

Disasters and Development in Agricultural Input Markets: Bean Seed Markets in Honduras After Hurricane Mitch

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The bulk of developing countries' populations and poor depend on agriculture for food and income. While rural economies and people are generally the most severely affected by natural disasters, little is known about how disasters and subsequent relief activities affect agricultural markets with differing levels of development. The article addresses this gap, drawing evidence from bean seed markets in Honduras after Hurricane Mitch. Case studies are used to address hypotheses about a disaster's effects on supply and demand in seed markets, farmers' responses and the performance of relief interventions in markets showing differing levels of development. The results show the importance of tailoring relief interventions to the markets that they will affect and to the specific effects of a disaster; the potential to use local and emerging seed distribution channels in a relief intervention; and opportunities for relief activities to strengthen community seed systems.

Keywords: Hurricane Mitch, agricultural input markets, seed system development, bean seed.

Introduction

It is broadly acknowledged that damage sustained in natural disasters happens disproportionately to developing countries, marginalised people within these countries and especially to rural people (OAS, 1990). Given that 60 per cent of developing countries' populations resides in rural areas, and agriculture provides livelihoods to 70 per cent of the poor and food insecure (either directly or indirectly), the speedy rehabilitation of agricultural sectors after a disaster is crucial both to relieve human suffering and to permit the recovery of the economy and society (FAO, 2001).

The links between disasters and development have been well articulated (see for example, Cuny, 1983; Anderson and Woodrow, 1991; Buchanan-Smith and Maxwell, 1994; Longhurst, 1994). On the one hand, the developmental status of a community and the people within it determines their vulnerability to losses in a disaster. On the other hand, the interventions that are carried out in response to a disaster can have either beneficial or detrimental impacts on the underlying economic and social systems in which the relief programme intervenes.

In their study of the effects of drought on sub-Saharan African countries, Benson and Clay point out that the 'impact of any exogenous shock depends not only

on the nature and magnitude of the shock but on the structure and prevailing economic circumstances of the affected economy' (1994: 24). Little is known, however, about the interactions of relief programmes and markets that reflect differing levels of development. This paper treats that issue, focusing on relief and development activities targeting agricultural input (specifically seed) markets. It draws evidence from bean seed markets in Honduras, and relief programmes following Hurricane Mitch, which struck Honduras in October 1998. The emphasis is on the effects of the disaster and interventions on local (community) seed systems, with the national-level seed system treated for the purpose of establishing the context in which local systems operate. Three research questions are addressed:

- How does a disaster like Hurricane Mitch affect supply and demand in seed markets?
- How does the level of seed market development condition farmers' options and responses regarding seed acquisition following a disaster?
- How do different relief interventions perform in communities whose seed markets reflect varying levels of development?

Field research was conducted during the summer of 1999, nine months after Hurricane Mitch. The research methods employed were a rapid appraisal of the seed system at the national level and case studies of local-level seed systems in communities reflecting varying stages of market development.

Data collection relied on key informant interviews and structured surveys. Key informant interviews were conducted with agents in government, the non-governmental community, private-sector seed industry, local community leaders and development and seed project personnel. Structured surveys were carried out with personnel from major agricultural development projects that implemented relief seed activities following Hurricane Mitch, as well as with farmers, seed producers and seed marketers at the community level.

The paper is organised as follows. First, the issue of seed market development is treated conceptually and hypotheses presented that respond to the research questions. Next, the empirical context — bean seed markets in Honduras following Hurricane Mitch, is introduced. Then, the results of hypothesis testing are presented and discussed, and finally, the implications of the results are addressed.

Conceptual framework

Seed markets as a vehicle of seed system development

Seed system development has been treated extensively in the literature (see for example, Douglas, 1980; Pray and Ramaswami, 1991; Jaffee and Srivastava, 1992; Maredia et al., 1997; Morris et al., 1998). The seed system is defined as 'the entire complex of organisations, individuals and institutions associated with the development, multiplication, processing, storage, distribution and marketing of seeds' (Maredia et al., 1997). Seed system development is a process involving the strengthening of capacities for the breeding, multiplication and distribution of seed of high physiological quality, including:

- a responsiveness to farmers' varietal requirements (as conditioned by their market orientation and agro-ecological positioning);
- effective channels for the distribution of new varieties; and
- capacities for the maintenance and periodic upgrading of seed stocks.

Since the dismantling of parastatal seed companies in the 1980s and arguments against the default reliance on NGOs as seed providers, markets have been recognised as a principal vehicle for the sustainable provision of high-quality seed to farmers, and their development thus constitutes an important activity in most seed system development programmes (Jaffee and Srivastava, 1992). Yet while the development of seed markets is a primary vehicle for seed system development, the two do not always progress hand-in-hand, nor need they for effective seed system development to take place. The association between seed market and seed system development is strongest when profitable output markets exist, so that demand for productivity-enhancing inputs like improved seed is an outcome of the development process, with the emergence of markets for their provision following (Rusike and Eicher, 1997; Tripp, 1997).

Stages of seed market development

Drawing from the available literature, a three-stage model of seed market development is outlined in this paper. Movement along these stages is characterised by an increasingly commercial orientation to crop production and attendant with this, the employment of productivity-increasing inputs such as fertilisers, pesticides and improved seeds; an increase in farmers' familiarity with diverse and non-traditional sources of seed; and an increasing portion of seed sourced from formal or commercial sources, even as informal sources, particularly farmer-saved seed, remain important regardless of the stage of development of the seed market.¹

The earliest stage of seed market development (associated with the 'traditional' stage in seed system literature), is characterised by an absent seed market. Here, farmers mainly produce crops for subsistence, although they may market their surpluses. Farmers have little familiarity with improved varieties or external sources of seed and rely almost exclusively on the informal seed system (including farmer-saved seed, friends and neighbours and grain markets; with exchange relations that are often socially delineated and include barter, cash sales and status-grant transactions) (Cromwell, 1990; Cromwell et al., 1992). The lack of an expanding output market inhibits farmers' purchases of productivity-boosting inputs such as improved seed, leaving little incentive for commercial firms to market seed in these areas. Projects to improve seed quality and 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 and improving local capacities for seed selection and storage, while strengthening links to the formal sector for inputs such as new varieties and technical assistance (Almekinders et al., 1994; Thiele, 1999). Given the lack of profitable markets for crop production and the consequent lack of impetus for seed markets to emerge and develop, activities to ensure the availability of quality seed and to develop and disseminate new varieties are often undertaken by public or non-governmental organisations (Jaffee and Srivastava, 1992).

The second stage of seed market development is characterised by an emerging seed market. This stage is observed in areas where output markets motivate the

production of beans in excess of local need, inducing farmers to use productivity-enhancing inputs including improved seed. At this stage the expansion of the seed market may be impeded by farmers' unfamiliarity with seed from commercial seed sources relative to local informal sources which are more familiar and trusted. Because one of the features of local seed sources that makes them attractive is that the socially based exchange relationships minimise the risk of opportunistic behaviour on the part of the seed provider, strategies to promote the emergence of seed markets at this stage emphasise the promotion of local enterprises that have the capacity to produce high-quality seed while still offering the benefits of local exchange mechanisms (Gisselquist, 1997).

The third stage of seed market development is the growth stage. At this stage, farming systems characteristically have a predominantly commercial orientation, and farmers use packages of purchased inputs including high-yielding varieties. Farmers are familiar with a variety of seed sources, including commercial input suppliers as well as local sources. At this stage, there may be significant constraints on the supply side because of a lack of competition. 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) organisations in ensuring that institutions are in place (for example, certification, labelling guidelines) that decrease the transaction costs² in exchanges between farmers and seed dealers (Jaffee and Srivastava, 1992; Tripp, 1997).

Effects of a disaster on seed demand and supply

Hypothesis 1: A natural disaster will reduce the availability of seed from both commercial and informal sources, and reduce farmers' effective demand for seed.

A disaster is expected to reduce the supply of locally available seed by affecting farmers' crops (from which seed would have been saved), local seed supplies, and local food markets (which also serve as sources of seed). Likewise, a natural disaster can reduce the availability of seed from external, commercial sources owing to its impacts on commercial seed that is being grown or in storage, or through damage to infrastructure used in the distribution of seed. The disaster's impacts on the supply of commercial seed will be manifested through reduced availability and/or higher prices.

At the same time, a disaster can reduce farmers' effective demand (namely, their willingness and ability to pay) for seed from local or commercial sources. Reductions in farmers' income and wealth following a natural disaster resulting from crop losses, job losses, as well as the need to make emergency expenditures on food and housing, will reduce their ability to acquire seed from either local or commercial sources (Hammerton et al., 1984).

Thus, depending on the specific impacts of a disaster, farmers may be left in a situation where the availability of seed from commercial and local sources is reduced, even as their ability to acquire the seed is affected. When a disaster curtails farmers' customary seed sources or their expression of demand for seed, then farmers who are accustomed to local informal sources will need to find alternative sources of seed, pay more for seed from their customary sources and/or reduce the amount of seed they consume by reducing the area they plant or their seeding rates.

Hypothesis 2: 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

because of differences in market links and seed availability, and farmers' familiarity with seed from alternative sources.

In markets that are more advanced in their development, so that farmers have stronger market links, farmers are expected to have greater access and capacity to use alternative seed sources when their customary local sources fail. At lower 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.

Objectives and performance of seed relief interventions

Understanding the objectives and activities of relief seed interventions in a relief-to-development framework requires clear differentiation between addressing the underlying factors that created vulnerabilities to a seed insecurity crisis following a disaster, versus the needs that arise from the disaster (the effects of the disaster) (Hay, 1986; Anderson and Woodrow, 1991).

Relief seed programmes target three general types of objectives. First and foremost, the immediate objective of any seed relief intervention is to offset the crisis of seed insecurity that was catalysed by the disaster in order to promote the recovery of farmers' livelihoods and food security (ODI, 1996). Second, is the treatment of vulnerabilities caused by low levels of seed system development which created conditions for the disaster to cause a seed insecurity crisis. Third, is a generalised hodge-podge of objectives which treat the intervention following a disaster as a unique opportunity to give a 'shot in the arm' to the seed system, although without attempting to address the underlying systemic vulnerabilities which gave rise to the needs in the first place (an example of such a programme is given by Bingen et al. (1988)).

A range of supply-and-demand-oriented market and non-market interventions are used to achieve the three general types of objectives, as outlined in Table 1. Examples of demand-side non-market interventions include the provision of information on alternative seed sources and assistance in accessing them. Market-based interventions on the demand side include the distribution of vouchers that can be redeemed for seed (from commercial input suppliers) or credit for the purchase of inputs. On the supply side, non-market interventions include the distribution of food aid (that may be appropriate for planting) or the distribution of seed either directly to farmers or through informal channels for redistribution to farmers. Market-based supply interventions include the distribution of seed to local commercial input suppliers for resale to farmers. Regardless of whether they are implemented using the market or not, all interventions can be expected to interact with the underlying market — for example, the distribution of seed through non-commercial channels will affect farmers' demand for commercially supplied seed.

Hypothesis 3: The appropriate intervention will depend on the developmental status of the market due to differences in farmers' familiarity with and access to alternative seed sources.

In general, it is hypothesised that farmers in markets that are more developed will be aided most and experience less disruption in their existing systems, through market-oriented interventions. In contrast, farmers in progressively less-developed seed market contexts may have their needs met more efficiently and effectively through more direct, non-market strategies such as provision of seed direct to farmers. However, even where explicit markets for seed are absent, market-based interventions

Table 1 Objectives and activities of relief seed programmes

<i>Objectives</i>	<i>Activities</i>
Alleviate immediate seed insecurity crisis caused by:	Supply-side interventions
Supply-side effects	Market
• Loss of farmers' seed stock	• Provision of seed to local suppliers for re-sale to farmers
• Damage or destruction of local seed sources	Non-market
• Reductions in commercial seed availability	• Food aid (used for planting material) or to reduce pressure on local seed sources
	• Distribution of seed through informal seed system channels
	• Distribution of seed direct to farmers
	• Classification and distribution of grain available in local markets for planting
Demand-side effects	Demand-side interventions
• Reductions in farmers' effective demand (loss of income/wealth, need to spend available finance on emergency expenditures)	Market
• Lack of access or unfamiliarity of farmers with alternative seed sources	• Distribution of in-kind vouchers redeemable for seed
	• Provision of credit
	Non-market
	• Provision of information on alternative seed sources
	• Assistance in accessing alternative seed sources
Redress weaknesses in system that cause vulnerability to seed insecurity	• Establishment of local seed production and distribution capacity
• Heavily centralised formal seed production and distribution systems	--Seed banks
• Unfamiliarity of farmers with seed from non-traditional sources such as commercial input suppliers, local seed enterprises	--Local seed enterprises
• Weak capacities for local production and distribution of seed	--Household seed production and storage
	• Use market, non-market interventions to increase demand for seed from non-traditional sources
	• Reduce transaction costs
	--Certification of seed quality
Miscellaneous objectives ('shot in arm')	• Distribute seed of target variety/crop
• Upgrade physiological quality of seed stock	• Distribute seed of high physiological quality
• Disseminate new variety	
• Encourage production of specific crops	

can still enhance recovery in seed systems in which local (non-commercial) seed production predominates, for example, credit, rather than the actual distribution of seed, can permit farmers to buy seeds of their preferred varieties through local distribution channels (Pratten, 1997). Also, where the state of market development permits, it is possible to use the intervention to promote the development of seed markets while still enacting an effective intervention, for example by channelling demand through nascent seed enterprises.



Figure 1 Map of Honduras showing case study sites

Empirical context

Bean and bean seed markets in Honduras

In Honduras, bean is primarily a smallholder crop, and 70 per cent of Honduras's bean farms operate under traditional production systems (with little use of commercial inputs) and cultivate less than 0.87 hectares of bean area (Departamento de Información Agrícola, 1998). Although total demand for beans grew considerably (by an average of 3.4 per cent per year) in the 1990s, farmers' access to markets is limited in many areas due to weak road and transport infrastructure, so that the expression of that demand in local markets may be absent or weak.

Several improved bean varieties have been developed that perform well in the low-input production systems that are typical of Honduras's bean producers (Rosas et al., nd). However, the diffusion of these varieties to Honduran bean farmers has been limited and the general quality of the bean seed stock is low throughout the country owing to a heavily centralised formal seed system, combined with weak local capacities for seed production and distribution, which result in the distribution of high-quality bean seed being concentrated in areas of more commercial bean production (Martel and Bernstein, 1994; Martel et al., 2000).

Introduction to case study areas

Figure 1 shows the locations of the three case study sites within Honduras. These case study areas are introduced in richer detail below.

Lempira Sur, characteristic of the absent seed market, is a mountainous region in the south-west of the country whose economy is heavily dependent on subsistence

agriculture as well as the commercial production of cattle, coffee and staple foods (maize, beans, sorghum). Bean production is dominated by traditional production systems and small parcel sizes (averaging 0.55ha). Production is largely oriented to home consumption, with an average of 46 per cent of bean output sold (Martel, 1995). Farmer adoption of improved seed in Lempira Sur is very low, with less than 5 per cent of bean area planted with improved varieties (PROLESUR, nd). In general, low adoption is attributed to two causes. First, access to external output and input markets is limited due to the poor transport infrastructure. Second, improved varieties are less consistently adapted to the specific agro-ecological niches that exist among Lempira Sur's mountainous terrain. Given these factors, farmers find it economical to acquire bean seed almost exclusively from their harvest or the local grain market. There is, thus, a lack of incentive to purchase seed from external (commercial) sources, and consequently for commercial suppliers to sell it.

Yorito, Yoro, is characteristic of the emerging market. Located in the northern region of the country, Yoro accounts for almost 10 per cent of Honduras's yearly bean output, with production on bean plots that average 0.9 hectares. While a dynamic output market exists in Yoro, farmers plant local varieties almost exclusively, and rely almost totally on local seed sources. Productivity is low because of agro-ecological constraints which limit yields of local varieties and the seasons in which beans can be sown. In areas where improved varieties that overcome these constraints have been introduced, they have been readily adopted. Farmers' limited awareness of these varieties has slowed diffusion, however, and inhibited the growth of demand for the varieties despite their demonstrated 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 use unfamiliar seed sources such as commercial input dealers because of the riskiness of acquiring varieties whose performance they have not seen and whose genetic and physiological quality is unknown. They tend to prefer to acquire seed from familiar sources — their own harvests, trade with neighbours, or local grain markets, rather than risk buying high-priced commercial seed from unfamiliar sources.

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 per cent of the annual bean output in Honduras. In this region, beans are grown in both the valleys and on hillsides and on relatively large acreage (average 1.25ha relative to a national average of only 0.86ha) (Martel, 1995). More than two-thirds of the farmers use modern, capital-intensive production systems including commercial inputs, mechanised land preparation (where parcel size and terrain permit) and improved varieties, and there is a competitive industry providing farmers with services and inputs including improved seed. While the primary source of seed planted in Danlí comes from local harvests, farmers report their familiarity with and willingness to buy seed from commercial sources to meet their periodic demand for fresh seed stock and to compensate for local shortages.

Effects of Hurricane Mitch on bean seed markets and description of interventions

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 widespread destruction of crops, livestock, land and infrastructure. In response to the threat of food insecurity immediately following Mitch, the government released strategic grain reserves and solicited food aid, while non-profit and relief organisations established food-for-work programmes and food distribution camps.

National-level impact

Bean production suffered heavily as the catastrophe occurred just prior to the late-season harvest, which normally accounts for 65 per cent of the country's annual bean production. Approximately 50 per cent of that season's production was lost, with regional losses reaching 80 per cent in some areas. The accumulated impact was estimated at a 35 per cent reduction in output for the year (Global Information and Early Warning System, 1999).

Mitch affected both national markets and local seed systems in communities that were directly affected by the hurricane. Here, several points are made about the effects and responses seen at the national level, with the purpose of framing further exposition of the local effects of Mitch and subsequent relief interventions.

First, given the loss of both commercial seed crops and bean (for consumption) crops after Mitch, seed insecurity was a major concern of the international community and substantial funds were made available for the production and distribution of bean seed by major government and non-governmental agencies. These agencies undertook large-scale multiplication efforts using irrigated cultivation during the winter season that preceded the early season planting. Much of these production activities focused on the multiplication of several improved varieties that have been shown to offer significant benefits in farmers' fields (particularly high yield and virus resistance) but that had seen low rates of diffusion to date.

Second, immediately following the hurricane and before beans from strategic reserves and food aid entered the markets, some of the large development agencies bought beans from wholesale markets and classified it for planting. Thus, they managed to withdraw a significant amount of viable planting material from national markets before these markets were flooded with seed from the food aid contributions and strategic reserves, as this seed was unsuitable for planting because of its being of unknown origin, varieties, and physiological quality.

The seed acquired from these national-level interventions was distributed through community-level organisations to farmers in areas that were directly affected by Mitch. Overall, the initial national level response was credited with the distribution of bean seed to more than 25,000 smallholders (approximately 20 per cent of Honduras's bean farmers).

Third, although prices of bean seed were not significantly affected by Mitch at the national level (because the major national-level organisations that produce and market commercial bean seed pledged not to raise prices in order to facilitate the relief efforts), national distribution channels were significantly altered. The major shift was

the withdrawal of seed from commercial distribution channels in favour of distribution through non-governmental and public development agencies that were expected to have more direct access to the small farmers who comprised the target population of the interventions.

Fourth, the distribution of seed through community organisations reflected not only an attempt to reach small farmers effectively, but also to counteract some of the causes of the local seed insecurity crises caused by Mitch. Specifically, there was an appreciation that capacities for the production and distribution of high-quality seed needed to be decentralised through investment in local seed enterprises and/or rotating seed funds, so that the national-level seed firms would not be the only established source of high-quality seed.

Local impacts in case study areas

What were the effects of Mitch on local seed systems and how did farmers respond given the developmental status of their local seed system? How did different efforts to alleviate local seed insecurity perform, and what were their short-term effects on the developmental path of the seed system in each community?

The western region, which includes Lempira Sur's absent seed market, lost approximately 50 per cent of the late-season bean crop due to Mitch, although losses in the case study area were estimated at only 20 per cent (Global Information and Early Warning System, 1999; PROLESUR, 1998). Because of the relatively minor extent of Mitch-related crop losses, effects on farmers' and consumers' demand for beans and seed were minimal and localised (at the household level rather than community or regional level). Thus, there was no generalised seed insecurity crisis after Mitch in Lempira Sur (Alvarez Welchez, 1999).

In the period following Mitch, PROLESUR, the major development project in the region, assessed local crop losses and food and seed needs, and then assisted local merchants in arranging the transport of maize and bean to deficit areas locally and other regions of Honduras (which were facing shortages) for use as seed and food. While leaving the transport and marketing of the grain to private agents, PROLESUR also purchased some maize and bean from consumer markets and appraised its suitability for planting, particularly seeking to preserve local varieties for which seed stock is hard to replace once lost locally. Through the competitive prices they offered to farmers when they purchased the beans, PROLESUR presented competition to the local merchants (while not seeking to displace them) and helped ensure that farmers would get some benefit from the higher prices that the merchants would receive for their sales.

At the same time, PROLESUR distributed the seed that they had classified to local communities which were facing deficits, using these distributions as an opportunity to capitalise rotating seed and input funds in many of these communities and promote long-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 (Alvarez Welchez, 1999).

In Yorito's emerging seed market, Mitch caused bean crop losses estimated at greater than 80 per cent (Global Information and Early Warning System, 1999). There was also extensive damage to the maize crop and coffee harvest, and the 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 and immediate rehabilitation and emergency expenditures (for example, housing repairs, food) left farmers without resources to save or purchase bean seed for the early season planting.

In Yorito, the main bean seed intervention following Mitch was the provision of improved seed through local agricultural projects to farmer-members of community agricultural 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 next planting. The extent of coverage within each community varied widely, as did the farmers' familiarity with the distributed improved variety.

Apart from the seed that was distributed directly to farmers for planting, a portion of the relief seed was also used to capitalise new seed production enterprises in several communities, with the intention that these enterprises would be a continued source for the improved seed of 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.

In El Paraíso, approximately 50 per cent of the bean crop was lost (Global Information and Early Warning System, 1999), and farmers reported losses of up to 80 per cent in Danlí, site of the growth-stage seed market. 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 to farmers through local public and non-governmental organisations for the early season planting, with the intention that it be multiplied and redistributed for the subsequent season. There was also a credit programme offering short-term loans at a rate of 15 per cent for the season (or 30 per cent per year) to help finance farmers' planting expenditures (land preparation and input packages, including the restocking of seed). However, the availability of credit through this programme was, according to farmers, insufficient to meet their demand. Meanwhile, there was little seed available through commercial input suppliers after its diversion to the national relief effort.

In Danlí, the commercial orientation of bean farmers meant that the loss of the bean crop represented a severe financial setback that significantly affected their ability to finance production activities in the coming season, as well as the loss of a food and seed source. Farmers' reflections on the destruction of the bean harvest and subsequent loss of revenue from bean sales centred on their dependence on it as a source of finance for their next season's crop, not only so that they could replenish their seed stock, but also for hiring machinery services and purchasing inputs which play an important role in their production systems.

The major effects of Hurricane Mitch and primary interventions are summarised for each case study area in Table 2.

Results and discussion

Effects of the hurricane on seed markets

It was hypothesised that a disaster such as Mitch would affect seed markets by shifting supply and demand, thus altering the availability of bean seed, the prices at which it is

Table 2 Mitch effects and seed interventions in case study areas

<i>Seed market</i>	<i>Market characteristics</i>	<i>Major effects of Hurricane Mitch —Bean crop and other</i>	<i>Primary interventions</i>
Absent market (Lempira Sur)	<ul style="list-style-type: none"> • Subsistence-oriented production • Informal seed exchange systems predominate • Low use of improved varieties 	<ul style="list-style-type: none"> • 20% loss to bean crops • No generalised seed insecurity crisis at community or regional levels 	<ul style="list-style-type: none"> • Facilitate private merchants' activities to export seed and grain to deficit regions • Purchase and classification of local grain for planting • Distribution of seed to nascent local input funds
Emerging market (Yorito)	<ul style="list-style-type: none"> • Bean production for sale and household consumption • Ready acceptance but low diffusion of improved varieties • Local informal seed channels predominate, farmers unfamiliar with commercial seed sources 	<ul style="list-style-type: none"> • 80% loss of bean crop and damage to other crops • Destruction of housing and roads • Household-level income losses and need for emergency expenditures 	<ul style="list-style-type: none"> • Provision of improved seed through local projects • Distribution of seed to capitalise nascent seed enterprises
Growth market (Danlí)	<ul style="list-style-type: none"> • Commercial bean production • High diffusion of improved varieties • Informal and commercial seed channels familiar to farmers 	<ul style="list-style-type: none"> • 50%–80% loss of bean crop and damage to other crops • Household-level income losses • Soil losses due to erosion and flooding 	<ul style="list-style-type: none"> • Provision of improved seed through non-profit organisations • Limited short-term credit to farmers to finance planting • Diversion of seed from commercial input channels

available and the ability of farmers to acquire it in the marketplace. This result was clearly evidenced (although with varying manifestations) in the case study areas.

In the absent market, Lempira Sur, the damage to the bean crop was relatively minor, so that shocks to the seed supply were very localised: at household level rather than community level or region-wide. Likewise, Mitch's effects on demand were also relatively minor in Lempira Sur. 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 their own bean crops and also could not access seed from neighbours given the extensive damage brought 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, local seed supply was severely affected by the loss of both hillside and valley bean crops, while the commercial seed was diverted from regular input channels as a result of the relief interventions. Farmers' access to replacement seed was perhaps the most severely hurt because of 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 — namely, damage to housing, agricultural land and productive assets and other revenue-generating crops.

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 seek seed from sources beyond the local saved seed that farmers customarily rely on. The lack of a generalised community or regional seed shortage in Lempira Sur, 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 hypothesised responses.

In Yorito's emerging market, the prediction that a local shortage would not drive farmers to seek seed from external sources was largely borne out. Here the key concern with the outside sources was their unfamiliarity, especially given the general economic insecurity faced by farmers following Hurricane Mitch, which made it a bad time for risky ventures. 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 input dealers and their familiarity with seed from these dealers reflected farmers' comfort in looking 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 programmes 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.

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 also largely 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 localised seed shortages did make effective use of direct provision of seed, it also demonstrated the potential for such activity to contribute to seed system development by using it to capitalise 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. 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 and external seed sources, transaction costs were a very significant barrier to farmers seeking alternative sources of seed.

Thus, the local enterprises were regarded with optimism. 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. Furthermore, the distribution of several improved varieties that had seen limited diffusion helped to increase farmers' familiarity with and access to them, and thus potentially helped both long-term demand and incentives to supply the varieties on a commercial basis.

In Danlí's growth-stage seed market, the expectation that market-oriented approaches to seed relief could be beneficial in more-developed seed market environments was clearly supported. From the viewpoint of Danlí's farmers, the loss of seed itself 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 neighbouring farmers, the widespread local losses curtailed both these options. Locally, the relief activities of the agricultural development projects that distributed seed to farmers helped to mitigate the shock to seed availability, yet they also altered existing seed distribution channels, away from the market to distribution through non-profit organisations. When farmers then sought seed from commercial input suppliers, these suppliers had little seed to offer.

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 their 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 provision of these services.

Implications for policy and future relief seed programmes

Alleviating seed crises after a disaster involves far more than the simple distribution of seed to farmers. First, because seed markets at differing levels of development will respond differently to a similar shock, interventions must be designed with an appreciation of the nature of the underlying seed system (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 mobilised after a disaster), as well as an understanding of the specific effects of the disaster. Did the disaster affect seed supply only? Or did it affect both supply and demand? Was the affected crop important as a source of finance for farmers' agricultural expenditures, or primarily as a source of seed? Given the answers to these questions, 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 utilised 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. This points to the need for interventions that mobilise local resources as much as possible, both to mitigate unintended negative effects of the interventions and to enhance their developmental impact. 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, and ensure equitable access to seed. 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 minimise the secondary effects of an intervention better than interventions that circumvent existing markets or channels. Furthermore, the interventions that are carried out should be targeted as closely as possible to the nature of the shock in order to minimise the disruption to existing systems, and structured to accommodate the developmental status and needs of the market — for example, a demand shock should be addressed through interventions that restore demand. Meanwhile, 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 if the seed supply has been diverted to other distribution channels as part of relief projects.

Third, relief seed activities can strengthen underlying seed systems and reduce vulnerability to future disaster impacts. The vulnerabilities resulting from heavily centralised supply systems are painfully evident immediately following a disaster enhancing political will to address the issue, while local 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 programmes to reduce vulnerability at this point. 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 value is proven in local contexts but whose dissemination is constrained due to farmers' unfamiliarity with the variety. Likewise, relief seed distributions can also be used as start-up capital for local seed enterprises, helping to decentralise and diversify seed supplies and reduce vulnerability to future crises.

Finally, using links among markets at different stages of development and in different regions, as promoted by PROLESUR in Lempira Sur after Mitch, is a crucial and under-exploited way to defuse the effects of a localised crisis, draw on the diverse capacities of inter-linked seed markets, and promote the spillover of development opportunities among them. Progress towards the creation and strengthening of such links 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 can contribute to smoother, more effective responses in times of crisis.

Conclusions

This paper has addressed research questions about the implications of a natural disaster for seed markets in developing countries, and provided evidence showing how the state of seed market development affects the impact of a disaster on local seed systems,

farmers' options and responses to the effects of a disaster, and the performance of different relief interventions. The focus of the research was on the short-term interactions between the relief interventions and the local markets. Further research is needed in several areas.

First, there is a need to examine the effects of the relief activities on the long-term development of the market. While the results of the current research indicate the potential for long-term benefits, research is needed to gauge how the initial effects that were observed are actually sustained over the medium to longer run. Important issues include adoption rates for the new varieties that 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 — namely to document the sorts of investments that were spurred by the initial interventions, and how these investments themselves may have created 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. It would also benefit from a comparison of similar seed markets that are the recipients of different interventions, so that the developmental paths of each system can be compared.

The second major area of research is an in-depth analysis of some of the structural aspects of the seed market, how they are affected by a disaster and how they can be strengthened and mobilised 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 mobilisation in effecting interventions after an emergency.

Research in these areas would enhance the effectiveness of relief programmes in the future, while also contributing to efforts to reduce vulnerability to future crises by strengthening the underlying systems.

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Notes

1. Throughout this paper, 'informal' and 'local' are used interchangeably, as are 'external' and 'commercial'. This use of terms reflects a generalisation that local seed is from informal sources and external seed is from commercial sources.
2. Transaction costs include searching for alternative seed sources, obtaining information on the quality of the seed, negotiating with the seller and seeking recompense if the product is faulty. If farmers incur very high transaction costs in acquiring seed from unfamiliar sources (for example, commercial sources of certified seed), then these costs can erode the net 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).

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