

RELIEF AND DEVELOPMENT:
BEAN SEED MARKETS IN HONDURAS AFTER HURRICANE MITCH

By

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1 Introduction

1.1 Problem statement and research questions

In October 1998, Hurricane Mitch hit Honduras, bringing high winds, heavy rain, and floods that caused horrendous human losses and devastated the country's civil and economic sectors. The agricultural sector suffered the heaviest damage with large scale destruction of crops, livestock, land and infrastructure. The heavy losses to maize and bean harvests were a special cause for concern as these crops are central to domestic food security due to their role as income generators and food for producers and consumers in the country. In response to the threat of food insecurity in the rural areas immediately following Mitch, the government released strategic grain reserves and solicited food aid imports, while non-profit and relief organizations established food-for-work programs and food distribution camps. Recognizing the impact that lost harvests had on the supply of seed, measures were also taken to ensure that farmers would have seed to plant in the coming *primera* season. The seed relief programs focused heavily on bean seed, as the late season (*postrera*) bean crops had suffered losses of 50%, and it was feared that shortages of planting material would delay the recovery of bean production (Global Information and Early Warning System, 1999).

Many of the emergency seed provision programs also attempted to address underlying weaknesses in the seed system that were felt to have exacerbated the problem of seed shortages following the hurricane. These weaknesses included the limited diffusion of improved varieties, deficient systems for seed production and marketing, and the generally degraded quality of bean seed in many areas.

The arguments for linking relief and development strategies are well documented in the literature (see for example Cuny, 1983; Anderson and Woodrow, 1991; and Buchanan-Smith, 1994). Building on this literature, approaches have emerged for creating programs that address institutional, political, technological, and economic aspects of populations' vulnerability to disasters, that recognize the role of shocks in exacerbating vulnerability, and that encourage the utilization of local capabilities in relief programs as a means of improving the effectiveness and efficiency of relief efforts. There is insufficient analysis, however, of how disasters affect rural economies, and how relief strategies in these economies should vary in terms of their requirements and strategies by which they can be effectively carried out, especially in communities showing differing levels of market development. This gap means that there is insufficient information for use in the development of a framework for integrating the design of relief strategies into the processes of economic development so that they integrate with and bolster the larger developmental process that is occurring in the economy.

Agriculture is an appropriate focus for the development of such a framework as it is typically characterized by a wide divergence between subsistence-oriented producers and more commercially-oriented producers, and so manifests a heterogeneity of market types which are representative of stages in the market development process. Theories on the development of agricultural markets provide a perspective from which we can consider relief interventions as an integral part of the larger environment in which market development takes place.

This paper addresses this research need through the development and application of a conceptual framework for analyzing the effects of a major shock—Hurricane Mitch, on Honduras’s agricultural sector. While both output and input markets provide appropriate material for consideration, the problems of relief interventions for input markets have been little examined and merit attention. Seed markets in particular provide an interesting case for study as the development of seed markets generally entails a shift in reliance on seed from local sources to externally-obtained seed, while local systems for seed production and distribution retain an important role at all stages of development.

Using the case of bean seed markets in Honduras, the paper addresses three research questions:

- What effects can we expect, on the basis of economic theory, that a shock will have on seed supply and demand, and what empirical evidence of these effects can be found?
- Does the developmental status of a seed market condition farmers’ responses to a shock’s effects? What do theoretical expectations and empirical evidence indicate regarding farmers’ options and responses in seed markets that show differing degrees of development?
- How does the performance of different approaches to seed relief vary across stages of market development?

1.2 Outline of the paper

The paper first establishes the context for Honduras's bean seed markets and characterizes them prior to Honduras Mitch. Next, it presents a conceptual model which identifies the developmental stages of seed markets, analyzes the determinants of supply and demand in markets for bean for consumption and seed, and presents hypotheses that respond to the research questions. In the following section, the hypotheses are tested using case studies of bean seed markets in Honduras, then results are discussed. The paper concludes with a summary of the key lessons from the research, implications of the research results for the design of seed relief interventions in different seed market environments, and issues requiring further research and limitations of the study are identified.

1.3 Methods and data sources

The paper draws on literature on post-emergency relief operations and agricultural market development to develop the theoretical framework and hypotheses. Hypotheses are addressed through empirical research which was conducted in Honduras during the summer of 1999, nine months after Hurricane Mitch. The timing of the field research (which followed the relief seed distribution and *primera* planting but was before the *primera* harvest or subsequent *postrera* season) did not permit first-hand research to quantify the results of the distribution in facilitating recovery of bean area and yields. However the study was appropriately timed to assess the specific research questions addressed in this paper as the disaster and initial relief activities were past permitting

research on their initial effects, but little enough time had passed for the issues and information to still be fresh in the minds and experiences of the key informants.

The hypotheses were addressed using a rapid appraisal and case studies which relied on the collection and analysis of both primary and secondary information. Key informant interviews were conducted with national level agents in government, the non-governmental community, and agents in the seed industry; and a survey of the seed activities of eighteen major agricultural development projects was conducted. The case studies were implemented in three bean production areas, each of which represented seed markets at different levels of development. Field research in the case study areas focused on the collection of data to assess: 1) the status of the local seed market prior to Hurricane Mitch, 2) the effects of Hurricane Mitch on the seed system, 3) the scope and nature of seed relief activities, 4) the performance of these relief activities in alleviating the immediate seed insecurity resulting from Mitch, and 5) the relief activities' effects on local seed markets. Qualitative data was collected in each case market area using key informant interviews of project personnel, community leaders, farmers, organizations that provided seed in the wake of Mitch, and local input suppliers. A roster of persons interviewed is provided in Appendix A.

2 Background—Beans and bean seed in Honduras

2.1 Bean production in a dualistic context

According to CADESCA's *Characterization of Honduras's Basic Grain Producers* (1990), and consistent with general theory on agricultural development, Honduras's bean producers can be characterized as following either a "campesino" or "commercial" rationale for their production. Campesino production is oriented to the reproduction of the production unit and household, with the production of basic grains for household consumption being a primary activity. These farmers tend to be identified with traditional production practices and limited access to and integration with markets that could catalyze the transition to a more commercial orientation. Commercial producers, on the other hand, exhibit strong linkages between the farm and the market for inputs, output, and labor, and a predominantly commercial orientation to production (CADESCA, 1990). In Honduras, bean is primarily a smallholder crop, and 70% of Honduras's bean farms operate under "traditional" production systems, with less than 0.87 hectares of bean area cultivated each year, while the average bean area farmed is only 1.06 hectares nationally (Departamento de Información Agrícola, 1998).

The expansion of output markets is a crucial catalyst to the development of a commercial orientation to farming. In Honduras, where demand for beans grew by an average of 3.4% per year during the 1990s, the profitability of bean production has increased rapidly and has overtaken other major crops such as maize, as seen in Figure 1. Expanding output markets create incentives for farmers to invest in productivity-enhancing inputs and technologies which, in turn, creates linkages with upstream suppliers

of inputs and ancillary services such as credit and farm machinery services. This shift from more subsistence-oriented production to a commercial focus does not, however, occur evenly throughout the country, as farmers' access to these markets is dependent on the presence of infrastructure and proximity to market areas. Thus, while the profitability of bean production has been increasing, different regions have responded to varying degrees to these new market opportunities, with regions that are closer to wholesale markets showing greater increases in production and productivity compared to areas that are more isolated. For illustration, the map of Honduras in Figure 2 shows the distribution of production across Honduras, with marketed-oriented production concentrated in higher potential areas that are close and well-connected (i.e. by all-season roads) to the major cities of Tegucigalpa and San Pedro Sula.

2.2 Bean seed in Honduras

2.2.1 Importance of seed

Agricultural intensification through the use of improved varieties is a primary means of

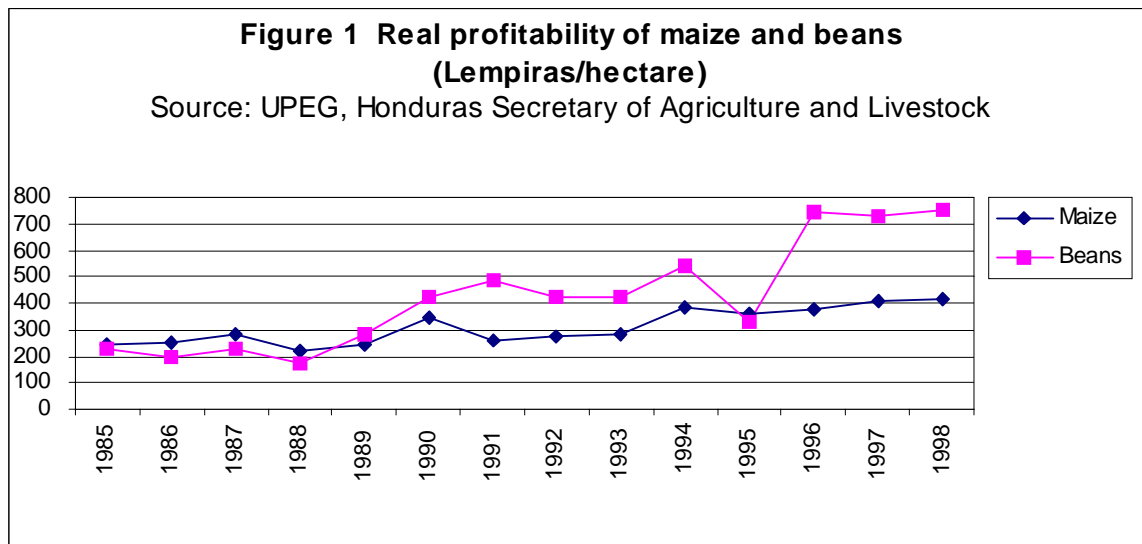
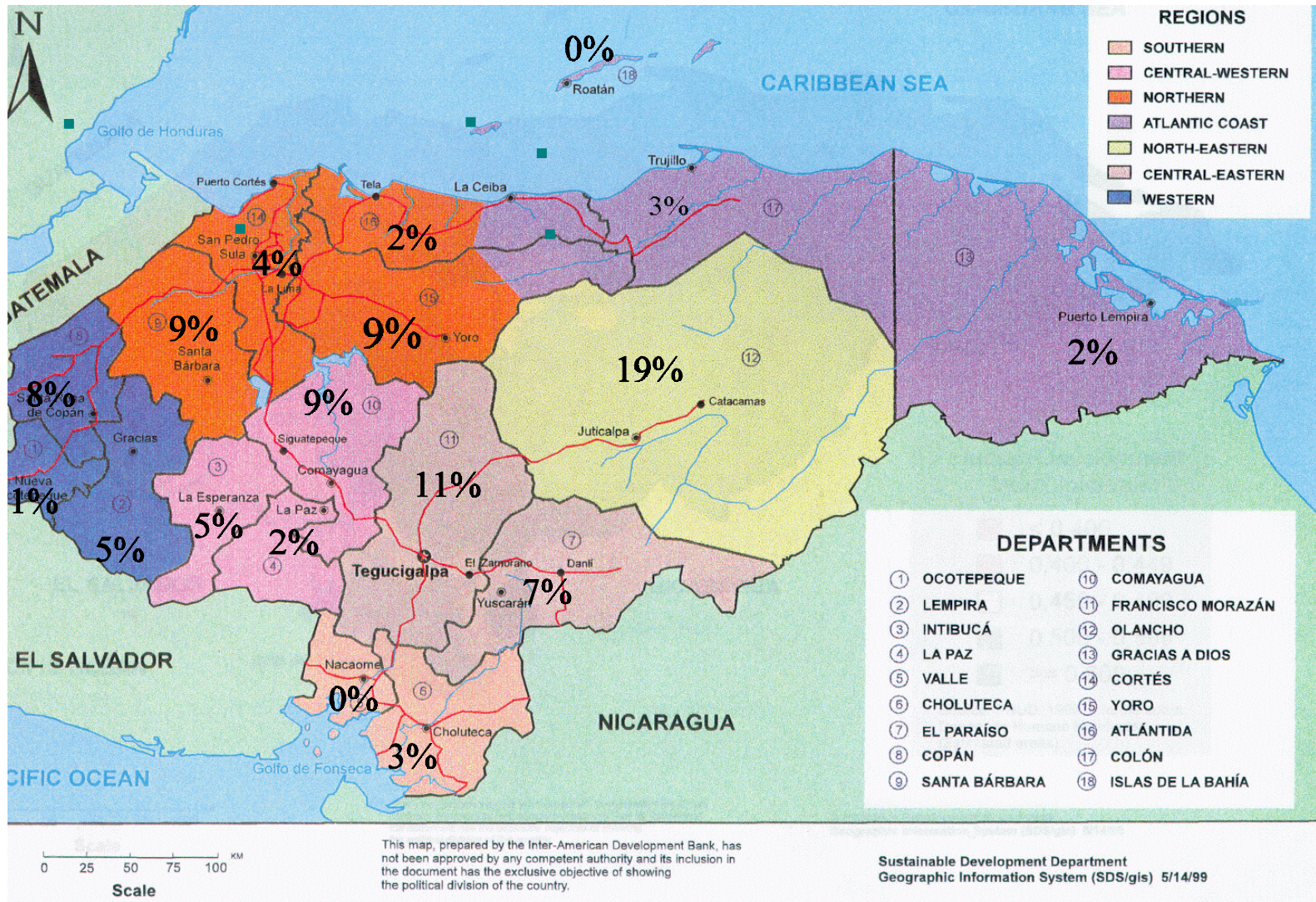


Figure 2 Distribution of Bean Production in Honduras (1993)



increasing the productivity and incomes of small farmers in a sustainable and economically competitive manner (Cromwell, Friis-Hansen et al., 1992). In Honduras, improved bean varieties such as *Tio Canela* and *Dorado* offer high yields and resistance to major diseases such as the *Bean Golden Mosaic Virus*, and perform well in the low-input production systems that are typical of Honduras's bean producers (Rosas, Castro et al., undated). Because of their scale-neutrality, potential to increase the yield frontier, and on-farm reproducibility, improved varieties are considered one of the best means available to increase the productivity and incomes of small bean farmers, as well as aggregate bean production in Honduras (Martel, 1998).

2.2.2 Demand for bean varieties

Demand for bean varieties is influenced by the varieties' genetic properties (e.g. yield potential, disease resistance and maturation time) and the presence of characteristics sought by processors and consumers. There are marked differences in the performance of indigenous/local varieties and existing improved varieties with respect to these issues. In general, improved varieties tend to have advantages in terms of their production characteristics in many areas of Honduras, with the exception of some specific agro-ecological niches where they perform poorly relative to local varieties that are specialized to these niches. Improved varieties can also be preferred by processors, as increasingly sophisticated urban markets and agri-business processors look for a homogeneous product which facilitates grading, processing, and marketing. Such demand is not met by bean

produced with most local seed sources that tend not to keep heterogeneous local varieties separate, leading to considerable variation in appearance within individual bean shipments.

In some cases several of the improved varieties that have been produced in Honduras have faced price discounts when marketed direct to consumers (i.e. not to processors) because their color is darker than consumers prefer. However, a 1995 survey showed that, because the increased yield that these varieties offered more than compensated for any price discounts that existed at that time, farmers' revenue was not hurt. Accordingly, the survey found that the use of improved varieties in commercial areas was high (Martel-Lagos, 1995).

Among subsistence producers, however, the local orientation of production encourages farmers to grow local varieties that are preferred for their color and cooking characteristics (Martel, 1998). Potential demand for improved varieties among subsistence producers in some areas is also limited by the unavailability of improved varieties that are appropriate to specific agro-ecological environments. This is seen, for example, in some parts of the Department of Lempira where the mountainous terrain creates agro-ecological niches in which currently-available improved varieties perform poorly (PROLESUR, undated).

These factors, along with the curtailed distribution of certified seed of improved varieties and heavy reliance on informal systems that have limited scope for genetic improvement, are reflected in the limited use of improved bean varieties in many areas of Honduras. In some areas, increasing market integration can be a means to increase

demand for newer bean varieties that offer a more standard product and offer yield and productivity advantages (Almekinders, Louwaars et al., 1994).

The use of improved seed is heavily concentrated in regions with a commercial orientation to bean production (Martel, 1998). For example, in the Mid-eastern region which accounts for about 30% of Honduras's annual bean production, 71% of bean farmers planted recently released improved varieties. Even within the region, however, adoption rates are found to be positively correlated with farmers' proximity to market centers (Viana et. al, 1997). In contrast to the high use of improved varieties in more commercial bean production areas, in Lempira Department, where farmers have weak links to bean markets and limited access to improved seed, only 5% of producers are estimated to be using improved varieties (PROLESUR, undated). Consistent with the tendency for larger producers to have a commercial orientation, the use of improved seed is concentrated among medium (10-50 hectares) and large farmers (>50 hectares), representing 24% and 46.5% of the area that these farmers cultivate annually. In contrast, small farmers (less than 10 hectares) sow less than 5% of their bean area with improved seed (CADESCA 1990 p.70).

2.2.3 Supply of bean seed

Two organizations are involved with developing improved bean varieties in Honduras. These are the Escuela Agricola Pan-Americana (a.k.a. Zamorano), an agricultural university with a mandate in bean breeding, and the Secretary of Agriculture's National Bean Program. The seed of promising new varieties is distributed by these organizations,

commercial seed suppliers, and governmental and non-governmental agriculture development projects. The slow diffusion of improved bean varieties and other productivity-enhancing technologies has been cited as a major constraint to improvements in bean production in Honduras (Martel and Bernsten, 1994; Bernsten and Mainville, 1998).

Farmers acquire seed through three main channels: Suppliers of certified seed, public and non-governmental (NGO) agricultural development projects, and informal sources such as local grain merchants and seed saved from harvests.

2.2.3.1 Certified seed suppliers

The two major commercial producers of certified bean seed are Zamorano which multiplies seed of the varieties it has developed, and Hondugenet, a private company that produces and markets seed of basic grains and bean. These two organizations produce approximately 70% and 30% respectively of the 200 tons of bean seed that is marketed annually, utilizing both their own land and contract farmers to grow seed. This seed is sold to individual farmers and agricultural development projects from Zamorano and Hondugenet's processing facilities at prices approximately double the market price of beans for consumption. Hondugenet also distributes through a limited number of input retailers. Prior to Hurricane Mitch, seed was only marketed in 50 lb. bags, although the post-Mitch relief effort, which was targeted to small farmers via distribution through agricultural development projects, led to seed being packaged in 10 lb. bags, a change which is expected to persist. The limited commercial distribution of certified seed, its

price, and until recently the large packages, are issues on the supply side that have severely hampered the use of certified seed by small farmers.

2.2.3.2 Agricultural development projects

In addition to the two large marketers of certified seed, non-governmental and public agricultural development projects provide seed to farmers by purchasing and then redistributing certified seed, by multiplying their own seed, or by promoting local artisanal seed projects. These seed provision initiatives are generally not based on cash sales due to farmers' economic constraints. Instead they utilize credit agreements (cash or in-kind), or introduce seed into rotating funds that require farmers to return an equal or double amount of the seed received after harvest for subsequent redistribution.

2.2.3.3 Informal sources

Informal sources, including farmer-saved seed, seed from neighbors, and the grain market, are the most important source of seed for farmers (in terms of the bean area sown). When farmers seek seed from local sources beyond their farm, exchange is generally made on the basis of social relations or at prices at par with beans marketed for consumption, making it an affordable source of seed. However the yield potential of seed obtained from local informal sources is typically low due to varietal mixing and degradation and the transmission of seed borne diseases. In agricultural zones for which appropriate improved varieties have been developed, limited diffusion and the continued prevalence of traditional varieties that are low-yielding and vulnerable to local pests severely constrain improvements to bean productivity.

2.2.4 Status of bean seed markets

Honduras's bean seed markets generally shows low levels of development due to constraints in supply, demand, and marketing and distribution.

Prior to Hurricane Mitch, the distribution of certified bean seed was concentrated in the areas of more commercial bean production, and its marketing was oriented to larger, commercial farmers. The lack of competition in the provision of certified bean seed is reflected in a heavily concentrated and centralized bean seed supply.

Recent analyses have identified deficiencies in the production and marketing/distribution components of the bean seed system as among the key factors limiting the diffusion of improved varieties to Honduran farmers (Bernsten, 1998; Martel, 1998). Current low demand for improved seed and high risk in seed marketing constrain private incentives to market seed commercially or otherwise invest in developing markets that show weak demand. These disincentives arise in part due to the structure of the bean subsector in which the bulk of production is carried out by large numbers of geographically-dispersed small farmers who have limited access to commercial seed suppliers, while also lacking information about new varieties and the benefits of improved seed.

In some areas of the country, demand for certified seed is further limited by farmers' preferences for seed from local sources which they prefer because they are able to observe the performance of the source crop in the field, and because the social, non-profit nature of local exchange minimizes the risk of opportunistic behavior on the part of the seed provider.

In recognition of the constraints to seed markets, many agricultural development projects have undertaken their own activities to multiply and distribute seed to beneficiary farmers. Generally these projects have the objective of improving bean productivity by upgrading degraded seed stocks and increasing the diffusion of improved varieties (Viana Ruano, 1998). A survey of major agricultural development organizations with bean seed projects indicates that these activities most commonly involve either revolving seed funds or artisanal projects, although projects with commercial focuses have recently gained popularity.

3 Conceptual framework

3.1 Stages of seed market development

Seed system development is addressed extensively in the literature (see for example, Douglas, 1980; Pray and Ramaswami, 1991; Jaffee and Srivastava, 1992; Rusike and Eicher, 1997; Morris, Rusike et al., 1998; Maredia et al. 1999). This section draws from the literature to build a three stage model of seed market development and link the developmental stages to the status of output markets for beans.

3.1.1 Absent seed market

The earliest stage of seed system development is commonly referred to as the *traditional stage* in seed system literature, and is characterized by an ***absent seed market***. Here, farmers mainly produce crops for subsistence, although they may market their incidental surpluses. In addition, infrastructure and input and output markets are underdeveloped. Farmers have little familiarity with improved varieties or external sources of seed and rely almost exclusively on the informal seed system for their planting needs. Furthermore, the lack of an expanding output market inhibits investment into productivity-boosting inputs such as improved seed, leaving little incentive for commercial firms to market seed in these areas. Projects to strengthen seed security in an absent market environment often rely on non-market solutions such as injecting seed of new varieties into the informal system (Thiele, 1999) and improving local capacities for seed selection and storage, while strengthening linkages to the formal sector for inputs such as new varieties and technical assistance (Almekinders, Louwaars et al., 1994).

In areas where incentives for investment into commercial bean production have increased due to growth in market demand, productivity increases may be constrained by the limited adoption of improved varieties. Here, the failure for a seed market to emerge may be a result of the low exposure of farmers to the benefits of improved seed. In such instances, market development efforts should focus on increasing farmer exposure to the benefits of improved seed, while simultaneously strengthening local capacity to multiply and distribute new varieties. By expanding the awareness of the benefits of improved seed, these efforts can lay the foundation for a willingness to pay for seed. This in turn, if combined with expanding derived demand for bean seed due to a dynamic output market, will help to induce commercial investment and allow a more dynamic seed market to emerge.

3.1.2 Emerging seed market

The second stage of seed market development is characterized by an *emerging seed market*. This stage is observed in areas where market opportunities motivate the production of bean in excess of local needs, thereby inducing farmers to use productivity-enhancing inputs including improved seed. The availability of a profitable output market is crucial to the development of dynamic commercial input markets as it determines both the volume and types of seed that farmers demand, and thus the incentive to supply seed commercially (Rusike and Eicher, 1997; Tripp, 1997). At this stage, however, the expansion of the seed market may be impeded by farmers' unfamiliarity with the benefits of improved seed. In addition, farmers' unfamiliarity with commercial seed sources may

make them reluctant to abandon customary local informal sources which are more familiar and trusted. In contrast to commercial seed sources, local, socially-delineated exchange relationships minimize the risk of opportunistic behavior on the part of the seed provider. Strategies to promote the expansion of emerging stage seed markets emphasize developing institutions, such as quality certification programs, that reduce the transactions costs¹ of commercial seed exchange (Tripp, 1997), and increasing farmers' exposure to the benefits of improved seed, for example through community-level demonstration plots. On the supply side, the low level of market demand continues to inhibit commercial investment in seed provision which serves to perpetuate the cycle of low exposure and low demand among the farmers. Thus, it is necessary to increase the availability of quality seed locally to increase farmers' exposure to and willingness to pay for the seed, and stimulate the development of the seed market.

3.1.3 Growth seed market

The third stage of seed market development is referred to as the *growth stage*. At this stage, farming systems characteristically have a predominantly commercial orientation, and farmers commonly use packages of purchased inputs including certified seed of high-yielding varieties. Farmers are therefore familiar with a variety of seed sources, including

¹ Transactions costs include the costs of searching for alternative seed sources, obtaining information on their product, negotiating a contract with the seller and seeking recompense if the product is faulty. If farmers incur very high transaction costs in acquiring seed from unfamiliar sources (i.e. commercial sources of certified seed), then these costs can overcome the productivity benefits of using improved seed, making it more economical to continue using less productive, local seed, whose acquisition involves lower transaction costs (Rusike and Eicher, 1997).

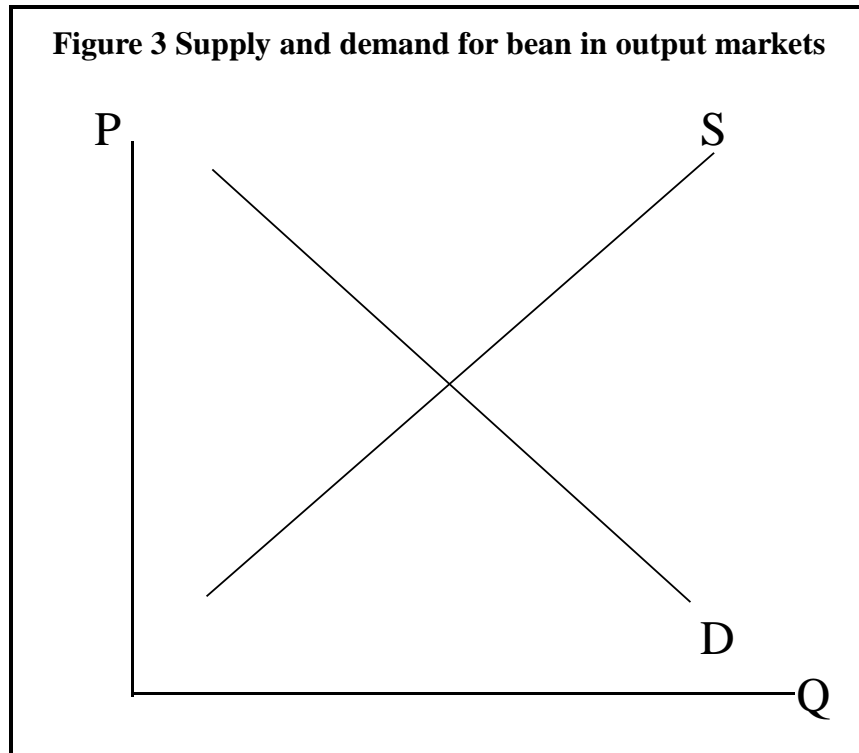
commercial input suppliers as well as the local sources that they have customarily used. Because non-profit organizations often take a role in promoting development at the earlier stages, the transition to the growth stage and a larger role for the private sector can potentially be inhibited by the failure of the non-profit sector to adapt their role to one of facilitation of the market rather than direct provision. At the same time, however, there may be a lack of competition in the seed industry as new firms haven't yet had a chance to enter and compete. Strategies to relax these constraints involve encouraging competition and promoting commercial investment in input supply, and include a role for non-profit (public and non-governmental) organizations in ensuring that institutions are in place (e.g. certification, labeling guidelines) that decrease the transactions costs in exchanges between farmers and seed dealers.

3.2 Model of bean output and seed markets

This section presents a simple conceptual framework of supply and demand in bean seed and output markets, and the linkages between these markets. Figure 3 shows supply and demand in markets where beans are marketed for consumption. Here, bean demand (D_b) is a function of a vector of prices (P) for beans as well as complementary and substitute goods, consumers' incomes (Y), and other demand shifters (N) such as consumer preferences and population. Bean supply (S_b) is a function of a vector of output and input (production and marketing) prices (P) and other exogenous supply shifters such as weather and quasi-fixed capital (X).

Bean demand: $D = f(P, Y, N)$

Bean supply: $S = f(P, X)$



Supply and demand in the market for bean seed is directly influenced by the output market. Given the possibility of acquiring seed from either local sources, including grain markets, or commercial sources, the supply of bean seed (S) is a function of a vector of prices (P) that includes the bean market price (for local seed) and the commercial seed price and costs of seed production, inputs, and marketing, as well as exogenous supply shifters (X) such as quasi-fixed inputs and weather. Demand for seed (D) can be differentiated between demand for commercial (D_c) or local (D_l) seed, and is a function of the vector of bean output and input prices (P) which determine the profitability of bean

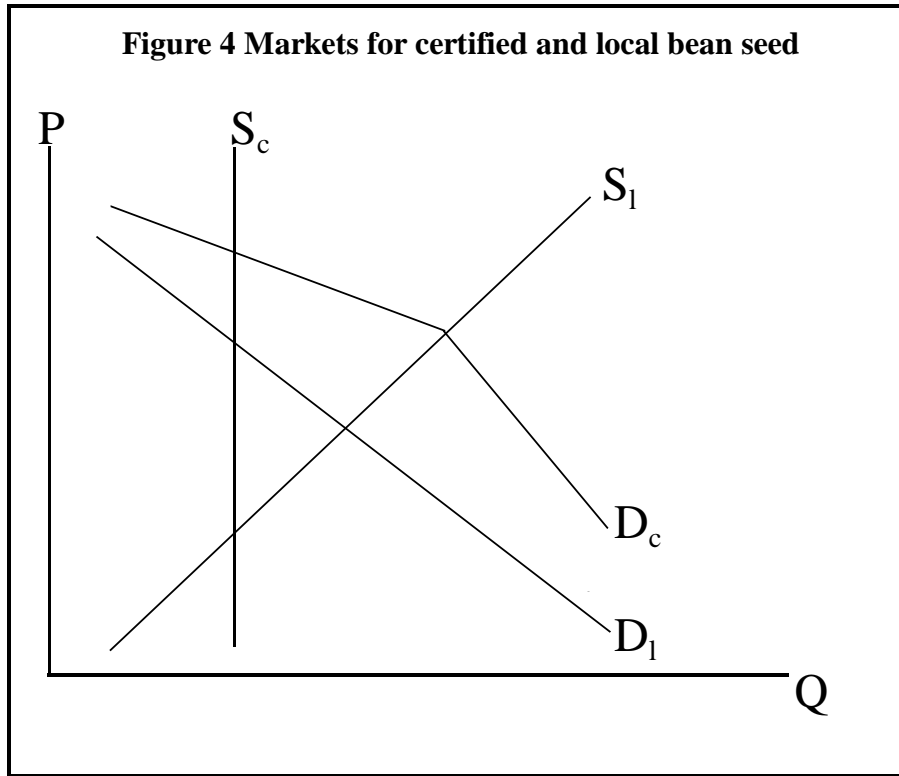
production and include the relative costs of acquiring seed from competing sources (local markets or commercial), the ability to demand seed (Y) which is determined by farmers' incomes or access to working capital, and exogenous shifters (N) including farmers' perceptions of the quality of the seed and its appropriateness to their production systems.

As shown in Figure 4, the demand curve for commercial seed shows a kink at the point where commercial seed prices rise above the price of its main substitute, local bean (Wiggins and Cromwell, 1995). At this point, because certified seed must compete on quality attributes alone rather than price and quality, the demand curve becomes more elastic. On the other hand, The demand for local seed is quite inelastic as the volume of commercial seed that is marketed is small relative to the total quantity of seed planted. Thus substitutes are limited and higher prices in the output markets do not push down bean demand because they increase the incentive to cultivate bean for home consumption or sale.

3.3 Hypotheses

3.3.1 Effects of a shock on supply and demand in bean markets

A disaster like Hurricane Mitch, which has pervasive effects on the resource base, economy, and civil structure, will affect seed and output markets for beans in numerous ways. These effects will be manifested through shifts in the supply and demand curves for bean seed and bean for consumption. Together, the effects of a shock on supply and demand will alter the quantities and prices of bean and seed that are traded and the ability of farmers to purchase seed to replenish their own planting stock.



Shocks to harvests, food markets, and infrastructure will shift the supply curve for commercial and local bean seed inward. Farmers, accustomed to saving seed from their harvests or acquiring it from neighbors or local grain markets, will be forced to respond by acquiring seed from alternative sources (such as commercial input suppliers that sell certified seed), paying more for seed from their customary sources, and/or by reducing their consumption of bean seed by decreasing the area they plant or their seeding rates.

A disaster will also generally cause a demand-side shock by reducing farmers' effective demand for seed thereby shifting the demand curve inward. Farmers' effective demand is reduced due to losses to income that result from the disaster, for example lost revenue due

to the loss of a crop or a job, or the need to make emergency expenditures after the disaster, such as for housing repairs, food purchases, etc. (Hammerton, Calixte et al., 1984). The effects of a shock on consumers' and producers' incomes will also affect demand for seed, by affecting derived demand for bean seed and by affecting farmers' ability to afford seed purchases. These effects will be observed as inward shifts in demand for seed from both local and commercial sources.

3.3.2 Farmers' options and responses in different market contexts

Farmers options and decisions on how to respond to a supply or demand shock will be influenced by the developmental status of the seed market (Almekinders, Louwaars et al., 1994). In markets that are more advanced in their development, so that farmers have stronger market linkages, farmers are expected to have greater access to and capacity to use alternative seed sources when their customary local sources fail. At lesser levels of market development, farmers are expected to have decreasing access to and awareness of alternative seed sources, and less capacity to accommodate demand shocks by transferring their demand for seed to alternative sources.

For example, given a supply shock in a growth stage market, the unavailability of local seed will cause an increase in demand for seed from commercial or other formal sources. In contrast, in the emerging stage seed market environment, given the lack of familiarity with alternative sources of seed, farmers are likely to reduce their bean area as a result of a shock despite the possibility that seed is physically available and accessible from other sources. Likewise, farmers in an absent stage seed market will have the least familiarity

with and access to alternative sources of seed. Lacking effective interventions to mitigate these effects, they are most likely to reduce their use of bean seed after a shock until stocks recover locally.

Similarly, the implications of a demand shock will differ among markets that are at different stages of development. In a growth stage market, it is expected that linkages to outside markets and the presence of markets for credit, as well as the likely greater financial security of farmers in such markets, will help farmers recover from demand shocks by allowing them to borrow or tap into savings or other wealth stores to make necessary purchases of seed.

In the emerging and absent seed market environments, however, it is expected that farmers' strategies to recover from a demand shock will necessarily be more reliant on local systems. The use of local networks based on social relations to lessen the effects of a seed shortage may be adequate if not all households in a community suffer losses, but may be insufficient if the shock affects the entire community severely.

3.3.3 Effects of interventions in different market environments

Relief seed interventions attempt to reverse the effects of supply and demand shocks to the seed system by a variety of methods. Specific interventions can be characterized as lying along a spectrum of relief activities ranging from those that act directly to mitigate the supply or demand shocks to those that rely on less direct, more market-based activities. Different approaches will have differing effects on the seed market. For example, on the supply side, distribution of bean for consumption as part of a food aid

package is a non-market intervention. Yet, it affects the local price of bean in the market even if the bean that is distributed itself can't be planted because of uncertainty about its variety or quality. Alternatively, strategies that release bean seed can rely on the market to varying degrees depending on whether the seed is distributed direct to farmers or through seed dealers. On the demand side, in-kind vouchers that permit farmers to acquire seed from local dealers or the provision of credit for agricultural inputs, including seed, also have varying degrees of reliance on the market versus direct intervention.

The appropriate intervention will depend in large part on the developmental status of the market. In general, it is hypothesized that farmers in markets that are more developed (i.e. the growth market) will be aided most and see the least disruption in their existing systems through market-oriented interventions. In contrast, farmers in progressively less-developed seed market contexts will have their needs met most efficiently and effectively through more direct, non-market strategies such as provision of seed direct to farmers.

4 Bean seed markets after Hurricane Mitch

Hurricane Mitch, which passed over Honduras between the 28th and 31st of October 1998 devastated the country's productive sector, infrastructure, and civil sector. The heaviest damage, in terms of the value of damages and cost of reconstruction, fell to the productive sector, which sustained 70% of the Hurricane's damage. Within the productive sector, agriculture was the worst affected as the heavy rains, high winds, and floods destroyed crops, killed livestock, and severely affected the land base and production and marketing infrastructure.

4.1 Hurricane Mitch and the bean seed market at the national level

4.1.1 Effects on seed supply

The bean crop suffered heavily as the catastrophe occurred just prior to the *postrera* (August to November) harvest, which normally accounts for 65% of the country's annual bean production. Approximately 50% of the season's production was lost, with regional losses reaching 80% in the Southern, Atlantic Coastal, and Northern regions. The accumulated impact has been estimated at a 35% reduction in bean output for the 1998/99 crop year (Global Information and Early Warning System, 1999).

Interviews with key informants at the national level indicated that the bean crop losses severely reduced the availability of seed for farmers to plant. The availability of seed from farmers' harvests was decimated, and the beans that were harvested tended to be of very poor quality due to excessive humidity. Farmers' most common alternative to their own saved seed, the grain market, was also severely affected by the crop losses. The importance of the *postrera* harvest to national bean production and the loss of the crop

meant that there was a bean shortage in the market, resulting in increases in wholesale bean prices in the period immediately following Mitch. These high prices persisted until the government was able to take ameliorative action through the release of strategic reserves and imports. Though this helped to relax the shortage of bean on the consumer market, it did little for the seed situation as the bean that entered the market through grain reserves was not necessarily fresh enough for planting, and the imports were frequently of types or varieties unknown to farmers. For example pinto beans were distributed for consumption as a substitute to the red beans that are customarily cultivated and consumed in the country.

Apart from the losses to harvests and shortages in grain markets, production of certified seed was also affected by Mitch. Although figures are not available to estimate losses to commercial bean seed growers, it is anticipated that they likely matched those of other bean growers in the areas where they were produced, and resulted in a severe economic loss for bean seed growers.

4.1.2 Effects on seed demand

At the national level, the effect of Mitch on seed demand was manifested by a shift away from dependence on grain and local seed markets (which were suffering seed shortages) to greater reliance on national grain and commercial seed markets. For the most part, this shift in demand was not accounted for by individual farmers. Instead, it was the result of the actions of the NGOs and other rural and agricultural development projects that attempted to acquire seed for their constituent farmers, resulting in a cumulative surge in demand. Though the economic losses that Mitch occasioned

throughout the country were severe, the organizations' ability to buy seed was not itself compromised due in large part to an influx of relief funds that were in many cases earmarked specifically for emergency seed provision.

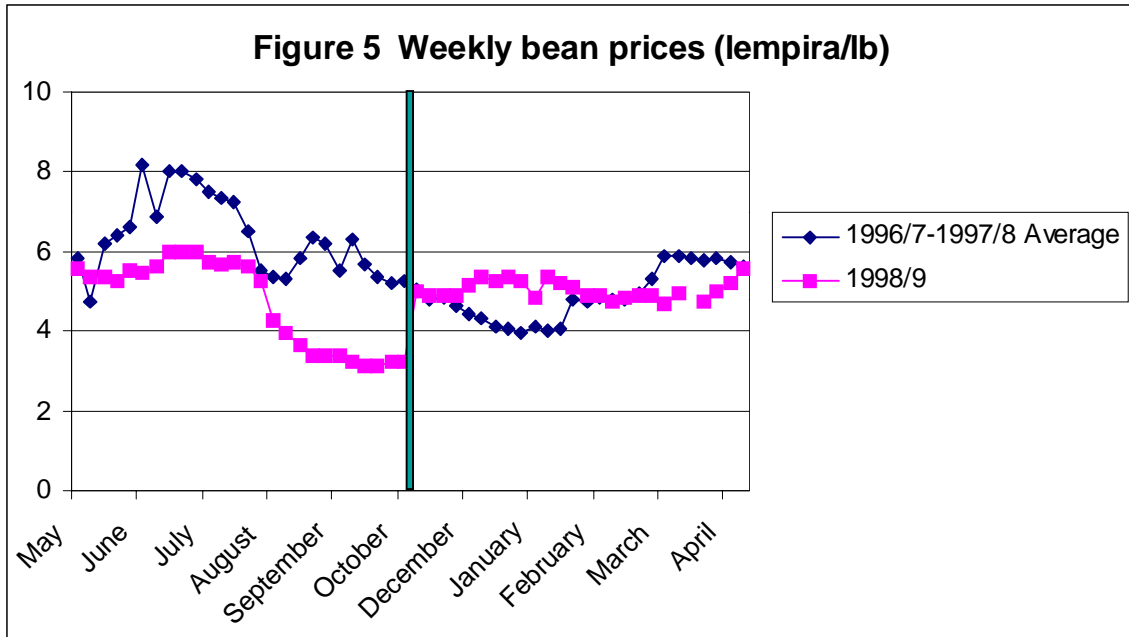
4.1.3 Effects on seed distribution and marketing

The shift in seed demand meant a change in the distribution channels for bean seed. The large scale effort to acquire bean seed on the part of agricultural projects meant that seed was diverted from the commercial distribution channels, and thus no longer available to individual commercial farmers from their customary outlets. This was the case for seed produced by both Zamorano and Hondugenet (Martinez, 1999; Moncado, 1999). A further change that was seen due to the shift in distribution from larger commercial farmers to smallholders was that the seed quantities that were packaged in individual bags were reduced from 50 pounds to 10 pounds (by Zamorano) or 25 pounds (by other organizations such as the International Center for Tropical Agriculture (CIAT)) in order to more closely match seed quantities with smallholders' bean seed needs.

4.1.4 Effects on seed prices

Significant fluctuations in bean prices were seen in wholesale markets, due first to the crop loss and subsequently due to the release of reserves and food aid. This is shown in Figure 5 which compares bean prices in 1998 to average prices in 1996-97, and shows a sharp increase in prices in November, at a point when the *postrera* harvest would normally be causing prices to decline. Despite the price fluctuations, and despite the large increases

in demand for certified seed, prices for certified bean seed did not change significantly in the aftermath of Mitch. This was because of an unspoken commitment of the major



producers, Zamorano and Hondugenet, to maintain stable prices in order to avoid speculation and to facilitate the accessibility of seed to farmers who had been adversely affected by Mitch.

4.1.5 Post-Mitch seed interventions at the national level

Following Mitch, the response of development organizations undertaking relief activities and the major seed producers was largely oriented towards increasing the accessibility of bean seed to farmers to speed their recovery, and also involved longer term investments to mitigate the seed system weaknesses that were perceived to have caused the initial vulnerability to the seed crisis.

Both Hondugenet and Zamorano, as well as several NGO and public development organizations that had their own seed projects, increased their production of improved seed so that quality bean seed would be available to farmers for the *primera* (May to August) planting. Zamorano and CIAT provided seed to agricultural development organizations for distribution to farmers in their constituent communities throughout Honduras. Immediately after Mitch, many projects also bought beans from local markets in order to retain local varieties for use as planting material rather than consumption. The Secretary of Agriculture also responded by temporarily loosening marketing requirements for seed, allowing the sale of seed that had only undergone laboratory tests for germination rather than requiring that seed producers comply with the entire certification process as is normally required.

The acute seed crisis that Mitch caused also brought to the forefront the issue of the underlying weaknesses in the seed system, namely the reliance on two major producers and chronic under-supply of seed, matched by poor a capacity to produce and market bean seed at the local levels. A widespread response on the part of the development projects in rural areas, as well as some of the larger organizations such as Zamorano and CIAT was to support the creation of local seed enterprises and/or rotating seed funds. In order to decentralize the seed supply and increase local self-reliance in seed. Nascent seed enterprises and rotating seed funds have benefitted from the distribution of certified seed that took place after Mitch, as this distribution has served as an initial injection of capital into the projects. The new projects have likewise increased the impact of the post-Mitch

distribution by requiring redistribution of second generation seed among farmers who did not benefit from the initial distribution.

At the national level, three benefits of the relief seed distribution are popularly recognized, though not yet formally quantified. The first benefit was the alleviation of seed shortages—an estimated 25,000 Honduran smallholders, representing more than 20% of Honduras's bean farmers received seed in the initial distribution². Typically organizations distributing the seed stipulated that farmers must return seed (an amount equal or double to what they received) for redistribution to other farmers, thus increasing the coverage significantly for the *postrera* planting.

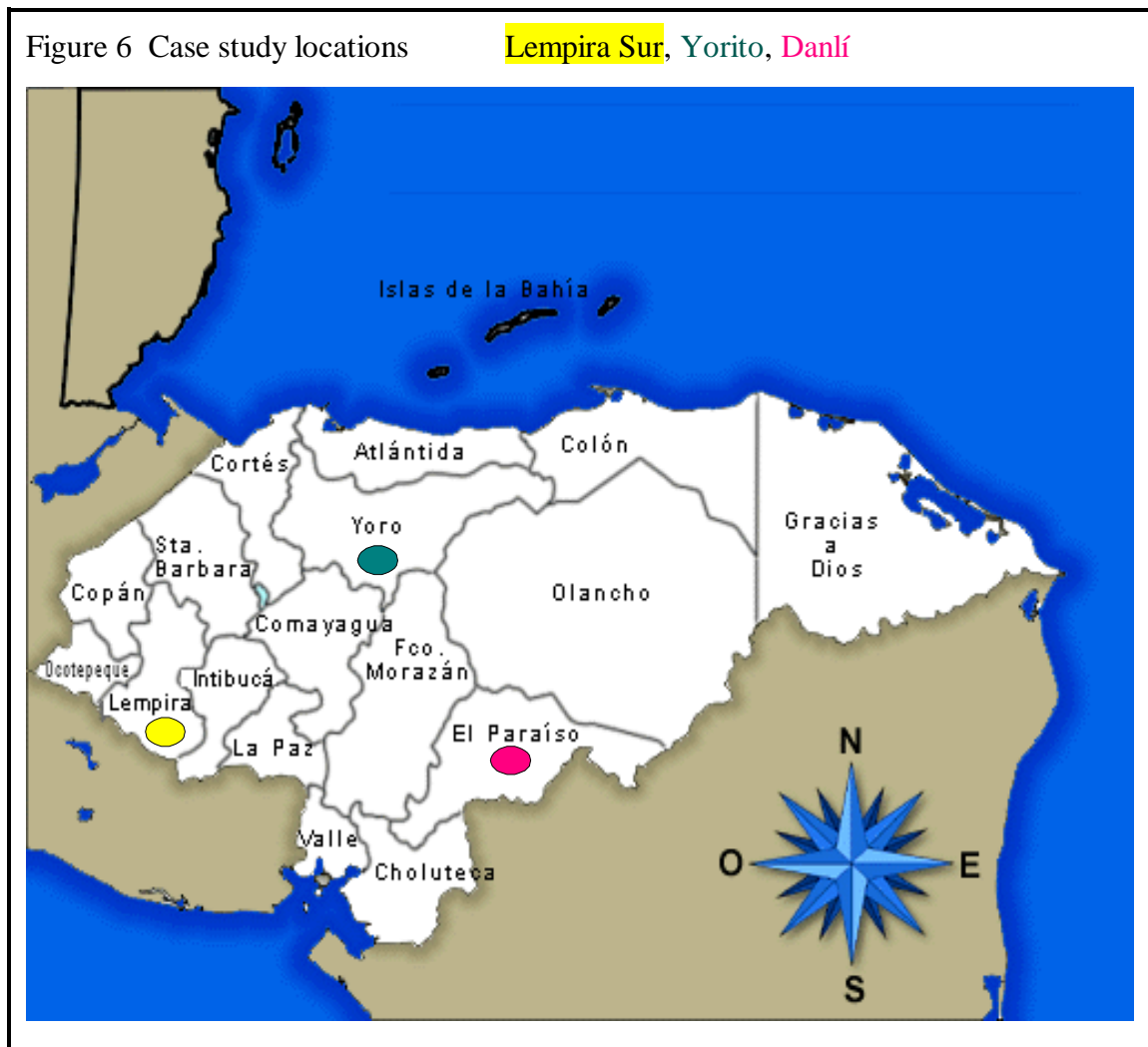
The second benefit has been the increased diffusion of improved varieties, especially *Tio Canela* which was the target of the certified seed distribution. While a formal study of adoption has not yet been carried out, key informant interviews with agencies distributing seed indicated that many were using the distribution as an opportunity to increase diffusion of the variety, and that it was well accepted by farmers at the time of the interview (partway through the *primera* planting season). Third, the genetic and physiological quality of farmers' seed stocks were boosted by the infusion of fresh seed of improved varieties.

² This estimate is based on estimates by Zamorano and CIAT of their initial seed distribution. Zamorano distributed 10 pound bags of seed through projects to approximately 20,000 farmers, while CIAT estimates that their distribution in the *primera* season benefitted approximately 7,700 farmers (Ignacio Sanz, 1999). The estimate is scaled down slightly, based on the fact that some NGOs were unable to distribute seed in time for the *primera* planting due to the vagaries of local planting seasons among their constituent communities and some production delays that set back distributions from Zamorano.

Despite the general enthusiasm over the results of the post-Mitch seed distribution, an analysis of how these relief activities interfaced with existing seed markets at the sub-regional level and at different stages of development as outlined in the research questions is lacking. The paper now turns to this question beginning with an introduction to the case study areas that were the subject of the empirical research.

4.2 Description of case study areas

The location of each case study area is indicated on the map in Figure 6.



4.2.1 Lempira Sur–Absent seed market

Southern Lempira (Lempira Sur) is a mountainous region in the Southwest of the country whose economy is heavily dependent on subsistence agriculture as well as the commercial production of cattle, coffee, and basic grains (maize, beans, sorghum). As the region with the highest incidence of poverty, malnutrition and illiteracy, Lempira Sur has been the focus of activities of a number of development organizations including the Food and Agriculture Organization's *Proyecto Lempira Sur* (PROLESUR).

Lempira Sur is characteristic of the *absent seed market*. Bean production in the mountainous region is dominated by traditional production systems and small bean parcel sizes (averaging 0.55 ha.). Production is largely oriented to home consumption, with an average of 46% of bean output sold (Martel-Lagos, 1995). Although there is a lucrative bean market in neighboring El Salvador, access to this market is constrained by the lack of a road to the border. Farmers wishing to sell beans must use pack animals for transport, requiring several hours to reach the market and limiting the volume that can be marketed. For farmers in this area, wholesale markets elsewhere in Honduras are likewise difficult to access, due to the mountainous terrain and rough, unpaved road linking Lempira Sur to these markets.

Farmer adoption of improved seed in Lempira Sur has been very low, with less than 5% of bean area planted to improved varieties (PROLESUR, undated). While, low adoption is largely attributed to the stagnant demand in bean markets, in some of the higher elevation agro-ecological niches, low adoption is also attributed to the unavailability of improved varieties with short maturation periods. A further disincentive

to the adoption of existing improved varieties is that some of the available improved variety beans (e.g. *Dorado*) are discounted in the El Salvador market due to their color which is slightly darker than traditional varieties which consumers prefer. Due to these limitations, farmers acquire bean seed almost exclusively from their harvest or the local grain market. Furthermore, productivity has been constrained by seed stock degradation and varietal mixing (PROLESUR, undated).

4.2.2 Yorito–Emerging seed market

Yorito, Yoro, is characteristic of the *emerging market*. Located in the Northern region of the country, Yoro accounts for almost 10% of Honduras's yearly bean output, with production on bean plots that average 0.9 hectares. While a dynamic output market exists in Yoro, (wholesalers from San Pedro Sula travel to the area to purchase beans at harvest time), improvements to bean productivity have historically been limited due to agro-ecological constraints which limit the productivity of local varieties and the seasons in which beans can be sown. Farmers in the area plant local varieties almost exclusively, and rely almost solely on local seed sources. Farmers prefer these sources because they are familiar with the varieties that are available through them, have an opportunity to see the quality of the crop that produces the seed, and prefer the terms of exchange (i.e. exchange at local market prices or loan of seed) that neighboring farmers offer.

In areas where they have been introduced, new varieties such as *Tio Canela* have been widely accepted. However, farmers' limited awareness of these varieties has slowed diffusion, and has inhibited the growth of demand for the varieties despite their potential

benefits. At the same time, despite some use of commercial inputs by farmers and the presence of local input retailers, farmers report that they are reluctant to utilize alternative seed sources such as commercial input dealers because of concerns over the risk of acquiring varieties whose performance they have not seen and whose genetic and physiological quality is unknown.

4.2.3 Danlí–Growth seed market

Danlí, El Paraíso, located in the Mid-Eastern region of Honduras, is representative of the *growth market* environment. Together with the Department of Francisco Morazán, El Paraíso accounts for approximately 30% of Honduras's annual bean output. In this area, approximately two-thirds of the bean area is cultivated under production systems that use a combination of commercial inputs, improved seed, and mechanized land preparation (Departamento de Información Agrícola, 1998).

In the Mid-Eastern region, beans are grown in both the valleys and on hillsides and on relatively large acreage (average 1.25 hectares relative to a national average of only 0.86 ha.) (Martel-Lagos, 1995). Most farmers utilize modern, capital intensive production systems, characterized by high rates of commercial input use, mechanized land preparation (when parcel size and terrain permit), and the use of improved varieties. In 1995, an estimated 71% of farmers in the Department of El Paraíso planted improved varieties (Viana, et al, 1997).

Concordant with the commercial orientation of the area, Danlí is well attended by agricultural services. Besides being the headquarters of the National Bean Program which

breeds, multiplies and distributes bean varieties, the commercial orientation of production supports a competitive input industry which provides farmers easy access to machinery services, chemical inputs, and improved seed.

While the primary source of seed planted in Danlí comes from local harvests, farmer appreciation of the benefits of improved seed is high. Farmers report that they are willing to pay for commercial seed to meet their demand for fresh seed stock and to purchase seed when it is not available locally due to local shortages. Although the actual number of farmers who purchase certified seed is low, input suppliers in Danlí are still an important seed source. This is because it is common for farmers who purchase from commercial dealers to supply second generation seed to other farmers in the community, allowing them to freshen their seed stocks without paying commercial prices.

4.3 Effects of Mitch and description of relief interventions

4.3.1 Absent market–Lempira Sur

The Western region, which includes Lempira Sur, lost approximately 50% of the *postrera* bean crop due to Mitch (Global Information and Early Warning System, 1999). In the Lempira Sur area specifically, however, Mitch losses were estimated at only 20%, largely due to the soil conservation methods that farmers use which reduced the impact of the rains (PROLESUR, 1998). Because of the relatively minor extent of crop losses due to Mitch, effects on farmers' and consumers' effective demand was minimal and localized. Thus there was no generalized seed insecurity crisis after Mitch in Southern Lempira (Alvarez Welchez, 1999).

In the period following Mitch, the primary relief interventions for grain consumption markets involved facilitating private purchases and the shipment of grain to deficit areas elsewhere in the country, and to ensuring that localized grain and seed deficits were met. After an assessment of area crop losses and food and seed needs, PROLESUR assisted local merchants in arranging the transport of maize and bean to the northern region of the country (which was facing shortages) for use as seed and food, as well as distributing to deficit areas locally. While leaving the transport and marketing of the grain to private agents, PROLESUR also purchased some maize and bean which they classified for use as seed. Through the competitive prices they offered on these transactions, PROLESUR offered competition to the middlemen and helped ensure that farmers would receive some of the benefits of the higher prices that were being offered in wholesale markets.

At the same time, PROLESUR distributed the seed that they had classified to local communities that were facing deficits. Though deficits weren't pervasive, the project's distribution of seed among the communities at this point was used not only to address short term seed needs, but also to capitalize rotating seed and input funds in many of these communities in order to enhance longer-term local seed security. The increased solidarity that emergencies can stimulate in communities was cited by PROLESUR as being instrumental in their decision to invest in such long term measures at this particular point.

4.3.2 Emerging market–Yorito

In the Yorito area, Mitch caused bean crop losses of greater than 80%, and the little bean that was harvested was of very poor quality and would not germinate (Global Information and Early Warning System, 1999). There was also extensive damage to the maize crop and coffee harvest, and severe destruction of housing and roads. The loss of much of the bean crop directly reduced the supply of beans for consumption and seed. Furthermore, farmers and project personnel in the area reported that the crop losses, economic losses and immediate rehabilitation and emergency expenditures on housing repairs, food, etc. incurred by area households left them with neither the resources nor the opportunity to save or acquire bean seed for the *primera* planting.

The main bean seed intervention following Mitch was the provision of seed (provided by Zamorano and CIAT) to several local agricultural projects. This seed was distributed to organizations that then distributed the seed to their constituents via community-level agricultural research committees. The seed was distributed with the stipulation that farmers return equal or double the amount they received to the committees for redistribution to other farmers for the *postrera* planting. The extent of coverage within each community varied widely, as did the farmers' familiarity with *Tio Canela*, the main variety that was distributed. For example, in one community where improved bean varieties had never been used, *Tio Canela* was supplied to every family in the community. In another, roughly 1/6 of the farmers received seed.

Apart from the seed that was distributed directly to farmers for planting, a portion of the relief seed was also used to capitalize new seed production enterprises in two

communities, with the intention that these enterprises would be a continued source for the improved seed and the specific variety that was being introduced to farmers through the relief distribution, as well as a channel for the diffusion of new varieties in the future.

Farmers reported that besides helping to ease the supply constraint and compensate for their lack of finance to purchase seed, the post-Mitch distribution also provided an alternative source of seed that they could look to in the future when they might face seed shortages or need to freshen their seed stock. Here, given their almost complete reliance on local, informal seed sources and unfamiliarity with commercial seed sources and seed coming from outside the locality, transaction costs were a very significant barrier to farmers in seeking out alternative sources of seed. Thus, the local enterprises were regarded with optimism as it was felt that they might fill an important market niche by being able to supply competitively-priced, commercial-quality seed while having the advantage of being local which would help them to gain the confidence of area farmers who were potential clients.

4.3.3 Growth market–Danlí

In El Paraíso, approximately 50% of the bean crop was lost (Global Information and Early Warning System, 1999), and farmers reported losses of up to 80% in Danlí, the case study area chosen as representative of the growth market for seed. These losses affected both the hillsides and valleys, and were accompanied by soil losses as a result of erosion and flooding brought on by the heavy rains.

After Mitch, improved bean seed was distributed through local NGOs, extension services, and the National Bean Program to farmers for the *primera* planting, with the intention that it be multiplied and redistributed for the main bean season, the *postrera*. There was also a credit program offering short term loans at a rate of 15% for the season (or 30% per year) to help finance farmers' *primera* planting expenditures (e.g. land preparation and input packages, including the restocking of bean seed). However, the availability of credit through this program was quite limited and, according to farmers, there was not sufficient finance available for all farmers who sought it.

In Danlí, the commercial orientation of bean farmers meant that the loss of the bean crop represented not only the loss of a food and seed source, but that it was also a severe financial set back which significantly affected their ability to finance cropping activities in the *primera*. Farmers' reflections on the destruction of the bean harvest and subsequent loss of revenue from bean sales centered around their dependence on it as a source of finance for their planting in the *primera*, not only so that they could replenish their seed stock, but also for hiring machinery services and purchasing chemical inputs which play an important role in their production systems.

From the viewpoint of Danlí's farmers, the loss of the seed source was a secondary issue relative to the financial crisis caused by the loss of the bean harvest. While farmers generally use seed that they save from a previous harvest or acquire it from neighboring farmers, the widespread local losses curtailed both these options. Demand then shifted to commercial markets for seed, increasing demand for certified seed for those who could afford it. The markets, however, had little seed to offer at this point due to the diversion of

commercial-quality seed to the relief agencies which were active in seed relief activities elsewhere in Honduras.

Locally, the relief activities of the agricultural development projects that distributed seed to farmers helped to mitigate the shock to seed availability. Apart from serving to reduce the threat of seed insecurity, it also altered the channels of seed distribution, away from the market to distribution through non-profits. These channels were also altered at the community level, shifting the flow of seed from the farmers who were known to purchase commercial seed and provide second generation commercial seed to other local farmers, to farmers who were clients or otherwise connected to the development projects. It was not clear, however, that these farmers were not in many cases one and the same, or that the overall distributive impact differed significantly as a result of this change.

Other effects of Mitch in Danlí included the temporary loss of local and improved varieties. Some farmers reported that they were unable to obtain the local varieties that they would have planted in the *primera* though they anticipated that by the *postrera* these would again be available locally. While the availability of *Dorado* and *Arbolito*, the most common varieties planted in the area was not curtailed (as a variety—the quantity available was of course affected), the newest variety to have been officially released, *Tio Canela*, had just been making in-roads in the region and was lost among some farmers' fields. Again farmers anticipated that by the *postrera* this variety would once again be available in the area.

5 Results of hypothesis testing

5.1 Effects of the Hurricane on seed markets

In Section 3, it was hypothesized that a disaster such as Hurricane Mitch would affect seed markets by shifting supply and demand, thus altering the availability of bean seed, the prices at which it is available, and the ability of farmers to acquire it in the marketplace. This result was evidenced both nationally and in the case study areas, as indicated by post-Mitch damage assessments and key informant interviews during the field research period. Both the supply and demand predictions were generally observed, though in national markets predictions of increased prices for commercial seed and seed shortages were not borne out due to the efforts of Zamorano and Hondugenet to administer prices and hold them constant after the Hurricane. In addition, Zamorano initiated a large-scale dry season planting of seed under irrigation to increase the supply of commercial-quality bean seed for distribution for the *primera* planting. Finally, while the expected increase in demand for commercial quality seed at the national level did occur, it was less a result of farmers shifting their demand to commercial markets than it was of development agencies which sought quality seed on behalf of their constituent farmers.

In the absent market, Lempira Sur, the damage to the bean crop was relatively minor, so that shocks to the seed supply were very localized, i.e. at the household level rather than community-level or region-wide. Likewise, effects of the Hurricane on demand were also relatively minor. In the emerging market, however, the damage was much more severe. In Yorito, reductions in seed supply and demand were both evidenced as farmers lost not only their own bean crops, but also could not access seed from neighbors given

the extensive damage that was brought about by the Hurricane. Demand was likewise affected as farmers faced not just the destruction of their crops (important sources of income and food), but also damage to their houses and other productive assets.

In the growth market, Danlí, seed supply was severely affected by the loss of both hillside and valley bean crops. Farmers' ability to acquire replacement seed was perhaps the most severely hurt due to the importance of the bean crop as a source of finance for the purchase of replacement seed, and because they also faced other income losses as a result of the Hurricane—i.e. damage to housing, agricultural land and productive assets, and other revenue-generating crops.

5.2 Farmers' responses in different market environments

Observations on farmers' responses to the shock supported the second hypothesis that markets at increasing levels of seed market development would show a greater tendency to acquire seed from sources beyond the local saved-seed that farmers customarily rely on. The lack of a generalized community or regional seed shortage in Lempira, the absent market case study area, made it difficult to evaluate the responses in this area, however the responses that were observed—of farmers meeting their seed needs through local sources do not contradict the responses that were hypothesized.

In Yorito's emerging market, the prediction that a local shortage would not drive farmers to seek seed from external sources were largely borne out. Here the key concern with the outside sources was their unfamiliarity to farmers, so that not only did they not come to mind as possibilities when there was a local shortage, but also the sources were

not trusted so that even if farmers had known of their existence, their lack of experience with them made farmers unwilling to source seed from them for the first time during the crisis situation. Farmer concern about the reputability of unfamiliar seed suppliers was reinforced by their unwillingness to obtain seed or varieties that were not produced locally, as this increased the risk that they would be inappropriate for the local agro-ecosystem. The response on the part of farmers who were not served by the development projects' relief seed interventions was to reduce their bean areas while they waited for local seed stocks to recover in subsequent seasons.

In Danlí's growth market, the commercial orientation of farmers, their established relationships with commercial input dealers, and their familiarity with commercial seed from these dealers meant that farmers were willing to look beyond their local, informal seed-sharing networks when faced with a seed shortage. Two major factors inhibiting this response were the short supply of seed from commercial outlets given its diversion to relief programs elsewhere in the country, and the lack of finance to acquire the seed given the demand shock that farmers had suffered as a result of their Mitch-induced losses.

5.3 Effects of interventions in different market environments

The expectation that relief interventions that make use of market forces would be more appropriate in seed markets at more advanced stages of development, and that direct activities that relied on local networks and direct (non-market) interventions would be most appropriate in less-advanced seed markets, was supported through the case study research.

In Lempira Sur's absent seed market, there was little opportunity to use market forces to deal with a seed shortage or shock to seed demand because commercial seed markets do not exist in the area and are costly and difficult to access outside of the region. While PROLESUR's efforts to ease localized seed shortages did make effective use of direct provision of seed, it also demonstrated the attendant possibility that such activity contribute to seed system development by using seed to capitalize local seed banks that would enhance farmers' local seed security, improve seed quality, and reduce vulnerability to future shortages.

In Yorito, the direct provision of seed through local development agencies with which farmers had established and positive relationships was a direct and effective method of reaching farmers and alleviating the seed shortage. At the same time, the use of the seed to capitalize emerging local seed enterprises was also a strength in that it helped to reduce future vulnerability to seed shortages by promoting new market-oriented suppliers. These suppliers, due to their presence and established reputations in the community, have high potential to establish themselves as sources of high quality seed and new varieties. Meanwhile, the direct provision of seed to farmers helped to increase demand for a new variety which previously had only been available on a limited basis in the community. Related to this, it is observed that the distribution of the seed to all farmers in the community, as seen in one case, can be expected to be less effective in stimulating linkages with the emerging local seed suppliers relative to the case in which seed was distributed to only about 1/6 of the community members, leaving room for farmers to acquire next-generation seed from these initial recipients or from the new seed enterprise.

In Danlí's growth stage seed market, the expectation was that more indirect, market-oriented approaches to seed relief could be beneficial in more-developed seed market environments. Indeed, while the seed distribution did help to speed the recovery of bean area given the threatening seed shortages, the advanced level of development of the market suggests that a market-oriented approach could have been more effective in meeting farmers' seed needs while being less disruptive to the area's seed market.

First, due to the capital-intensive nature of Danlí's bean production systems which require substantial early-season cash expenditures on inputs and land preparation services, the loss of the bean crop in Danlí threatened farmers' ability to replant due to financial constraints rather than a simple shortage of seed. This point argues that the provision of credit—a market-oriented demand intervention, would have allowed a more complete recovery of farmers' activities by facilitating farmers' access to complete input packages, rather than to just one input—seed.

Of course, given the diversion of seed from commercial channels after Hurricane Mitch, increases to farmers' demand would have also required concurrent assurances of a seed supply to meet this demand. Overall, given the established market channels and farmers' familiarity with commercial seed, it is evident that providing seed through existing market outlets which already dealt in bean seed could have reduced the secondary economic effects of reduced demand for inputs, while reinforcing farmers' use of the seed and services that the commercial outlets offer thus promoting the continued development of these services.

6 Conclusions and implications

This paper has addressed three research questions about the implications of a natural disaster for seed markets in developing countries. Case study research provided evidence supporting hypotheses of how a disaster affects supply and demand in seed markets at different levels of development, how farmers' feasible options and responses after a shock differ depending on the developmental status of their local seed system, and how interventions that seek to mitigate a disaster's effects can be more effective and help reduce future vulnerability to disasters if they accommodate the developmental status of the market in their design. The paper concludes with a summary of key lessons learned, their implications for future seed relief programs and policies, and a reflection on the shortcomings of the study and outstanding research needs.

6.1 Summary of key lessons from the case studies

Several key points emerge from the case studies of Honduras's seed markets. First, because seed markets at differing levels of development will respond differently to a shock, different interventions are required to ensure seed security, even if each faces a similar shock initially. In some cases, distributions of seed itself may either be unnecessary or inadequate, depending on the availability of seed through commercial outlets, the nature of the production systems that are utilized in the area, and whether the supply shock has affected an entire area or just isolated households within the area.

Second, in areas where a commercial seed supply exists, relief seed distributions that circumvent existing market channels can exacerbate the economic effects of the disaster,

while neglecting valuable opportunities to promote the continued development of these same markets.

Third, well-designed relief seed operations can help to stimulate farmers' willingness to pay for seed by increasing their exposure to high-quality seed or varieties whose dissemination is otherwise constrained. However this should not be interpreted as suggesting that new varieties should be forced upon farmers at times of vulnerability, for example by making them the only option available, especially if they are unproven locally.

Fourth, relief seed distributions can also be used as start-up capital for local seed enterprises, helping to decentralize and diversify seed supplies and reduce vulnerability to future crises.

Finally, utilizing linkages among markets at different stages of development and in different regions, as promoted by PROLESUR in Lempira after the Hurricane, is crucial to mitigating the effects of a localized crisis and promoting the spillover of development among inter-linked markets.

6.2 Implications for policy and future seed programs

Alleviating seed crises after a disaster involves far more than a simple distribution of seed to farmers. The linkages among markets for bean output and bean seed, and linkages among seed markets at differing stages of development condition the appropriate choice for a seed intervention after a disaster. An effective response will also take into account the relation between a market's vulnerability to crisis and developmental status. Several implications follow for policy and future relief seed programs:

First, the underlying status of the seed market and the effects of the crisis cannot be assumed. Any intervention must be based on a concrete understanding of a particular seed market, specifically the type of seed demand that farmers exhibit, the alternative sources of seed that are commonly used and emerging in the area, the chief areas needing investment for the development of the seed market, and the local capacities for response that exist and can be mobilized after a disaster.

Second, an understanding of the specific effects of a disaster is also required for the design of an appropriate and effective intervention. Did the disaster affect seed supply only? Or both supply and demand? Was the lost crop more important as a source of finance for farmers' agricultural expenditures, or just as a source of seed? The interventions that are carried out should be targeted as closely as possible to the nature of the shock in order to minimize the disruption to existing systems, and structured to accommodate the developmental status and needs of the market. That is, a demand shock should be addressed through interventions that restore demand, etc. Furthermore, it is imperative that the potential interactions between the disaster and interventions' effects also be anticipated. For example, providing credit to help farmers purchase replacement seed stocks will not be effective unless there is a supply of seed available for them to purchase.

Third, interventions should attempt to mobilize local resources as much as possible. This will help to minimize any potential negative impact of the intervention. On the supply side, local seed channels should be used to the full extent possible for any distribution of seed, and complemented where necessary to compensate for any obvious weaknesses in

the system, ensure equitable access to seed, etc. In the case of demand-side interventions, the use of credit or vouchers that can be redeemed with local commercial outlets or community seed sources can encourage the use of existing channels and minimize the secondary effects of an intervention more than interventions that circumvent existing markets or channels.

Fourth, seed relief activities provide an opportunity to promote investments to decentralize and diversify the seed supply, as the dangers of overly-centralized and undiversified seed supplies are painfully evident immediately following a disaster. This leads to increased political will to address the issue, while community solidarity is at a high enabling progress where it might otherwise be bogged down by local political and social issues. The availability of relief funds can also help to overcome economic constraints to the implementation of programs to reduce vulnerability at this point.

Finally, concurrent with the need for centralization and diversification of seed supplies is the need to forge linkages among seed markets, so that localized crises can be defused, and responses to generalized crises can draw on the diverse capacities of the heterogeneous seed markets that are linked. Progress towards the creation and strengthening of such linkages does not demand a crisis situation, as opportunities exist even in “normal” times for the exchange of seed, varieties, and grain among diverse markets, all of which contribute to smoother, more effective responses in times of crisis.

6.3 Issues requiring further research and limitations of the study

This paper has addressed the effects of a disaster on the bean seed system, and considered how different seed relief interventions interface with local seed markets that are at different stages of development. The focus of the research was necessarily on the short term interactions between the relief interventions and the market.

The paper leaves room for further research in three important areas. First, there is a need to examine the effects of the relief activities on the longer term development of the market. While the results of the current paper indicate the potential for longer term effects, research is needed to gauge how the initial effects that were observed are actually sustained over the medium to longer run. Important issues, for example, related to adoption rates for the new varieties which were diffused in the relief distribution, and whether the distribution affected farmers' willingness to pay for seed and use new seed sources. Related to this, the dynamic effects of the interventions also need to be considered over the medium to long term—i.e. to document the sorts of investments that are spurred by the initial interventions, and how these investments themselves create endogenous change in the bean seed system. Such research would require an analysis of markets at several points in time, preferably with a base period established prior to the disaster for use as a reference point. It would also benefit from a comparison of similar seed markets that are the recipient of different interventions, so that the developmental paths of each system can be compared and evaluated.

The second major area of research that is needed is a more in-depth analysis of some of the structural components of the seed market, how they are affected by a disaster, and how they can be strengthened and mobilized through relief interventions. For example, it is well accepted that formal and informal/local seed systems are complementary in serving small farmers' seed needs. There is virtually no information, however, on how informal systems respond to crises, nor is there any typology of informal systems which can be used to guide their mobilization in effecting interventions after an emergency. This makes it more difficult to design an intervention (for either general seed system strengthening or a relief intervention) at the regional level that can increase its effectiveness by taking an integrative approach of utilizing both the formal and informal systems.

Third, knowledge about relief seed interventions would also be increased through a more formal assessment of the issues that were raised in this paper. The rapid appraisal methodology, while enabling the identification and exploration of crucial issues in an efficient and timely manner, did not allow for quantification of the effects that were observed or a more formal testing of the hypotheses. Ideally, the rapid appraisal would have been used to initiate the research process, and facilitate the formation of hypotheses that could have then been tested more formally. Due to time limitations, however, this was not feasible for the research that was conducted.

Despite the success of the rapid appraisal in identifying salient issues relating to the disaster intervention, it is a key limitation of this study that a more formal assessment was not carried out based on the observations and issues brought out in the appraisal. Issues that would have benefitted from more extensive investigation include the extent of bean

crop and seed losses to Mitch both nation-wide and in the case study areas; the variety and reach of the different relief actions that were employed; more extensive consultation at the project sites and the national level, especially with individual growers of commercial bean seed who market to Hondugenet and Zamorano; and a more comprehensive survey of the bean seed system in Honduras, including both its horizontal and vertical linkages. It is recommended that this paper be used as the basis for a follow-up study that addresses the longer-term interactions between the relief interventions and the development of seed markets. Such a study could also utilize more formal hypothesis testing in order to provide more concrete evidence in support of the findings that were presented in this paper.

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Appendix A

Bean Production Before and After Mitch*

	<i>Primera</i>			<i>Postrera</i>		
	Area harvested (mz)	Production (QQ)	Yield (QQ/mz)	Area harvested (mz)	Production (QQ)	Yield (QQ/mz)
1990-98 Average	48,299	454,138	9.64	96,468	1,004,504	10.4
1999	68,590	615,341	9.0	88,829	645,959	7.3
Difference	142 %	135%	94%	92 %	64%	70%

Source: Dirección General de Estadísticas y Censos

*Preliminary estimates

Appendix B

Persons interviewed

Name	Organization
Juan Carlos Rosas	Bean Research Program, Escuela Agrícola Panamericana
Raúl Espinal	Grain and Seed Technology Unit, Escuela Agrícola Pan-americana
Danilo Escoto	National Bean Program
José Aguilar	Seed Certification Dept., Secretary of Agriculture and Livestock
Edgar Salinas	Seed Certification Dept., Secretary of Agriculture and Livestock
Guillermo Giraldo	Seeds of Hope Project, CIAT
Rafaél Martínez	Hondugenet
Francisco Pérez	SEAGRO
Tom Crowley	APSO-Agency for Personal Service Overseas
Raúl Iglesias Rovelo	CARE-Honduras
Jacqueline Chenier	CARITAS
Rigoberto Gomez	CEPA-Centro de Entrenamiento para Pequeños Agricultores
Manuel de Jesus Castillo	CEPA-Centro de Entrenamiento para Pequeños Agricultores
Oswaldo Díaz	CRS-Catholic Relief Services
José Luís Flores	COHASA II
Utilia Hernández	CCD-Christian Development Comission
Paul Teeple	Peace Corps
Carlos Amaya	FEPROH-Fomento Evangélico para el Progreso de Honduras
José Angel Ferrufino	FEPROH-Fomento Evangélico para el Progreso de Honduras
Sonia Euceda de Cruz	FEPROH-Fomento Evangélico para el Progreso de Honduras
Federico Rodríguez	GTZ-AG-Vegetable Sanitation Project
José Jimenez	IPCA-Investigación Participativa en Centro América
Hernán Avila	PLANDERO-Plan de Desarrollo Rural de la Región de Occidente
Justo Domingo Torres	PLANDERO-Plan de Desarrollo Rural de la Región de Occidente
Federico Trece Ramos	PRODERCO-Proyecto de Desarrollo Rural en el Centro Oriente
Luís Alvarez Welchez	PROLESUR-Proyecto Lempira Sur
Pablo Zelán Mejia	PRR-Programa de Reconstrucción Rural
Rosa María Hernández	TROCAIRE
Laura Guzmán	TROCAIRE
Raúl Zelaya	World Neighbors

Yorito Case Study

Freddy Sierra	IPCA-Investigación Participativa en Centro América
Nery Murillo Sosa	COSAPSYL
Marvin Sanchez	CARYOSVYL
Joel Martinez	Yoro Regional Development Project
Saúl San Martin	Sertedeso
José de la Paz Matute	Los Cafetales-Comite de Investigación Agrícola Local (CIAL)
Manuel Castro	Los Cafetales-CIAL
Mauricia Velazquez	Los Cafetales-CIAL
Elbia Cruz	Los Cafetales-CIAL
Cesar Romero	La Sabana de San Pedro-Comite de Investigación Agrícola Local

Danlí Case Study

Vladimir Heromín	Red Cross
Séverin Mellac	Acción contra el hambre
Manuel Alvarez	AgroComercio Danlí
Jorge Pineda	World Food Program

Lempira Sur Case

German Flores	PROLESUR-Proyecto Lempira Sur
Edgardo Navarro	PROLESUR-Proyecto Lempira Sur
José Canales	PROLESUR-Proyecto Lempira Sur
Enrique Valdez	Mennonite Social Action Committee
Manuel Bonilla	Mayor, Input supplier
Pedro Escalante	Input supplier
Carlos Melendez	Input supplier
Atilio Nataren	Seed project participant
Hernan Nataren	Seed project participant