their usefulness. Even when policy interventions are effective in the short run, a long term effect often is that centralization takes on a life of its own.

In Mozambique, past policy was that local authorities could prevent product from moving out of the district if deemed necessary for local food security. Officially all products are now free to move across district and provincial borders. In fact, local authorities continue to regulate product movement.

Past policy granted geographic and product monopolies to individual traders who were to purchase all product and sell to the state marketing board. Now, official policy is that any trader who can meet minimum capital requirements can receive a wholesaler's license. In fact, former monopolists continue to enjoy dominant market position and are able to discourage entry of other traders (Dias *et al.*, 1991).

In Zimbabwe, controls on sale of sorghum and millet have been removed in the most famine-prone areas, but grain traders remain convinced bans are still in effect and so do not trade in these commodities, even when there is a strong local demand. In addition, local representatives of the Grain Marketing Board, which controls trader licensing, discourage resale of maize by traders they oversee, even though it is legal (Chisvo *et al.*, 1991).

Once centralized policy changes are introduced and enforced, they may be extremely difficult to change. Privileges and authority, once granted, may be difficult to rescind.

Policy consistent with household food security. For any market policy interventions to assist in famine mitigation, they must first be consistent with household food security. One method to accomplish this goal is to first perform village trials with household level measurements. If interventions are successful in increasing food security, then policies should be designed which would strengthen the successful interventions. Martinez, Sain and Yates (1991) have developed a 5-step farm-based policy analysis framework which was successful in accomplishing policy changes based on successful household-level interventions. The five steps are: successful on-farm and household famine mitigation interventions identify policy-induced constraints; the rationale behind the policy is determined, decision-makers to whom results should be communicated are identified, solutions or policy options are determined and results are communicated in that context to decision-makers.

Entitlement and class. Entitlement approaches focus on lack of food to certain classes. In some versions, this then means that interventions will most help only those classes without the ability to produce their own food. If a large number of landless laborers are not present, these classes will be the better off.

Increasing exchange entitlement mappings to some may reduce others' entitlements. The key is increasing the ability to adapt and respond to changes rather than imposing an artificial equilibrium, as entitlement approaches are wont to do.

Many authors dismiss even the possibility of successful market interventions since such interventions don't empower anyone--except the few merchants who learn how it is done.

> *"The market system reinforced this urban bias: trade made fortunes . . . rather than land or productive investment." (Watts, 1988)*

4.1.2 Cash Crops vs. Food Crops

Some decry the promotion of cash crops in the belief that production of food crops is thereby reduced. Recent studies show no indication that such is the case (e.g., DeWalt *et al.*, 1990). Usually it's not an either/or situation. Resilience and diversification are the keys and the main consideration is whether or not the cash crop increases the flexibility and diversity of smallholder choices. Another significant determinant is whether the cash crop takes away from work for food production (Fleuret and Fleuret, 1991).

4.1.3 Economic Factors in Grain Storage

Many factors constraining grain storage are economic rather than technical. The need for cash at harvest is a principal factor constraining lack of grain storage. Often the marketing system also facilitates this by insuring that grain is exported out of the producing area (Jayne *et al.*, 1990). Grain then has to be bought back at a higher price when the hungry season comes. Increasing local storage capacity is a necessary first step to reversing this phenomenon.

4.1.4 Local Markets and Famine Mitigation

Ethiopia is typical of famine-prone countries in that markets are complex social as well as economic phenomena. They are not quick, efficient product-for-cash transaction. Prices are not standard and buying and selling is time consuming. The average peasant frequents several markets in, usually, 10-15 km walking distance of his home (Caldwell, 1991).

More formal markets meet in specific locations weekly. Informal markets meet in neighborhoods several times a week. Different markets exist for different goods. The peasant can sell at local, area or regional markets, though merchant involvement is higher at area and regional markets.

In Mozambique, according to Dias *et al.* (1991), the *logista*, or local store, owner, serves as the first buyer of both food and cash crops for most farmers and sells food and basic consumer goods to farmers and other consumers. The *ambulante* is a new market entrant with no fixed place of business who travels into production areas and purchases product for resale in population centers. The wholesaler has enjoyed a legal monopoly in his district and continues to have great advantages over all potential competitors. The third type of marketer, the informal retailer, operating in municipal markets, or *candongas*, sells to consumers in small volumes at market prices.

Despite this complexity and certain vestiges of past market control, in both Ethiopia and Mozambique there is transfer from surplus to deficit areas (Rahmato, 1988; and Dias *et al.*, 1991) when war permits. Thus local markets contribute to famine mitigation.

Zimbabwe, though producing much more food than Ethiopia and Mozambique, is a stark contrast regarding local markets. The country is divided into two areas. Area A includes the large-scale farming, commercial and urban areas. Area B is comprised of communal lands and wildlife reserves. Area A has all the major grain depots and processing facilities.

No maize can move from Area A back to Area B, only refined meal. Only approved buyers in area B can sell to the Grain Marketing Board (GMB) and these must sell everything to the GMB. Officially, they can also buy from the GMB to sell, but, in practice, the GMB managers do not encourage this practice, since *"exploitative retail grain prices in remote deficit areas"* would be likely. Traders know that such trade is discouraged and are disinclined to even request permission given the attitudes of the local GMB managers. In addition, traders consider it illegal to buy from other sources for resale. In effect, they simply will not sell or, at least, will not admit to selling grain in communal areas. Buyers make money by buying grain as cheaply as possible and selling it to the GMB (see Chisvo *et al.*, 1991, for details).

The only remaining source is farmers selling directly to consumers, which is rare beyond the family.

The goal of Zimbabwe's system of grain marketing is to move grain to a central store for sales at the highest price possible. Anything else is discouraged by law, by competition and by bureaucratic inertia.

Thus in Zimbabwe, any informal trading is very clandestine and grain does not move readily or easily from grain surplus to grain deficit areas.

Interventions in local markets, unless through storage and transportation, appear likely to have marginal impact in famine mitigation. More informal markets are insecure sources of food, subject to wide shifts in prices and dry up in risky situations. As Gregoire (1990) points out, private sector food marketing networks have a complex structure conditioned by social and cultural interrelationships between traders, farmers and consumers which may not ensure an efficient distribution of food during periods of food crisis.

More controlled markets have difficulty in meeting the variable and rapidly changing demand. Local authorities have more influence than government policy and can thwart most interventions. The best opportunity for intervention is facilitating marketing with storage and, in some cases, transport.

4.1.5 Subsidized Food Shops

Priestley's (1986) examination for UNDP of famine mitigation strategies proposed only two non-policy interventions: seed banks and subsidized food shops. The intervention of improving food distribution through local food shops and grain outlets in food deficit areas can have laudatory short-run effects. More food is available where it is needed. But if these shops and outlets are subsidized, the long-term effect will be increased dependency. If subsidies are interrupted through such calamities as war or structural adjustment, famine will be worse than ever. If the outlets are not subsidized, then households will have reduced real income and assets since they will have to buy the needed food. The increased debt and pressure to produce income will usually result in further depletion and degradation of resources.

4.2 Social considerations

Household resilience has as much to do with social organization as with production opportunities. Famine mitigation based on enabling coping strategies to enhance assets requires maintenance and support, rather than disruption, of existing social structures. This includes helping people to stay in their homes. When this cannot be done, the relevant constraints are those of refugees, which are similar to those of other newly settled people:

a. A general lack of local agroecosystem expertise,
b. Agroecosystem/food habit incongruity, and
c. Asset and coping strategy incongruity.

Long-term status as a refugee leads to the loss of skills and coping strategies applicable to the areas from where they came. This has been especially well documented for pastoralists (e.g., Salole, 1988).

In such situations of disrupted social structure, sanitation skills and other health interventions are first priorities for refugees, agricultural interventions must wait. Refugee camps do provide opportunities for enforced intensification of agriculture--learning from the compound systems.

Transportable assets and skills which are less dependent on non-transportable assets are key to future famine mitigation for refugees.

Disruption by well-meaning intervention. Many who endorse "participation" decry the value of indigenous local organizations and insist on setting up new groups within the community to implement a project (Salole, 1991a). In fact, any new group will necessarily build on existing social structures. If we seriously consider social systems to be important coping strategies and integral parts of agroecosystem functioning, then existing formal and informal associations will be an intimate part of successful famine mitigation.

This does not mean that all existing social structures are used. Rather, as noted previously, careful selection of groups is necessary. However, subverting the productive, cohesive groups by creating new ones will harm preexisting activities and make famine mitigation less cost-effective.

4.2.1 Indigenous Knowledge and Group Processes

In haste to provide relief, many agencies destroy those social structures which provide support for the indigenous knowledge of reliable coping strategies. An effective first step in famine mitigation is to look for constructive local groups (Bratton, 1987; Worstell, 1991). Since a goal of famine mitigation is autonomy, not dependency, the tendency of program administration should always be away from administrative fiat toward enabling constructive local leadership (Mortimore, 1989).

4.2.2 Cash for Work and Food for Work

If the social characteristics of the population includes large numbers of agricultural laborers, then CFW and FFW make sense because the key source of entitlements is wages given for work. However, as noted above, the labor market can clear though leaving many starving. The reason for this is that by consuming their endowments poor peasants can undercut the wages of the poorest. It is the latter who perish because the minimum wage they can work for is above the market clearing rate (McGregor, 1990).

4.2.3 Land Tenure

In situations where enabling intensification is a goal, a key prerequisite is stabilization of land tenure. This is not usually a specific intervention goal, but may be assisted through support for local leadership.

4.2.4 Labor Constraints

Labor is a real constraint to many new interventions--especially those involving changes in management techniques (Prah and Okeyo, 1989). Much of so-called family labor is, in fact, female labor and may often be increased only with neglect of children. Among the Beja in Sudan, Morton (1990) found that sufficiency of labor explained most of the variation in success of household coping strategies. Labor shortage also correlated with a negative evaluation of labor (reflected in leisure of household head).

Changes in inputs such as seed do not involve increases in labor if the new types of seed are well adapted, as they must be, to the local farming systems. Altering soils and water catchment do increase labor and are thus more appropriate when C/FFW can be implemented.

4.2.5 Food Choice and Trends in Consumption

Maize consumption is conditioned largely by socio-cultural, not economic, technical or agroecological factors. According to Muwonge (1991) people moved to semi-arid areas and took maize with them in many areas of sub-Saharan Africa.

But what does the future hold? Wheat. Wheat consumption has doubled since 1960 in southern Africa--from 5 to 10% of cereal consumption. Ninety per cent or more is imported. Eicher (1991) suggests that Africa will likely follow the rule of thumb established in several Latin American countries where wheat becomes the staple of choice when consumers reach about $1000 annual income.

Maize can be justly castigated as a "fashionable" crop (Lipton with Longhurst, 1989). Researchers have certainly spent an inordinate amount of effort on maize to the neglect of sorghum and millet--though this is being rectified by the ICRISAT/SADCC Bulawayo research center.

But maize is not just fashionable to researchers, it is fashionable to consumers. In fact, that's largely why it is fashionable to researchers. Further, as consumers move to wheat, so will research dollars and likely not back to sorghum and millet unless IARCs can find alternate uses and, thereby, markets (Eicher, 1991).

4.3 Political Considerations

4.3.1 Seed

Sub-Saharan African government seed programs have little focus on drought-resistant varieties for arid and semi-arid environments, shortages of experienced staff and often restrict research by other entities. This has had an effect of stifling seed innovations which could be beneficial to seed interventions in famine mitigation.

Transnationals are coming to play an increasingly important role in seed efforts in many sub-Saharan Africa countries (Groosman, Linnemann, and Wierema, 1991). However, this trend may be limited since governments in famine-prone countries seem especially prone to try to control seed and grain trade.

One tendency of national governments is to encourage local varieties and sources as opposed to exotics. But this ideological stance is not translated into support for rigorous local seed multiplication schemes. Governments have been more interested in intervention to insure that local grains are used in preference to imported grain. Sudan, for instance, decreed that a 20% sorghum flour be used by all bakeries starting in 1991.

4.3.2 Food and Grain Storage

Political problems are rife in central storage systems. Political control of such systems insures they are prone to inefficiencies and mismanagement leading to increased storage costs. Costs of assembling and distribution are higher than in local storage. Distribution may even be impossible when grain is most needed (in the hungry season when the rains have just begun). Furthermore, the scale of operations can never meet the scale of need due to government finance limitations.

Perhaps the most serious drawback is the conflict between famine mitigation and price stabilization (to insure low prices for urban populations). The high price of grain during the months or years preceding a famine, combined with the desire to keep prices low, can result in depletion of reserves much sooner than necessary due to political considerations.

4.3.3 Cereal Price Regulation

Ethiopia provides an example of the problems arising from regulation of prices. Prior to 1975 the Ethiopian government did little to intervene in food markets. The Ethiopian Grain Corporation, established in 1960 with a mandate of maximizing exports of grain, failed miserably and by 1975 held only about five percent of the grain market share. Land reform and the end of tenancy in 1975 seems to have induced smallholders to retain and consume more of their own production so that by 1977/78 the market surplus was estimated at only 11 percent (Webb *et al.* 1991). Reductions in marketable grain caused significant rises in the urban consumer price in the mid to late seventies. These rising prices were one element that led to the creation of the Agricultural Marketing Corporation (AMC).

The AMC established centrally fixed grain prices by the end of 1976. Prices were set uniformly throughout the country (pan-territorial pricing) despite wide disparity in the quality of grain, transportation prices, storage costs, seasonality of supply or demand, etc. An *ad hoc* committee formulated producer prices for the farm gate, wholesale markets, and state farms. The wholesale price was generally set at 4-5 Birr/100 kg above price paid to farmers. State farm prices averaged about 20% above the wholesale price. No accommodation for changes in input prices were made. It has been estimated that farm gate prices averaged less than half of those prevailing in urban markets between 1979 and 1983.

According to Webb *et al.* (1991) the AMC operating mode remained essentially unchanged until fairly recently (except for a 2.2 percent increase in producer prices granted for teff and sorghum in 1982/83). In 1988, as a result of intensive donor pressure, producer prices were allowed to increase by 7 to 10 percent and more rises were announced in 1990.

In addition to attempting to stabilize cereal prices, the Ethiopian government also tried to stabilize grain supplies to urban markets through the introduction of a quota delivery system and a parallel curtailment of private grain trading. From 1978 through 1980, peasant associations were required to release 100 quintals of grain to the AMC. This quota was increased to 150 quintals in 1981 at the same time producer prices were increased. Licensed grain traders were required to make at least 50% of their purchases available to the AMC. In the high production regions (Shewa, Gojjam, Arssi), these policies covered 100 percent of all privately traded grain (Webb *et al.* 1991). Traders not fulfilling the quota requirements lost their license. Finally, interregional trade was severely restricted, a policy that has only recently been changed.

Such political constraints on prices and product movement are extreme, but illustrative. If prices are controlled and movement restricted, overly high prices in one area will maximize inefficient production, while low prices in another area hinder production. The above scenario of controls on sales between areas combined with low price will surely lead to low production, hinder famine mitigation and even be a contributing cause of famine.

4.3.4 Training and Extension

Famine mitigation intervention which require extensive training or extension will necessarily rely on governmental action to have any widespread effect. Information diffusion does little to foster adoption of any but the simplest, least time-consuming and least costly practices (e.g., for soil conservation examples: Napier, 1991).

Developing new cash crops can, rarely, permit the capital needed for adoption. Such development is unlikely in most famine-prone areas, so famine mitigation efforts must depend on government integration of training and extension. A number of successful PVO/NGO models are available which integrating training and input supply in ways consistent with asset enhancement through multiple coping strategies (Worstell, 1991).

4.4 Technical Considerations

Beyond those technical aspects already covered previously, the long term effects of famine mitigation interventions on environmental parameters must also be considered.

4.4.1 Ecological Degradation

Long term effects of famine mitigation interventions must be anticipated lest famine-prone areas become even more susceptible to future famines. Past agricultural activities have already made land degradation the second most important brake on current agricultural growth according to Zhao *et al.* (1991).

In order to estimate such effects, monitoring indicators of ecological degradation is a minimum step. Soil is the most important resource determining agricultural sustainability. Indicators of degradation include: depth, organic matter, crusts, salt or alkali content, dust deposits. Indicators of water resource degradation include: depth to groundwater, quality and extent of surface water, status of drainage systems. Indicators of vegetative resources include: percentage ground cover, reflectance, biomass above the ground, yield, species composition.

Cultivation always increases the chance of degradation. Any crops which lead to decreases in cultivation will decrease chances of degradation. Small-seeded crops require fine seedbeds which are more susceptible to erosion. The potential for erosion is enhanced by agricultural practices such as 1) soil tilling with final plowing downslope to facilitate drainage, 2) mono-cropping, 3) lack of cover during the rainy season, 4) use of crop residue and dung for fuel rather than as soil cover, 5) insecurity of land tenure.

Soil degradation in a famine-prone country is illustrated by conditions in Ethiopia (Caldwell, 1991). The areas most severely eroded in Ethiopia include Tigray, Eritrea, and densely cultivated and cropped areas of Gondar, Wollo, and northern Shewa. FAO estimates that erosion in these areas is reducing crop yields by 1 percent per annum and that biological degradation (e.g., loss of soil organic matter) is resulting in another 1 percent decline in crop yields.

Many famine-prone areas have no soil to spare. In Wollo and Eritrea, provinces with very high rates of erosion, over 50% of the land has soil 10 cm or less in depth. One big problem is that as agricultural land loses large amounts of soil, and as soil depths are reduced to 10 cm, the land becomes more difficult to reclaim. Much is lost as potential area for reforestation, or revegetation has to begin with a less productive, but more soil-building, stage (grasses/shrubs). The areas with the greatest soil erosion problems are nearly always also the areas most susceptible to famine. Every study of famine-prone areas predicts the erosion situation to worsen without intervention. One scenario for Ethiopia (Caldwell, 1991) suggests that between 1985 and 2010 soil erosion will cause an increase in land incapable of being cropped from 2 million hectares to 10 million hectares - an area covering approximately 17 percent of the highlands.

Soil losses due to erosion average between 23 and 42 metric tons/ha on cultivated land and 4.5-7 M tons/ha on grazing land. Average soil loss/soil production ratio is on the order of 6 for tilled land and 1.5 for grazing land. It is estimated that over 1 billion tons of topsoil flow from Ethiopia's highlands annually.

Axum, in the northern highlands on the Tigray Plateau, was once the center of the Axumite kingdom, one of the oldest empires in the world. It is now the most environmentally degraded area in Ethiopia. In the northern Ethiopian highlands, environmental degradation makes area more susceptible to vagaries of weather. Less than normal rainfall results in a period of food shortages or famine. An increase in rainfall results in severe flooding, erosion and loss of topsoil.

The cumulative impact in Ethiopia is now quite evident. Soil loss is exceeding soil formation by a factor of 6:1, or 5-10 tons/ha nationally. Erosion of the most productive soil horizons is also resulting in reduced fertility, stagnant or decreasing yields, loss of organic matter, and loss of soil moisture retention.

Conditions such as those extant in Ethiopia admonish that seeds and tools interventions must carefully monitor effects on soil to be certain short term interventions don't have deleterious long-term effects. But in addition to direct effects on soils, effects on vegetation such as shelter belts can have long term ecological impact. In drought prone areas large numbers cut firewood for cash (33% in Kenya, Downing *et al.*, 1989), so cash for work may decrease cutting firewood and thus protect soils and other resources.

Fallow periods are vital to soil fertility in traditional systems in most famine-prone areas. Biological events during the fallow periods regenerate the productive capacity of the soil. Any processes which can be incorporated into the cropping system to gain the effects of the fallow period, without losing production years, will be extremely useful in famine mitigation. One possibility is mound farming as described from Zambia by Stormgaard (1991).

Cover crops intended to recreate some effects of fallow while decreasing erosion should have the following characteristics: cover soil well, not become weedy, and degrade readily into the soil.

4.4.2 Innovations and Local System Compatability

A number of innovations being touted for increasing agricultural production in famine-prone areas are simply inappropriate in many agroecosystems. An example is the use of legumes as green manure, advocated by many researchers (e.g., Glasener and Palm, 1991), but not adopted by farmers. A much better system is to feed legume leaf to animals and then apply the resulting manure to the cropping area. Introducing an entirely new system is entirely inimicable to the approach of facilitating existing coping strategies.

Another example is alley-cropping. IITA has promoted and invested heavily for years in alley-cropping research. This research began with a valid premise, trying to copy multiple cropping compound strategies with trees as an important N-fixing component. But the effort attempted to put a compound system component into an extensive farming system. Francis and Atta-krah (1989) summarize this experience by noting that, though trees were established successfully under farmer management, the key problem was incompatibility with established cropping systems. Farmers can't use them if they conflict with crucial aspects of their existing system. Closer contact with farmers prior to major research investment would have prevented this waste of resources.

Matching cropping systems to agroecosystems. Maize is given by many as an example of a crop which is grown in semi-arid, famine-prone areas where sorghum and millet are more appropriate. The trend toward increasing maize production in these areas is encouraged by experiment station reports such as that of Shumba (1991) asserting that maize always outyields sorghum and millet. Certain maize lines can outyield unproductive sorghum lines in semi-arid areas. But, as a blanket statement, Shumba's assertion is patently untrue. This fact is almost irrelevant when so many farmers and opinion leaders contend that the only time sorghum and millet are preferable to maize is as buffer crops in case of extreme drought.

The reason for such allegiance to maize by farmers throughout South and East Africa is that they prefer eating maize. For similar reasons, hybrid yellow maize has not been adopted because it does not have the taste of open-pollinated, traditional white maize varieties. Even larger farmers continue to plant white maize because they are afraid they will not be able to obtain it on the market if they grow only the better yielding hybrid maize. Among smaller farmers, all land is planted to white maize.

Maize is also preferred to sorghum and millet for other reasons when agroecological considerations do not rule maize out. Maize is less vulnerable to bird damage and has a higher cash value. Millets and sorghum are quick-growing and drought-resistant, but they are much more labor intensive in every aspect: weeding, bird-scaring, harvesting, threshing and food preparation.

Maize is also seen as an asset builder. Maize can produce so much in one year that it seems worth the risk, given the guaranteed low yields of more drought-tolerant crops. Good years encourage farmer to ignore bad years, especially when input costs are low and prices for other grains are even lower, because of the vast asset build-up the good years can achieve.

Hybrid maize production is also growing rapidly due to strides in breeding--especially in coastal West Africa (Delgado, 1991). As private plant breeding companies become more active in Southern and Eastern Africa, similar advances can be expected in maize productivity. The plasticity and wide variety of maize germplasm, and dedicated low-input breeding program [e.g. Cornell, Barker (1991)] indicates maize improvement will continue apace.

Finally, farmers will plant maize knowing it will sometimes give lower yield, because at least they can eat it and they can't be sure of getting edible maize from the market. Even if the preferred maize varieties are available in the market, they are extremely costly and often not milled in the preferred form.

The new SADCC/ICRISAT sorghum and millet research center at Bulawayo in Zimbabwe may be able to make the largest inroads in increasing small grain use by breeding for feed use and research on industrial uses, since farmers are not likely to return to planting sorghum or millet for their own use. As Rohrbach and Mwila (1990) note, sorghum and millet development cannot simply be based on a perception of their drought tolerance. Food security concerns are not translated into the investment needed to promote the production and marketing of these crops. Instead, focus should be on sorghums for flour composites with wheat and as barley malt substitutes.

Certain crops which fit semi-arid agroecosystems (relatively early-maturing and drought-tolerant species) have been adopted by smallholders in some famine-prone areas. One example is sunflowers in Zimbabwe (Shumba, 1991). Of the total crop, 96-98% is grown by communal farmers in Zimbabwe, according to Govereh and Mudimu (1991).

Cropping systems match agroecosystem parameters in sustainable systems. Requirements which would enable such crops to assist in famine mitigation include: secure markets for the new crop and reliable food grain supply at reasonable prices relative to return from the new crop. In areas of Zimbabwe where the latter is not the case, Chigume and Jayne (1991) report that even when prices are extremely high for oilseeds, if farmers can't be sure of getting foodgrains, they will devote scarce land area to maize, even when maize only makes a crop every other year. As a result price incentives have concentrated benefits among relatively wealthy smallholders who can afford to grow both their food maize and sunflowers.

4.4.3 Intercropping

A number of technical considerations from recent intercropping research are relevant to assisting coping strategies. A new summary of research shows that intercropping reduces risk to farmers in a variety of situations (Rao and Singh, 1990).

Intercropping yields in low input, semi-arid areas. Intercropping pearl millet with cowpea results in less cowpea infected with thrips (Maiga *et al.*, 1991) and subsequent yields will be higher (Nouri, Reddy and Mason, 1991). The effect is strongest under conditions of no fertilization: overall yield (of both millet and cowpeas as measured by land equivalent ratio) was 61% higher and the increase occurred without decreasing millet yield. Under fertilization, millet yield is decreased slightly, but this is more than made up by the cowpea yield--giving a combined yield increase of 34%.

Related research has shown that pearl millet/cowpea intercrops also results in increased soil organic matter (Reddy *et al.*, 1991).

4.4.4 Forage Legume Research

Local coping strategies in many situations may be assisted by forage legumes. Integration of forage legumes in cereals-based low input farming systems in semi-arid areas has a potential to sustain soil, crop and livestock productivity. In Niger, *Stylosanthes* species intercropped one year with millet did not decrease yields that year. Yields the next year of millet alone on previously intercropped fields yielded 78% more grain and 98% more total nitrogen than a continued millet monoculture (Kouame *et al.*, 1991).

A relatively little known species, *Clitoria terrenata*, is widely reported to increase yields of subsequent grain crops. Sudanese research indicates *C. terrenata* was the best legume tested for increasing yields of a subsequent sorghum crop (Mohamed, Clegg and Parkhurst, 1991).

Recent research in Mozambique has shown *C. terrenata* is also the most productive forage legume in dry matter production on infertile, sandy soils (Muir and Jardao, 1991).

Other tropical forage legumes also have usefulness in forage production. One consideration is that a particular forage line may not be productive in the establishment year, but could have the highest long-term productivity In Mozambique, *Glycine wightii* had virtually no production in the first year. But during the second year, production was more than twice that of the well-known *Macroptilium atropurpureum* cultivar Siratro. In addition, persistence of *G. wightii* was much improved over Siratro: 95% versus 29.3% (Muir and Jardao, 1991).

Replacing weedy fallow with productive legumes in semiarid areas is an especially likely role for forage species. In 380 mm average rainfall, P-deficient soils in Morocco, initial research indicates *Medicago* and *Vicia* (vetch) species are most effective. But further variety trials are needed (Derkaoui *et al.*, 1991).

Atriplex has proven effective in arid conditions as a drought-tolerant perennial forage. Some lines are now available from Australia which thrive in semi-arid conditions.

4.4.5 Seed Multiplication

Viable seed tested in similar edapho-climatic conditions is necessary intervention before many forage legumes can be expanded in local coping strategies.

New seed varieties. Famine mitigation efforts should be very alert to new varieties of crop and forage species. Haugerud and Collinson (1990) report the especially heartening increased effort of IARCs on breeding for low-input conditions. Varieties will be spinning out of these efforts. But they will need to be tested under management systems of famine-prone areas. Any new variety must prove itself over time. In most cases, better interventions are plenteous stocks of tried and true varieties.

Blends and mixed varieties. Seed multiplication requires keeping lines separate. For planting the best choice may be a mix of two or more varieties. Recent research from Cameroon, indicates alternate rows of improved short-cycle variety with a long-cycle local variety can be higher yielding than either variety in pure stand and more stable across environments (Russell *et al.*, 1991). Problems with isolation and harvesting each row separately complicate on-farm seed multiplication.

4.4.6 Seed Distribution

Problems with parastatals are illustrated with an example from Ethiopia. Only 2% of Ethiopian farmers are estimated to use improved seed (Caldwell, 1991). Although improved varieties exist for the major crops, farmers have not been convinced that the performance of these varieties is superior to local varieties already in use. Several factors further limit the use of improved seed. High price, low quality, limited availability, all discourage wide-scale use of improved seed and other inputs by small farmers.

A parastatal (AISCO) is the prime handler of seed and, as such, is responsible for procurement and distribution of planting seed. Most small farmers retain portion of their harvest for planting in the next cropping season and do not rely on purchasing seed from AISCO. State farms have been the primary purchaser of improved cereal seed (64% of all seed purchases). Only 19% of sales have gone to cooperatives. AISCO has purchased large quantities of maize seed from Kenya and vegetable seed from Holland. Most other cereal seed are purchased locally in the open market. The Ethiopian Seed Corporation has primary responsibility for cleaning and treating seed.

Problems in securing adequate seed supplies have plagued AISCO in the past. For example, in 1986 only 40% of cereal seed requested was actually provided.

This situation is not at all unique and points to the necessity of enabling seed distribution networks other than parastatals if famine mitigation is to be effective.

4.4.7 Breeding for Ancillary Characters

Significantly for famine mitigation in semi-arid areas, Katumani and other early maturing maize genotypes have recently been shown to avoid *Striga* parasitism (Ransom and Odhiambo, 1991).

One active area of breeding research for those interested in seed which can assist in famine mitigation is for characters which confer adaptation to semi-arid conditions. Water-use efficiency has been one of the most intensively investigated. A recent review indicates it is not well-correlated with yield due to three facts: the underlying process only works in extremely dry conditions, the same anatomical structure which must open to take in carbon dioxide releases water at the same time and the water produced when carbon is fixed must be removed before the plant can fix more (Baker, 1989). Though research continues, no specific character has emerged which is predictive of drought-tolerance.

4.4.8 Germplasm Preservation

The chief centers of diversity for many food crops are in Africa. In fact, Ethiopia was the origin of cultivated sorghum and yearly new biotypes are reported from the highlands. The guinea and caudatum sorghums both have centers of diversity along the Ethiopia-Sudan border. Bullrush millet and fonio have centers of diversity in western Sudan (Hiernaux, 1974) as does sorghum (Doggett, 1988). Any famine mitigation interventions should not result in long-term degradation of these invaluable resources. Wherever possible, preservation of unusual types should be facilitated during seed selection and storage.

4.4.9 Animal Traction Constraints

One hundred twenty five animal traction projects have been conducted since the 1930's in Francophone Africa alone (Delgado and McIntire, 1982). The rate of adoption is low and decreasing. Reasons include poor health of animals, plowing is impossible until rains have loosened soil, cultivation increases erosion unless done by experienced operator, inexperienced operators hesitate to use animals for danger of hurting crops, training animals is costly and, finally, without dedication to training, farmers will not achieve economic margin justifying change from hand tillage or even recouping initial cost (Deuson and Day, 1990).

However, animal traction technology is quite specific to type of farmer. The single ox plow developed by ILCA has not been widely adopted, but small farmers in some areas of Ethiopia have enthusiastically adopted it (Kebede *et al.*, 1990).

4.4.10 Tied-ridge Cultivation

Research on the recently popular semi-arid innovation of "tied-ridge cultivation" shows benefit only on slopes. The key benefit may result simply from slowing down run-off so it can be soaked in--which depends on porosity/organic matter of soils. A variety of traditional practices can accomplish same effect (Wright *et al.*, 1991). Other water catchment considerations are covered in section 3.13.

4.4.11 Fertilizers

Subnormal rainfall and high temperatures makes soils "hot" and fertilizer applications must be delayed until rains seem established. Recent research indicates that the effect can be so intense that no yields are achieved on manured fields and virtually normal yields occur on non-manured fields. Inorganic fertilizer, being more concentrated, can be even more dangerous.

5.0 STRATEGIC RECOMMENDATIONS: GENERAL

5.1 Asset Assessment

The analyses of successful famine mitigation strategies described above indicates that the most useful strategy is one of asset-enhancement. Asset preservation and enhancement are key to both smallholder and pastoralist. The ironic aspects of keeping animals alive while suffering hunger (Walker, 1989) are apparent only to the urban-oriented who are out of touch with production constraints under conditions of scarcity. Anyone dependent on his own production for his livelihood knows he must maintain his productive assets or his entire household is lost.

Our key general recommendation is that famine mitigation efforts should determine the assets needed to enable the most resilient coping strategies and then provide a means of enhancing those assets which strengthens local institutions.

5.2 Early Warning Systems

Early warning systems would profitably track whether key assets were being enhanced or declining. Enhancing assets, whether increasing the food in storage, improving fertility of soil, improving pasture forage production capability, improving water catchment, acquiring oxen or hand tools, or increasing seed in storage, are indicators that a household is becoming less susceptible to famine. Declining levels of these same assets should be instituted as the earliest warning indicator.

Natural resources such as soil, water and vegetation are crucial assets enabling nearly every household coping strategy. Indicators of ecological degradation of these resources, such as those noted earlier, will be crucial in monitoring the impact of interventions as well as for early warning.

Women are the best source for early indications of incipient famine, for compound system techniques useful in intensification of bush cropping systems and for techniques for food and seed storage.

5.3 Local Appraisal of Constraints and Opportunities

In addition to assessment of key assets, the indigenous coping strategies must be identified which can enhance or decrease these assets. Identifying indigenous strategies requires local input which can most effectively be provided by PVOs and NGOs. An early step is establishing a process by which constraints and opportunities within these strategies can be explored. Though strategies will be very locally specific, this process will look at interventions which facilitate a broad range of strategies.

> ***Recommendation:*** *A participatory agroecosystem analysis (PAA) which includes intensive involvement of PVO/NGO practitioners is the first step in creating sustainable famine mitigation interventions in any famine-prone area.*

This analysis could be accomplished with a series of participatory appraisals in various NGO impact areas culminating in a workshop with each NGO participating. Appendix 1. provides a detailed description of PAA methodology.

The topics explored would be the constraints to famine mitigation, the best opportunities within those constraints and examination of possible interventions. Examination of interventions would follow the basic criteria checklists common to such NGOs as World Neighbors (Bunch, 1985) and Save the Children (Worstell, 1991).

Such an approach would permit famine mitigation strategy building to begin to approach a level of specificity not possible in this paper. For example, we noted above that animal traction interventions have not in general been well-received. Yet the single ox plow has been enthusiastically adopted by small farmers in Ethiopia (Kebede *et al.*, 1990).

General principles such as outlined above invariably do not fit in some local systems. The PAA would not begin with a set of interventions and try to promote them. The IARCs have provided a number of such examples with interventions which don't fit local systems, e.g., alley cropping and green manures.

The same is true for any famine mitigation intervention. It must first be shown to work at the household level. Policy interventions must flow from ability to facilitate household coping strategies. As Nagy *et al.* (1990) stated so well,

> *"Previous attempts to introduce apparently promising technologies based on research that had not directly involved the farmer and that had not benefitted from farmer-feedback have been largely unsuccessful."*

In developing famine mitigation interventions, watch for the tendency to derogate strategies as old, out-dated, desperate survival attempts. The unconscious tendency is to want something new, e.g. a new tool, a new seed variety, market interventions. If new interventions do not facilitate existing coping strategies, they cannot help no matter how effective they are in other systems.

5.4 Seed Interventions

The analyses in previous sections indicates that the most cost-effective mitigation interventions will often be increasing quality and availability of seed. As Adesina and Sanders (1991) showed through a stochastic programming analysis,

> *"by carrying a portfolio mix of varieties of varying maturities and making sequential decisions based upon rainfall expectations, farmers can adapt to the production uncertainties [of semi-arid areas]."*

Specific recommendations in the following section note ways seed, food storage, hand tools, water catchment and soil enhancement can be improved within existing marketing and transportation systems.

5.5 Relief Interventions

Specific recommendations for the incorporation of relief must await input regarding local conditions, but a few general recommendations can be made. Relief efforts should enhance local distributional capacity rather than bypassing it, e.g., organize donkey trains rather than hiring helicopters. The means of providing relief should be designed so that indigenous strategies are strengthened. An example would be to distribute locally preferred seed varieties, which means maintaining stocks of them, preferably through local seed multiplication and storage. Relief interventions should provide or enhance productive assets of targeted groups. One such example would be to distribute relief food in containers that are also suitable for long-term grain or seed storage.

> *"Relief food operations should mesh with the survival strategies which rural people traditionally adopt in times of food shortage, which may play a greater role in preventing starvation than food distribution." (Eldridge, 1989)*

The timing of interventions, to be most effective, must be early enough that recipients can still preserve assets. However, no matter how destitute, nearly everyone has assets which can be enhanced. Relief can assist in this process, but only if it empowers rather than creating dependency (McCann, 1987). This can be accomplished if relief aid is used to improve the effectiveness of indigenous coping strategies.

5.6 Additional Recommendations

The recalcitrance of donors and host governments can be overcome by focusing interventions through the PVO/NGO community.

The focus population for famine mitigation in sub-Saharan Africa should be smallholders.

In-country lead agency. An output of the PAA will determining who knows the local coping strategies. This organization should be the one to cultivate as lead operational agency with veto power over famine mitigation interventions in particular agroecosystems.

Fertilizer and hybrid seed are useful interventions only when delivery of inputs and marketing of outputs is reliable (e.g., Niger, McIntire and Fussell, 1989). Unless both these goals have been achieved, interventions in storage and transportation will be more useful.

Policy should be viewed not as an intervention in itself, but as establishing the prerequisites needed for technical interventions to succeed. General policy goals should ensure that:

a. Markets respond to scarcity and increased efficiency.
b. The input supply system delivers seeds and tools reliably.

c. Land tenure is settled and farmers can depend on continued use of land and benefit from asset-enhancement.

Particular policy changes should depend on farm-based policy analysis (Martinez *et al.*, 1991) in which successful on-farm and household famine mitigation interventions identify policy-induced constraints.

A final general recommendation is that whenever inputs are provided, **training and input supply are always integrated**. No seed or tool is ever provided without complete training in its most efficient use. Some reciprocation is expected as part of the input supply, training certainly, and repayment if a credit mechanism is established, or in-kind reciprocation if not.

6.0 SPECIFIC RECOMMENDATIONS

Specific recommendations must be tailored to a particular agroecozone, the assets present in households there and the coping strategies employed by those households. The PAA recommended above or a similar RRA must be held in each region before any specific recommendations are finalized. As noted above, this analysis could be accomplished with a series of participatory appraisals in various NGO impact areas culminating in a workshop with each NGO participating. Appendix 1. includes specific guidelines for this appraisal.

However, with the caveat that specific recommendations cannot be final until this process in complete, a number of conclusions can be made about the most likely specific interventions. Previous sections provide more detail about each of these areas.

If the most cost-effective means of improving local coping strategies is with interventions which bolster a large number of indigenous coping strategies, then six intervention areas stand out as crucial in famine mitigation.

Every strategy aimed at increasing production will be improved by increasing quality and availability of seed. Furthermore a variety of seeds enable farmers to adapt to the agroecological variability of semi-arid areas. Therefore, seed quality and availability are a likely intervention in nearly every famine-prone area.

However, food storage may be just as important in many areas. The above review of coping strategies indicates that food storage is both a coping strategy in itself and the foundation for success of a number of other coping strategies.

Interventions in hand tools, water catchment, soil improvement and transportation can also increase the resilience of a number of coping strategies. These six key intervention areas, then, are the focus for our specific recommendations.

6.1 Improving Seed Quality and Availability

Seed provide the simplest examples of interventions which support multiple household coping strategies. In fact, for multiple coping response in highly variable environments to be effective, the crucial intervention is one that makes a wide variety of appropriate seeds available. If a household has seed available of species and varieties which match their needs in each of the possible conditions, the household will be better able to tailor its strategies to its environment. A key famine mitigation objective is to determine the seed varieties farmers know are most useful in drought situations, identify existing stocks of those varieties and make sure that those stocks are preserved and available to farmers at planting time.

The best intervention is to provide high quality stock of farmer-tested varieties. Preferably these varieties will be self-pollinating landraces adapted to similar climatic and cultural conditions. Seed interventions should provide a range of lines which can meet the variety of climactic and agroecological conditions possible in the area. These should be chosen primarily from those currently being grown by farmers. Vierich and Stoop (1990) reported that the most successful smallholders in the West African savannah maintain a large assortment of sorghum materials which allow them to switch varieties readily in response to changing wet-dry cycles. Seed provided should not be just of the most drought-tolerant lines, but of the variety of lines needed to adapt to the multiplicity of agroclimatic conditions encountered by local farmers.

Seed packs should also include samples of new varieties for farmer trials. In famine-prone situations, farmers in many study areas have been eager to experiment with short season varieties (e.g., Colson, 1979). If seed packets distributed are pure, but genetically diverse and short season, they may be the best long term means of increasing smallholders' resistance to famine.

An assessment of seed deficit must also include an assessment of seed viability. Rolling up seeds in wet newspaper and checking germination after a week provides a simple and fairly accurate measurement of seed viability. If germination is less than 60-70%, seed quality is likely to be declining rapidly and the provision of new seed will be the best intervention. If seed retain normal viability, maintaining that quality through improved seed storage will be the intervention of choice.

Whether new seed are sold, loaned for in-kind return or given away will depend on a local assessment of past interventions.

Famine mitigation efforts should be very alert to the possibilities and drawbacks of new varieties. Since all indications are that maize will continue to be in demand, famine mitigation efforts should look to continued advance in Katumani-derived materials and other early maturing maize genotypes (Ransom and Odhiambo, 1991).

A number of new varieties will likely be produced from International Agricultural Research Centers in the next few years, given the huge effort on breeding for semi-arid, low-input conditions (Haugerud and Collinson, 1990). Any new variety must be carefully tested under management systems of famine-prone areas.

Cooking and processing quality must also be important considerations when introducing new varieties Examples of nonacceptance of high yielding varieties due to bad taste are legion. Other important processing qualities are ease of threshing, cooking time, palatability when served cold, nutritional composition of secondary parts.

Whenever a variety new to an area is being considered, keeping quality should be examined. Many new varieties have been selected solely for high yield and store very poorly. Traditional varieties in locally made stores often suffer minimal losses (Gibbon and Pain, 1985).

New species and radically different varieties will only rarely achieve acceptance, even with an extremely vigorous campaign, and almost undoubtedly not soon enough to fit any a famine mitigation time-frame. The best approach is ample supply of tried and true varieties and trial packets of any experimental line.

6.1.1 Seed Storage

The ultimate goal of seed storage interventions is a safe, secure supply of seed for every farmer. In most famine-prone agroecosystems, this means that the goal is that each farmer saves his own seed. This in fact is what often happens to successful seed bank programs: farmers adopt the practices and find it more convenient to just keep them in their households (Anderson and Woodrow, 1989).

Many interventions for grain storage are also applicable in seed storage. The principles are the same; chiefly, keep it cool and keep it dry. But, seed are a bit trickier than grain, especially in the drying process. One perspective seems to be consistent among several successful NGO seed program managers. They stress to farmer groups that seed are living organisms. Interventions in grain storage can provide farmer groups with the basic principles needed in seed storage, except that seed stores must preserve life in addition to food value.

Interventions based on detection and modification of high seed moisture content are the most basic of seed interventions. Drying interventions, such as those detailed earlier, will insure proper pace of drying, if chosen based on agroecosystem fit.

Household storage. Provision of impervious, sealable containers with proper training in seed storage has been a successful intervention at the household level. Tins or jars with tight lids are ideal for seed storage if they are kept tightly closed. An intervention useful in nearly all agroecosystems is to keep seeds cool by burying the airtight containers in moist, shady soil to a depth of 60-90 cm. (Rice *et al.*, 1986).

When food stocks become extremely depleted, however, household storage may not be the safest place for seed. The intervention of buying seed from families with the agreement that they can buy it back on credit at planting time has been used by some NGOs who have established high levels of trust with community groups.

Community seed-banks. A high degree of success has been reported with community seed-banks if administration can counteract class problems and distribution problems (Anyango *et al.*, 1989; Anderson and Woodrow, 1989).

Regional/national seed-banks administered by PVOs/NGOs or transnational companies are the only seed suppliers at this level to show timely distribution and reasonable cost in famine-prone countries. Efficiencies of scale are achieved only if highly qualified managers are in charge. A local appraisal well before intervention will be necessary to provide the needed assessment.

Extra-country seed storage. Though encountering many of the problems mentioned above (especially propounded in distribution), storing seed of crucial varieties outside the country may be an intervention appropriate for international PVOs working with private seed companies. However, once a crucial variety is known to be in short supply inside the country, the best strategy is to import the variety and move it into local storage as soon as possible.

> *Recommendation: PVOs should join with competent seed companies to take responsibility for each famine-prone area to insure that each type of needed seed is readily available for movement into local storage.*

6.1.2 Other Seed Interventions

Germplasm preservation. Famine mitigation cannot be primarily concerned with preservation of local germplasm--overemphasis on an admittedly admirable goal will dilute effectiveness of famine mitigation activities. But interventions in local in seed storage, will produce more preservation of local germplasm than most "PGR" activities to date.

Famine mitigation interventions should give special attention to provision of grain legume seed. Grain legumes not only are a valuable source of protein, they usually have a short maturity period (lending drought-tolerance), grow vigorously in a wide range of environments on poor soils without nitrogen fertilization and, furthermore, are nutritionally complementary to the starchy staples in the diets of most rural households

Seed for soil improvement. Fallow dynamics are well know to farmers and "planted fallows" are an often easily accepted intervention when rainfall is adequate. Richards (1986) found two nitrogen-fixing, water-efficient cover crop species (*Pueraria phaseoloides* and *Calapogonium mucuonides*) to be especially well-accepted in his Sahelian region.

The success of intercropping as a famine mitigation intervention depends on various seed interventions. Each line used must be kept pure. Seed packs provided must have both cowpea and pearl millet seed or whatever lines mesh in that agroecosystem.

On-farm Seed Multiplication. The On-farm Seed Multiplication Project (Osborn and Faye, 1990) has provided a wealth of information on seed multiplication by village-level farmer groups in West Africa. These case studies are the starting point for on-farm intervention efforts. Farmers often have the basics skills related to roguing and plot isolation needed for seed multiplication. The basic lack is adequate storage, techniques for insect control in storage and good quality seed to begin multiplication of new or lost varieties.

Vegetatively propagated species. The main reason cassava is not used more often as a hunger breaker is due to the lack of shoots to plant when the first rains come (Watts, 1987). A useful famine mitigation strategy would be to support nurseries of cassava in areas where cassava use is established and valued.

The same applies to wild food niche fillers, especially since we can expect fallow areas to continue to decline in quality and quantity. However, propagation of some wild species may be difficult and make this intervention untenable.

One intervention in use in Malawi as a hunger breaker is a traditional sweet potato line which produces hundreds of microtubers along with the large harvested tubers (Carr, 1991). The microtubers lay dormant in the soil until the first rain and then spring up with a very nutritious and palatable flush of leafy growth. By not requiring planting, they also mature more quickly than standard lines. This line is presently being tested by IITA for adaptability to other areas.

Distribution. In areas where farmers purchase most seed or when PVOs are supplying seed as an intervention, distribution must be accomplished effectively. The two key problems in seed distribution systems, quality control and transportation bottlenecks, can both be avoided with interventions focusing on the enhancement of local seed storage skills.

Quality control on a national level, through either market control or pre-market control, is not a viable alternative in the near future in most famine-prone countries. Pre-marketing control can even make good seed harder to obtain. Intervention at a policy level to encourage market control may make more seed of more varieties available in the long term.

Transportation bottlenecks are often the bane of any famine mitigation or relief activities. Though not solely a seed intervention, the resilience of input supply networks must be a topic for early assessment in famine mitigation reconnaissance surveys.

Breakdown in a national seed supply chain means seed is not available or arrives too late. Often late seed must still be paid for--especially if purchased on credit from a government agency or parastatal. On-farm seed multiplication efforts, combined with village and women's group communal storage facilities has created a resilient distribution system in Gambia for Save the Children. This should be closely examined for possible replication in other drought and food shortage-prone areas.

Private seed companies. In many cases an external source of seed will be needed to provide foundation seed to begin seed multiplication programs or when stocks needed lines have been depleted. Private seed companies increasingly have the willingness and capacity to provide foundation seed of local varieties where partnerships between NGOs and seed companies can be established.

Legumes. No legume seed should be distributed without the appropriate *Rhizobia* innoculant unless the planting sites can be shown to contain effectively cross-inoculating native strains.

6.2 Food Storage

Storage inspection. One basic technique is crucial to both an RRA detection of food storage constraints and intervention to mitigate effects of food storage losses on famine: inspection to detect both biological heating due to wet grain and fungal, bacterial or insect infestation. This is especially vital in warehouse storage. Cleaning to remove infested portions and redrying are the crucial follow-up activities. Interventions involving hiring villagers to inspect food stores will reinforce indigenous knowledge and protect food resources. These interventions and contribution to RRA can be instituted at any stage in famine onset.

Food drying. Grain drying is the key to storage and can be accomplished through the most appropriate of the number of processes detailed earlier. Interventions in food storage must be consistent with, and improve if possible, existing drying techniques. Grain drying interventions should be made prior to seed drying efforts. Farmers with the most effective grain drying skills can be employed as monitors of seed storage operations and facilities.

Meat drying, encouraged where good storage conditions exist, can insure that maximum value is obtained from animals at the time when market price may be falling and before they have lost weight.

Nomads food storage. Pastoralists' herds are their food stores. Interventions to improve herd health and survival will be key to food availability.

Beyond the techniques mentioned above for dealing with insects in storage, a number of IARCs are focusing on insect infestation. Famine mitigation efforts focusing on storage should maintain contact with ICIPE and IITA (especially for work on weevils) for recent research findings.

Community-level grain storage. Cereal banks have proven effective in a number of famine-prone areas (see Anderson and Woodrow, 1989, for discussion). Their best use is as a method of demonstrating techniques with the goal being improved household-level storage. Community-level storage does provide a means of improving a key component of distribution systems--leading to market development or more effective relief.

Relief food aid should strengthen existing food storage, marketing and distribution systems. If viable cereal banks exist in a community, they provide both an efficient means for moving food into secure storage and a tested distribution system.

Individual household food sufficiency is often best predicted by management skills of female household heads. The care and skill of women in storing, rationing and distributing food often determines whether the household's children are seasonally or permanently malnourished (Messer, 1989). Pre-famine mitigation attempts may best target women in the intervention area of food storage.

Interventions to introduce more nutritious weaning foods prepared from local legumes can be among the most effective strategies for using stored food to reduce the impact of food shortage on the most at-risk household members.

6.3 Soil Improvement and Water Catchment

Intensification of production should be a goal of all famine mitigation activities. Compound garden systems provide local models for intervention in any agroecosystem. Interventions which promote production intensification should pay particular attention to local means of maintaining soil fertility and water catchment. In any specific area, strengthening the most successful such strategies discussedfrom sections 3.13 and 3.14 will produce the most effective enhancement of these assets. The incorporation of legumes will be especially appropriate for soil improvement in many areas.

Encouraging appropriate intercropping will increase production and enhance soils. ercropping is not advantageous unless done properly. If cowpea is planted in millet too early, millet yields are vastly reduced. If too late, rains will not be sufficient to produce a crop. Ongoing research at IITA should be followed as major efforts are being directed at low input intercropping systems, i.e., involving cowpea which is early and used as grain and fodder (Ntare, 1990).

Women have the most responsibility for production in the compound plots. Since these are the plots most likely to continue production as famine approaches, interventions should focus on women. The possibility of adapting coping strategies from the compound system to the bush system to increase intensity of production in the latter should be a primary focus of preliminary RRA-type assessments.

6.4 Hand Tools and Other Local Manufacturing

Adaptable hoes are a tool intervention which could enable smallholders to use multiple strategies to cope with variable environmental conditions. The possibility of numerous blades on one wooden stock vastly increases the efficiency of farmers and cost-effectiveness of intervention.

Blacksmiths. The key intervention which will most assist in use of better tools is blacksmith skill enhancement. If workers can work well with steel and join steel to wood, most tools can be manufactured and maintained.

Smithys are just one of the enterprises providing productive tools and assets which make long-term famine mitigation possible. Hand tools, oxen plows and harness, equipment for grain drying and grain storage all must be supported by decentralized local manufacturing to strengthen local resilience. Sustainable interventions will also strengthen skills of masons and carpenters.

Food and cash for work projects which manufacture storage containers and structures from local materials would provide useful skills and immediately increase food storage capacity and, therefore, resistance to famine. From the perspective presented in this paper, the determining criteria for judging C/FFW projects (beyond nutritional improvement) is their ability to supply or enhance crucial productive assets, which may include expanded local storage capacity, improved local transport, soil improvement, improved water catchment, expanded local tool manufacture and, especially, strengthened local social organization.

6.5 Transportation

Relief operations frequently provide opportunities to reinforce and improve local transportation systems as noted above. Unless required to move in relief food, however, emphasis on transportation should await strengthening of local productive capacity through the food storage, seed storage and multiplication, hand tool improvement and other interventions recommended above. Given improvement in productive coping strategies, however, a number of coping strategies can become more effective upon interventions to improve efficiency of traditional carts, wagons, harness and pact apparatus and their local manufacture.

6.6 Summary

Effective famine mitigation will employ Participatory Agroecosystem Analysis (PAA) to examine each famine-prone area to determine how coping strategies can be made more effective through interventions in seed availability and quality, food storage, soil improvement, water catchment, hand tool availability, and local transportation.

Seed availability determines the ability of farmers to pursue multiple strategies adapted to agroecosystem changes. Seed multiplied, dried and stored locally with local skills can provide the surest route to security of seed supplies. High quality foundation seed from external sources, often private industry, are needed to insure that local efforts produce the highest quality seed.

Community seed banks, improved local drying and processing, and secure, skilled household storage can all increase the effective productivity of any food production strategy in addition to providing a crucial component for more effective marketing and distribution systems.

Sustainable hand tool availability depends on tools being fabricated and repairable by local blacksmiths and artisans.

Water catchment and soil improvement both enhance basic assets and are the foundation of multiple coping responses in every agricultural system.

Finally, improving and supporting local transportation systems when providing famine mitigation inputs will increase the resilience of local response patterns by facilitating the marketing and distribution of food, seed and tools from surplus to deficit areas.

Improving household and community assets in any of these six areas will support improvements in many of the other areas. The most cost-effective responses will be those interventions which increase the resilience of the largest number of indigenous coping strategies.

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APPENDICES

Appendix 1. **Participatory Agroecosystems Analysis (PAA)**

Appendix 2. **Regarding Summary Conceptualizations of Response Patterns**

Appendix 1. Participatory Agroecosystems Analysis (PAA)

The participatory agroecosystems analysis (PAA) recommended in section 4 will be a type of Rapid Rural Appraisal focusing on the assets and coping strategies which are used in a particular agroecozone to cope with food insecurity. The process will be informed by the principles and techniques reported in this paper, but throughout the process participants will engage in an unrestricted multiple hypothesis testing process

Tentative working hypotheses at the onset of the PAA may be revised during the various stages of PAA or abandoned altogether, and new hypotheses may emerge. A wide range of data collection methods related to the issues of timelines and accuracy will be employed (e.g., Frankenberger and Lichte,1985). The basic procedure will be that of Conway (1986): key questions, guidelines and working hypotheses. An example of such a key question, guideline and working hypothesis chain is given below.

The overall objective of this approach is to identify interventions to strengthen the resiliency of smallholder households and the traditional forms of cooperative agriculture employed under conditions of food insecurity. The major output of the PAA will be a convergence of evidence which produces working hypotheses for pilot testing to verify several interrelated famine mitigation interventions.

To achieve this objective, four distinct areas will be explored:

1. Rural input supply sector.
2. Traditional smallholder sector.
3. Agroecological zones.
4. Smallholder survival strategies.

This multiple hypothesis testing process will be structured to provide, first, a series of interactions of external multi-disciplinary technical specialists (2-5) with community members and leaders facilitated by local NGO staff; and, second, an agroecozone-wide workshop. The workshop will include NGO/PVO staff, donors, ministry officials and local researchers to promote awareness, interest, participation and cooperation among all relevant groups and to report findings, to prioritize interventions and to rally support for pilot testing.

Wherever possible, existing PVO/NGO background and baseline data will be used, after verification, to provide needed information.

1. Rural Input Supply Sector.

Output: A catalogue of human skills and other assets needed to improve the timely supply and quantity and quality of seed, hand tools, oxen ploughs, seed and food grain drying and storage devices at the local community and household level and the identification of rural towns best suited to concentrate input supply sector interventions.

Method: Review of secondary sources, observation, interviews, informal random sampling, use of dynamic and iterative data collection process, and previous knowledge of development practitioners and research personnel.

Procedure: In this sector, the locus of the diagnostic research will be the rural towns and, as necessary, the peri-urban areas. Key activities will include an assessment of town infrastructure including electricity and water supply, roads, transportation and marketing networks in relation to smallholder villages. Observation and discussion with blacksmiths, carpenters, mechanics, masons and semi-skilled laborers and owners of input supply services which provide productive resources for smallholders is another major focus.

Observation and discussion with staff of organizations which provide seed supply and storage research and services,and individuals and groups which provide informal credit to finance the rural enterprise sector will complete the major activities for diagnosing the input supply sector.

Units of analysis:

1. Non-farm rural enterprise sector.
2. Artisan/skilled labor sector.
3. Semi-skilled seasonal labor sector.
4. National and local government, universities, non-government and private sector organizations with activities in seed research, seed multiplication, and seed storage.
5. Rural money lenders: marketers, cooperatives, rural banks.

Example

The process of multiple hypothesis testing results in a series of key questions which are then refined into hypotheses and guidelines for pilot testing. One example from this sector is below.

Key question: Since timely planting, timely application of soil nutrients and adequate soil moisture are the key factors when producing adequate levels of food in rainfed agriculture, how can the timely supply of improved oxen ploughs be speeded up to enhance the resiliency of smallholder households to produce adequate levels of food when they experience irregular rainfall?

Guideline: Improve the skills of blacksmiths in plough making and improve the traditional and modern transportation networks at an affordable cost to smallholders.

Working Hypothesis: Improved oxen plough technology will be adopted more readily by small holders when it is durable; when it improves yields at affordable costs and when an adequate supply of improved ploughs can be maintained.

2. Traditional Smallholder Sector.

Output: A working understanding of the smallholder microenvironment at the dimension of social economic factors, traditional production factors, and agroecological factors. Based on these, identify improved traditional production techniques for field and garden crops and wild foods; improved seed and food grain drying and storage techniques and appropriate technologies; improved post-harvest handling and storage of vegetables. Other key outputs are cost-effectiveness and cost-benefit analyses which identify in-kind local community costs or cooperative agriculture costs along with financial costs, including possible FFW/CFW schemes for each suggested intervention. If possible it would be most instructive to compare and contrast adjacent smallholder communities which suffer food insecurity with those that do not while trying to identify any patterns of cooperation between the two communities.

Method: When possible engage in participant/observation with farmers in their fields on more than one occasion. Interview not only male heads of households, but also women and older offspring. In the case of women, interviews may have to be conducted where women perform farm and household tasks. The team, in addition to establishing an intense learning and collaborative relationship with smallholders through participant/ observation, will repeat the methods delineated in the input supply sector.

Unit of analysis:

1. Farm Households (socio-economic survey)
   - Number of families and average size per household
     - -migration of household members
   - Division of farm labor by crops (compound and bush)
     - -plowing
     - -hoeing
     - -planting
     - -weeding
     - -bird scaring
     - -harvesting
     - -threshing and winnowing
     - -drying
     - -storing
     - -marketing (cash, food crops)
2. Farm Household Assets (productive resources survey)
   - -land holding
     - plot size in relation to cereal, grain legumes, and horticultural crops planted
   - -land classification
     - compound and bush plots (fertility, water catchment status)
   - -hand tools
   - -draft animals
   - -seeds
   - -food storage capacity
   - -access to surface and groundwater resources (capability to exploit)
   - -manure
3. Women farmers
4. Group leaders
5. Informal group structure.

Key questions about women farmers:

a. What are the special contributions of women in famine prevention?

b. What are the constraints to their full participation in famine prevention?

c. What are the important field crops, garden crops and wild foods in which women play significant production roles?

3. Agroecological Zones.

Output: A description of the present agroecological resources linked to the socio-economic imperatives and agricultural practices that threaten the stability of the agroecosytem. The identification and development of working hypotheses for testing interventions that enhance the resilience of famine zones is an additional crucial output. A dynamic analysis will be produced which discerns the state of stability and the state of degradation of the various components of the agroecosystem. These would include the polyculture, watershed and water resources, soil types in relation to water retention, fertility, and the carrying capacity for livestock and humans. Each threat to the agroecosytem will be described and related to on-farm objectives and targets, resource base and resource utilization.

Method: Data will be gathered from secondary sources, and through observation during field visits with farmers and local officials to identify land resources and to observe their state of stability and degradation. Again, we will repeat the methods delineated in the input supply sector.

Procedure: Observe, classify, describe and verify agroecological resources through field visits with farmers and local officials. Timing is crucial. Ideally, field visits should be made during dry and wet periods to verify what are the causes of agroecosystem degradation and to identify the potential low cost farmer group and household level interventions which can be employed.

Units of analysis:

1. Physical Characteristics
   - -Rainfall zones (unimodal/bimodal), variability
   - -Altitude (highland/lowland)
   - -Water resources (ground and surface)
   - -Soil Characteristics (fertility, structure, texture, water holding capacity)
   - -Topography
   - -Fauna & Flora
   - -Ambient temperatures (diurnal)
   - -Photoperiod
2. Land use and tenure
   - -Rainfed agriculture
   - -Irrigated agriculture (production inputs)
   - -Field Crop varieties
   - -Garden Crop varieties
   - -Wild Foods
   - -Cropping patterns (cash/food crops in relation to traditional and modern production practices)
     - monocrops
     - multiple cropping (intercropping, relay cropping, alley cropping, sequential cropping)
   - -Soil building
     - species (e.g. cover crops)
     - manure (livestock)
     - fertilizer use
     - fallow use
   - -Crop protection methods
     - companion planting
   - -Forest resources

Key questions: These concern the variables and processes that positively and negatively affect productivity, stability, sustainability and equitability of villages in famine zones (Conway, 1986).

In terms of productivity:

a. What are the resource enhancing activities in the form of land development, road networks, new varieties, knowledge and credit?

b. What are the constraints to productivity in the form of land shortage, water shortage, weeds and seasonal labour shortages?

In terms of stability:

a. What is the level of integration between livestock and crops?

b. What degree of group involvement in cooperative agriculture exists?

c. What are the constraints to stability in the form of crop diseases, crop pests and infertile soils?

In terms of sustainability:

a. What are the resource enhancing activities in the form of animal manure, cover crops, crop rotation, and companion cropping?

b. What are the constraints to sustainability in the form of deforestation, water and wind related soil erosion, and flooding?

In terms of equitability:

a. What are the levels of traditional cooperation, and village organization?

b. What are the constraints to equitability in the form of land sales, low levels of education and high levels of out-migration?

4. Smallholder Survival Strategies

Output: Gain a working understanding of the dynamics of famine survival strategies from the level of the smallholders, identification of methods to mobilize local groups to enhance the traditional resiliency to combat famine. Gain a deeper understanding of how to link traditional responses to famine with efforts of National governments, PVOs and UN agencies.

Methods: Case studies, observations, household surveys, interviews with rural households, joint FEWS surveys with participating farmers and rural households.

Procedure: Includes several overnight field visits with smallholders, village and local officials.

Unit of analysis:

1. Local/traditional FEWS
   - crop monitoring
   - rainfall monitoring
   - intra and inter family/community methods of communication
2. Coping strategies
   - rainy season behavior
   - dry season behavior
   - traditional cooperative farming
   - household food management (storage, use of wild foods)
   - migration for wage employment
   - liquidation of productive and non-productive resources (land sales, livestock sales, sale of oxen plough and tools, sale of food grain)
   - informal money lending

Key question: How can national and international famine prevention organizations align their programs with the traditional coping strategies of the smallholders?

Appendix 2. Regarding Summary Conceptualizations of Response Patterns

The innumerable local conditions and innumerable strategies lead many (e.g., Mortimore, 1989) to contend that any general model of coping structure undoubtedly oversimplifies and often misinterprets interactions of a particular strategy with the many factors conditioning its use.

However, a distinguished phalanx of food security researchers feels that such systematization of coping responses is valid. Beginning with Jodha (1975) and Burton *et al.* (1978) and including Colson (1979), Cutler (1985), Turton (1985), Glantz (1987), Corbett (1988), Rahmato (1988), Watts (1988), de Waal (1989), Walker (1989) and Frankenberger and Goldstein (1991), a number of authors have systematized the variety of coping or adaptive strategies which accompany the onset of famine.

The effort to systematize response patterns is largely motivated by the attempt to discern leading indicators which signal relief is needed. Hence these models are less useful in describing responses most relevant to mitigation. However, the detail of some of the models could be useful if changing external conditions (including possible interventions) were incorporated such that multiple end-points could be generated, if a longer pre-famine perspective were taken and if existing assets and coping strategies which enhanced those assets and agroecosystem parameters were included.

However, linear models with time as the sole independent variable are most popular--with Watts (1988) being the most cited example. These models begin with FEWS warning (after asset depletion is widespread) and end with destitution, mass migration and death. The most basic danger of these models is internalizing the assumption of a linear, lock-step sequence.

These models are not very useful for mitigation since they show no choice points where intervention is possible, reflecting a basic assumption that *"famines are not usually reversible events"* (Longhurst, 1992). The only possible end point in these models is migration to relief camps--making an implicit rationale for relief spending. The goal of stimulating relief interventions is facilitated by these models' stress on the last stages before destitution and mass migration.

A subset of the linear model approach divides the coping responses into stages, usually three, with the last one being starvation and mass migration (e.g, Walker, 1989). However, the broad brush necessary to creating summary categories is virtually useless for specific intervention. The summary term, *"change in cropping patterns,"* provides little useful information, yet it is noted as a key coping response in several models (e.g., Cekan, 1990). The term "using stored food" (e.g., Frankenberger and Goldstein, 1991) likewise refers to a crucial response, but hardly specifies anything unique to famine.

Part of the inherent problem in these models is the difficulty of arriving at a general term which encompasses the myriad of possible situations. But even when a summary term is generally applicable (such as *"use of wild foods"*), limiting it to just one stage is difficult. Use of wild foods occurs early in the onset of famine, but it also occurs later--in fact, as long as such foods are available.

Lack of attention to assets. By emphasizing responses immediately preceding famine, these models also neglect the asset enhancement which is vital to famine mitigation. Only a small number of these models incorporate coping responses which could address asset enhancement by household coping strategies (i.e. with seeds, tools or livestock) directly: 2 of 10 coping responses in Watts (1988) and 3 of 13 in Frankenberger and Goldstein (1991), to take two typical examples.

Asset depletion is recognized as important by some of the models. Frankenberger (1990) labels one of his stages *"disposal of productive assets."* de Waal's (1989) two stages are non-erosive coping and erosive coping, both referring to erosion of assets.

But asset creation is not a concern of these models. The focus is on the helpless depletion of assets. None of these models show possibilities of empowerment, just passive adaptation. Though some authors note the careful planning and husbanding of resources of famine survivors over years (e.g., Corbett, 1988; Frankenberger and Goldstein, 1991), none mention the creation and augmentation of assets.

Given these shortcomings, it comes as no surprise that choice of strategies is not related, in any of these models, to agroecosystem variability.

Summary of famine response models. The most prominent famine response models, in summary, have a number of shortcomings when applied to famine mitigation:

1. No provision for changing external conditions (including intervention),
2. No provisions for multiple endpoints,
3. Vague, non-specific summary terms,
4. Stages which are not discrete
5. Neglect of the several year cycle which precedes nearly all famines in sub-Saharan Africa.
6. Lack of attention to assets underpinning coping responses.
7. No consideration of agroecosystem variability (e.g., rainfall).

A few authors have attempted models which edge toward multiple possible external conditions and endpoints (Cutler, 1985; Sinha *et al.*, 1987; and de Waal, 1990). de Waal has developed the first systems approach (incorporating feedback loops) but it is at a rudimentary stage of development.

Cekan (1990) has developed an approach which has possibilities. Her focus on strategy categories[6] could be combined with an incorporation of external variability (including outside interventions) to produce a useful multidimensional model.

Another recent effort by the University of Arizona and USDA/OICD (1991) has made the most progress toward that end. This model incorporates multiple internal and external conditions (called strategy determinants) and multiple possible interventions.

Building on these efforts, the model needed for famine mitigation must become more systems-oriented (e.g. include feedback, multiple external conditions and multiple endpoints) and reflect the influence of asset-enhancement on effectiveness of coping strategies.

None of the models mentioned above makes any effort to incorporate the possibility of multiple coping strategies in response to varying situations. The explanatory power of such an approach would, however, add a great deal of rigor to these systematizations.

The best of these models detail stages in particular sectors (such as food grain disposal; McCorkle, 1987) closely enough, that movement toward models incorporating multiple coping strategies and asset enhancement could occur if a broader time frame were examined and changing external conditions were included in a systems model.

However, the usefulness of these models in famine relief may never be matched in famine mitigation:

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[6] Cekan's (1990) categories include: intensification (including intercropping, multiple cropping and cereal and food storage, substitution (crop substitution--wholly abandoning certain crops, substitution of foods, pastoralists becoming agriculturalists, wild foods, increased cash cropping), extension (no annual cropping, reliance wholly on wild foods, CFW, FFW, sale of productive assets) and abdication.

> *"To anyone familiar at the practical level . . . with all the factors that can distort the real behavior of such systems, such modeling efforts are extremely simplistic and naive. They cannot be used in any way as predictive models capable of giving guidance on specific issues, or of producing information directly useable by decision-makers." (Rykiel, 1984)*

Fortunately, an approach stressing multiple coping strategies and asset-enhancement does not require a complete model of famine onset. Instead, the need is only to determine the most widely useful coping strategies, not to systematize all possible coping strategies occurring in famine situations. In fact, the most useful famine mitigation interventions will be those which improve the largest number of coping strategies at the largest number of stages in famine onset and are not focused narrowly on any particular one.