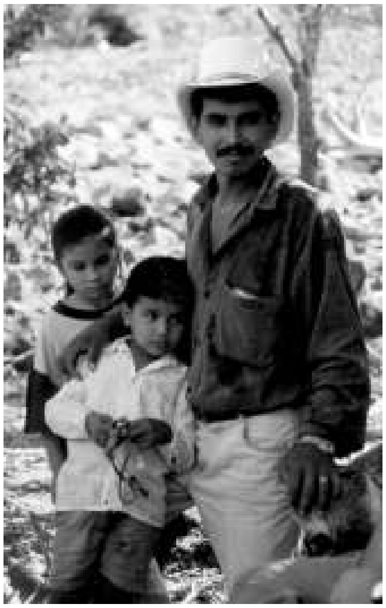
Lessons from the Field

Reasons for Resiliency: Toward a Sustainable Recovery after Hurricane Mitch

This report presents the methods and findings of an action research effort to measure and compare the impact of Hurricane Mitch on conventionally and agroecologically farmed lands in Honduras, Nicaragua and Guatemala. The project included farmers, promoters and local organizations as full partners in the research process, from beginning to end, and was designed to stimulate reflection and action based upon the lessons learned.

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Table of Contents

Acknowledgments

This project would not have been possible without the involvement of many people who gave their time and enthusiasm for a process they strongly believed in. Foremost among those who should be thanked are the nearly 2,000 farmers and promoters in Honduras, Nicaragua and Guatemala who took responsibility for collecting vital data and testimony about the impact of Hurricane Mitch at a time when they were still recovering from the storm themselves.

Members of the regional research team and national teams in each country were instrumental in carrying out this project. Eric Holt-Giménez conceived of the project, designed the methodology and served as regional coordinator. Gonzalo Rodríguez served as associate regional coordinator, and Ana Sonia Recinos served as regional methodologist and compiled the qualitative results. Jorge Cabrera and Grupo Kukulkan in Guatemala supported regional advocacy and outreach.

Pascal Chaput was national coordinator in Nicaragua and contributed to the survey design. Maritza Zuleta served as national coordinator for Honduras, and Manuel Camposeco served as national coordinator for Guatemala. All three provided invaluable skills and leadership. Data was analyzed by Nicolas Arroliga of Geodigital, in Nicaragua, and by Angel Rodríguez and Luís Caballero, of the Panamerican School of Agriculture at Zamorano, Honduras.

More than 40 local institutions involved in sustainable agriculture and rural development took part in this project, providing technical staff, creating local research teams and identifying farmers in the communities where they work to take part in the study. A full list of participating institutions is included in the Appendix, and all are gratefully acknowledged.

World Neighbors staff supported the project throughout. Raúl Zelaya, then Country Director for Honduras, and Oscar Castañeda, Country Director for Guatemala, provided strong leadership in their respective countries. Essential administrative support was provided by Nelly Cañadas in Honduras, Karla Calderón and Carla Aguilar in Guatemala and Doris Gómez in Nicaragua.

From World Neighbors headquarters in Oklahoma, José Quiñónez managed logistics, Pawan Gulati kept accounts, and Lala Ramirez provided administrative support.   Jim Durbin assisted with grant proposals, and Jethro Pettit supported the regional team and edited the final report. Catheryn Koss designed and produced the English report, and Raúl Zelaya and Nelly Cañadas translated and produced the Spanish version. Ron Burkard encouraged the project and ensured financial backing from World Neighbors.

A documentary video entitled *Changing Course* complements this report.   It was filmed and produced by Nicole Betancourt with Bray Poor and other associates of Nota Bene Productions. Without their donations of time and equipment, the video would not have been possible.

Finally, the generous and timely support of several private foundations gave this project the necessary resources to move forward. Grants from the Ford Foundation, The Rockefeller Foundation, The Summit Foundation and the Inter-American Foundation provided essential backing for the research process. Additional grants for local research teams in Nicaragua were made by Oxfam (Great Britain), ADESO (Nicaragua), SWISSAID (Switzerland), COOPIBO (Belgium) and Catholic Relief Services (USA). Intercooperacion (Swiss Aid) and ANAFAE (the Honduran National Network for the Promotion of Ecological Agriculture) provided funding for the research in Honduras.

Executive Summary

Hurricane Mitch

In October of 1998 Central America was devastated by Hurricane Mitch, the worst natural disaster to strike the region in 200 years. A tropical depression with heavy rainfall caused widespread flooding and landslides, destroying homes, bridges, roads, crops and animals, impacting 6.4 million people.

After the storm, much of the damage appeared to be related to poor land use and deforestation. The damage to agricultural land was especially uneven: farms using soil and water conservation methods and other agroecological practices seemed to have survived better than those using conventional farming methods.

Action Research

Many similar observations were shared among farmers and promoters involved in Farmer to Farmer, a grassroots movement promoting sustainable agriculture in Central America. In January 1999, a research team embarked on a participatory action research project to compare the impact of Hurricane Mitch on agroecological and conventional farms.

The project was designed to include farmers, promoters and local organizations as full partners in the research process from beginning to end, and to stimulate reflection and action based upon the lessons learned. In addition, the project aimed to inform decision makers and donors, and to influence recovery priorities and policies.

World Neighbors agreed to sponsor and facilitate the research, and helped obtain support from the Ford, Rockefeller, Summit and Inter-American Foundations. Additional support for research teams in Nicaragua was provided by Oxfam (Great Britain), ADESO (Nicaragua), SWISSAID (Switzerland), COOPIBO (Belgium) and Catholic Relief Services (USA). Intercooperacion (Swiss Aid) and ANAFAE (the Honduran National Network for the Promotion of Ecological Agriculture) provided funding for the research in Honduras. Forty local and international organizations joined the project, forming 96 local research teams to carry out field work in Honduras, Nicaragua and Guatemala.

The study examined paired plots of farmland that were selected for their similarities in nearly every respect. They shared the same topography, angle of slope, location on the watershed, intensity of the storm, type of crops, etc. The only variation was that one was agroecologically farmed and the other conventionally farmed.

A total of 1,804 plots were surveyed (902 agroecological and 902 conventional) in 360 communities spanning 24 departments of the three countries. Of these, 1,738 were found to have valid data and were included in the analysis. Data was processed for each of the three countries and the results were confirmed and validated in workshops with participants at the local, regional and national levels.

Participating farmers were also interviewed about their farming practices, economic and labor investments, crop types and yields, crop losses and observations of the hurricane's impact. Farmers were not objects of the study, but rather involved subjects and took an active role in the data collection and analysis, using and developing their own knowledge and technical abilities.

Executive Summary

Key Results

Data from all three countries demonstrated that plots farmed with sustainable methods withstood the force of the hurricane better than conventionally farmed plots on the most vital agroecological indicators, such as topsoil depth, moisture content and surface erosion.

The sustainably farmed plots had 28-38 percent more topsoil and 3-15 percent more soil moisture than their conventional neighbors. Surface erosion was 2 to 3 times greater on conventional plots than on agroecological plots, which suffered 58 percent less damage in Honduras, 70 percent less in Nicaragua, and 99 percent less in Guatemala.

Some results varied among the three countries. Landslides were 2 to 3 times more severe on conventional farms than on agroecological farms in both Honduras and Guatemala, but were worse on the agroecological farms in Nicaragua. Gullies were less pronounced on the agroecological plots than on conventional plots in Honduras. But in both Nicaragua and Guatemala, gullies were more severe on the agroecological plots.

Overall, the damage from gullies and landslides seems to have been equally severe on both types of plots, indicating that agroecological methods may not contribute to resilience in all conditions. Many gullies and landslides originated uphill or upstream from the test sites, on poorly managed, degraded or deforested slopes.

One lesson learned is that when promoting agroecological systems, conservation of the entire hillside and watershed must be considered. Protecting the upper areas of the watershed can help reduce damage in the lower elevations, where extreme water runoff can cause landslides and gullies. Working at the farm level alone is not enough.

It may be that certain steeply sloping or vulnerable lands should not be cultivated at all. Such areas may be better protected as forests. If true, this has implications for both land reform and reforestation efforts. Farmers on high-risk hillsides would need access to better land and/or incentives to grow and manage forests instead of farming.

These results were made all the more powerful by the fact that they were arrived at through a participatory process. The action research approach had a direct impact on the more than 2,000 people and 40 institutions involved. The study became a dynamic process of learning, sharing and validating knowledge and methods.

In the course of the research process, relations among technicians, promoters and farmers were strengthened; institutional networks were broadened; women and indigenous people were engaged in the process; family and community bonds were enhanced; and local decision makers were influenced.

Testimonies and opinions expressed by participants are shared throughout this report, reinforcing the technical findings and attesting to the positive influence of the action research on participating farmers and organizations.

A documentary video of the research process is also available in Spanish and English from World Neighbors.

Introduction

The Impact of Mitch

In October of 1998 Central America was devastated by Hurricane Mitch, the worst natural disaster to strike the region in 200 years. Winds of 180 miles per hour struck the Caribbean coast, followed by a tropical depression that hovered over the region's interior for a week, dumping more than 50 inches of rain.

> *That noise we heard was like a low-flying airplane. The rain sounded like a river. The noise could be heard for four days, and then that slowed a little. Then we heard the wind, that surrounded the trees and shook them from side to side. The creek thundered like a river...*
>
> **Nora Aguilar**
> Matagalpa, Nicaragua

The rainfall provoked massive floods and landslides, destroying homes, bridges, roads, crops and animals, impacting 6.4 million people. Of these, 9,976 were killed, 11,140 were never accounted for, 13,143 were injured and 500,000 lost their homes.[1]

In both Honduras and Nicaragua, a third of the population suffered some kind of loss or damage from Mitch. Eastern Guatemala was also heavily damaged. Total economic losses in the region were estimated at more than US$7 billion.[2]

Mitch affected all sectors of the population, but the poorest people in both urban and rural areas suffered the most. Most vulnerable were those living and farming on hillsides and near river banks. Floods and landslides damaged crops, land and infrastructure, and cut off vast rural areas from markets and services. One third of all economic losses were in the agricultural sector, at an estimated cost of US$2.3 billion.[3]

In Honduras, agricultural damages were estimated at US$1.7 billion. Thirty-two percent of farmers suffered total crop losses. Ten thousand hectares of land were stripped of their topsoil, and at least ten of the major watersheds were destroyed.

In Nicaragua, Sixty-two percent of farmers experienced losses. Fifty-nine percent of the bean crop and 35 percent of the corn crop were damaged, and thousands of hectares of land suffered from erosion and landslides.

In Guatemala, agricultural losses were estimated at US$258 million. Seven percent of all farmland (8,800 km sq) was affected by the hurricane. Ten thousand agricultural workers lost their jobs.[4]

Root Causes

In the aftermath of Mitch, it appeared that much of the damage was related to poor farming practices and deforestation. During the decades prior to this disaster, a massive loss of vegetative cover occurred throughout Central America. The extensive clear-cutting of forestlands for timber, ranching and farming, combined with widespread burning, left the region's mountainous terrain in a fragile and degraded state.

Between 1990 and 1995, Central America lost 2,284,000 hectares of forest cover, a trend which continues at the rate of 44 hectares per hour. In Honduras, for

ested areas were reduced from 41 percent of the country's land to 35 percent during this five-year period.[5]

More than 75 percent of the land in Nicaragua, Honduras and Guatemala is mountainous and ecologically fragile. The expansion of ranching, logging and plantation agriculture displaced millions of small farmers from lowland valleys into hillside areas. In Honduras, 82 percent of the rural population (2.1 million people) now lives on sloped land. Similar numbers are reported in Guatemala and Nicaragua, where more than two thirds of the rural populations farm on hillsides.

Land tenure is another factor. In Honduras, more than 80,000 farmers have plots half a hectare or smaller in size, and 250 thousand families own no land at all. Ninety percent of prime farmland belongs to ten percent of the population.

In San Marcos, the best land is owned by the rich, the cattle ranchers. The farmer is working on the highlands, and that is where most of the destruction has occurred.

Roberto Avila, Agriculture Promoter
San Marcos de Colón, Choluteca, Honduras

In Nicaragua, one of the poorest countries in the hemisphere, 75 percent of the people in rural areas live in poverty. The majority of small farmers lack credit, land titles and the technical help needed to diversify their farms and improve the fertility of their lands.

In Guatemala, approximately 87 percent of farms are smaller than seven hectares. These plots make up 15 percent of the total farmland, while 65 percent of all farmland belongs to only 2.6 percent of the farms.

Faced with very small holdings or no land at all, and a lack of reliable credit or technical assistance, rural families have little incentive to manage land in sustainable ways, to conserve soil and water, to protect forests or to prevent erosion and landslides. National policies that might encourage sustainable land use are weak or nonexistent. Indeed, most policies favor conventional farming and short-term land use, leaving both natural resources and rural people more vulnerable to disasters.

Central America's widespread rural poverty, unequal land tenure, and destructive patterns of farming and land use all contributed to a disaster simply waiting to happen. The degraded state of upland areas had devastating consequences for those living "downstream." As barren hillsides failed to retain or absorb water, a massive runoff carried away tons of topsoil, rocks and vegetation. Choked by the volume of water and silt, rivers overflowed their banks and destroyed urban centers, roads, bridges and farms.

A significant portion of Central America's population depends upon hillside farmers for food and grain. For example, 66 percent of the corn, and 80 percent of the beans consumed by Hondurans are grown on hillside land. The agro-export model that has prevailed in the region has intensified the challenges facing hillside farmers. Grain imports create a disincentive to local grain producers, restricting internal commerce and lowering prices to below their production cost.

Hurricane Mitch brought global attention not only to the vulnerability of small-scale, hillside farmers in Central America, but also to the important role they play in local food production and natural resource management. The hurricane exposed a vital connection between social and environmental sustainability – and put a spotlight on the role farming methods can play in resisting or accelerating disasters.

Mitch was not a natural disaster. The disasters have been happening over the years while we have been devastating the forests, burning the soils, and leaving the watersheds unprotected. Mitch was just a response to all those disasters.

Raúl Zelaya
World Neighbors Area Representative,
Central America

An Uneven Pattern

Hurricane Mitch left a devastating path, but the damage to agricultural land was uneven. Soon after the tragedy, it appeared that farms using soil conservation methods and other sustainable practices survived better than those using conventional farming methods.[6]

Observations were quickly shared among promoters and researchers involved in agriculture and rural development, suggesting that "areas where a lot of soil conservation has been done were only lightly hit"[7] and that "soil needs to be tied to the hillside."[8]

One program testing the impact of soil conservation in Honduras since 1993 reported that "cropped sites with vegetation contours, rock walls and tree fallows withstood the storm quite well, but sites that did not have these investments were devastated."[9]

Additional evidence was shared among farmers and farmer-leaders involved in the grassroots sustainable agriculture movement in Central America known as *Campesino a Campesino* (Farmer to Farmer), giving impetus to this action research project.[10]

Sustainable Agriculture

During the past 25 years of social and political turmoil, Central America has witnessed a "quiet revolution" in the area of sustainable agriculture, also known as agroecology. This movement has been led mainly by local, national and international non-governmental organizations.[11]

Using techniques that recover and build upon traditional knowledge, agroecology provides viable alternatives to soil degradation, burning, chemical use and the depletion of natural resources. Agroecology is also about social sustainability, seeking to address the poverty and insecurity that affect rural populations subsisting on hillside farms.

A wide range of soil conservation and other sustainable cultivation methods have been tested and promoted by these farmer-led initiatives in Central America over the years. Some of the most popular innovations include:

- **Soil and water conservation methods**, such as contour barriers, ditches, and terraces created with earth, rocks, live grasses and other plant species to hold the soil in place and help retain water.

- **Cover crops**, leguminous and other plant species grown with or between crop cycles to fix nitrogen, provide mulch or "green manure" as composting material, protect soil from the elements, control weeds and conserve water.

- **Agroforestry**, the practice of growing trees on farmland to provide a source of fuel, food, fodder, timber, fruit and compost material as well as to prevent erosion.

- **In-row tillage**, a practice of cultivating only the areas immediately around the seeds or plants in order to reduce soil runoff and concentrate nutrients.

- **Organic fertilizers** created from composted organic matter or using vermiculture, and applied to fields to increase soil fertility and help retain moisture in the soil.

- **Integrated pest management**, rotating crops, cultivating beneficial plants and insects, and using natural repellents and traps to protect crops from harmful insects.

- **Reduced or zero grazing**, whereby livestock are not allowed to roam through fields and are kept in pens, stalls or controlled pasture lands for easy feeding, collection of manure for fertilizer, and reduced damage to soil and croplands.

Conventional Agriculture

The dominant farming system among smallholders in Central America combines traditional shifting cultivation with modern chemical inputs. Farmland is typically cleared and burned before the planting season, plowed with the slope, and planted extensively. Inputs include hybrid seeds, fertilizers, pesticides and herbicides.

As land becomes scarce, it is farmed more continuously and with shorter fallow periods, which normally allow the soil to recover. This pushes farmers to literally "mine" the soil for nutrients, and to increasingly rely on chemical inputs.

Agroecology represents more than a substitution of natural for artificial inputs. It is a shift towards an altogether different farming system, one which is more intensive and permanent, and which works with the forces of nature by regenerating and conserving nutrients and other natural resources.

Farmer to Farmer

Some of the earliest agroecological efforts in Central America began in Guatemala in the 1960s and 1970s. This work was initiated by World Neighbors and supported by Oxfam UK in the community of San Martín, Jilotepeque in the department of Chimaltenango.

World Neighbors identified and trained about 50 indigenous agricultural promoters, who are now considered to be the founders of the Farmer to Farmer movement in the region. The methodology was first captured in the now-classic book *Two Ears of Corn*[12] by Roland Bunch.

During the early 1980's, the Farmer to Farmer movement spread to Mexico, Nicaragua and Honduras, where communities were organized to promote sustainable agricultural techniques such as soil conservation, in-row tillage, crop residue management, cover crops, agro-forestry, companion planting and use of organic fertilizers.[13]

In Nicaragua, the spread of the Farmer to Farmer movement was encouraged during the 1980s by the National Union of Farmers and Ranchers (UNAG), with support from the Nicaraguan government, the Ford Foundation and many other international agencies.

A hallmark of the Farmer to Farmer approach is the participation and leadership of farmers in all research and extension activities. By the late 1990's, an estimated 10,000 farmers and farmer-promoters were applying more than 35 technological packages on demonstration farms. The movement continued to receive support from dozens of local and international agencies.[14]

This is a program to transfer technology through horizontal channels of communication. First you teach a farmer, then he teaches another. That is why it is known as Farmer to Farmer.

José Andino, Nicaraguan Promoter

The Farmer to Farmer principles are to "learn by doing" and to respect the farmers' environment, their analysis of their situation, and their traditional knowledge. The training is effective because it is done orally, using simple, everyday language, and in a manner that respects cultural values. Frequent field visits serve as forums for feedback and sharing of results.

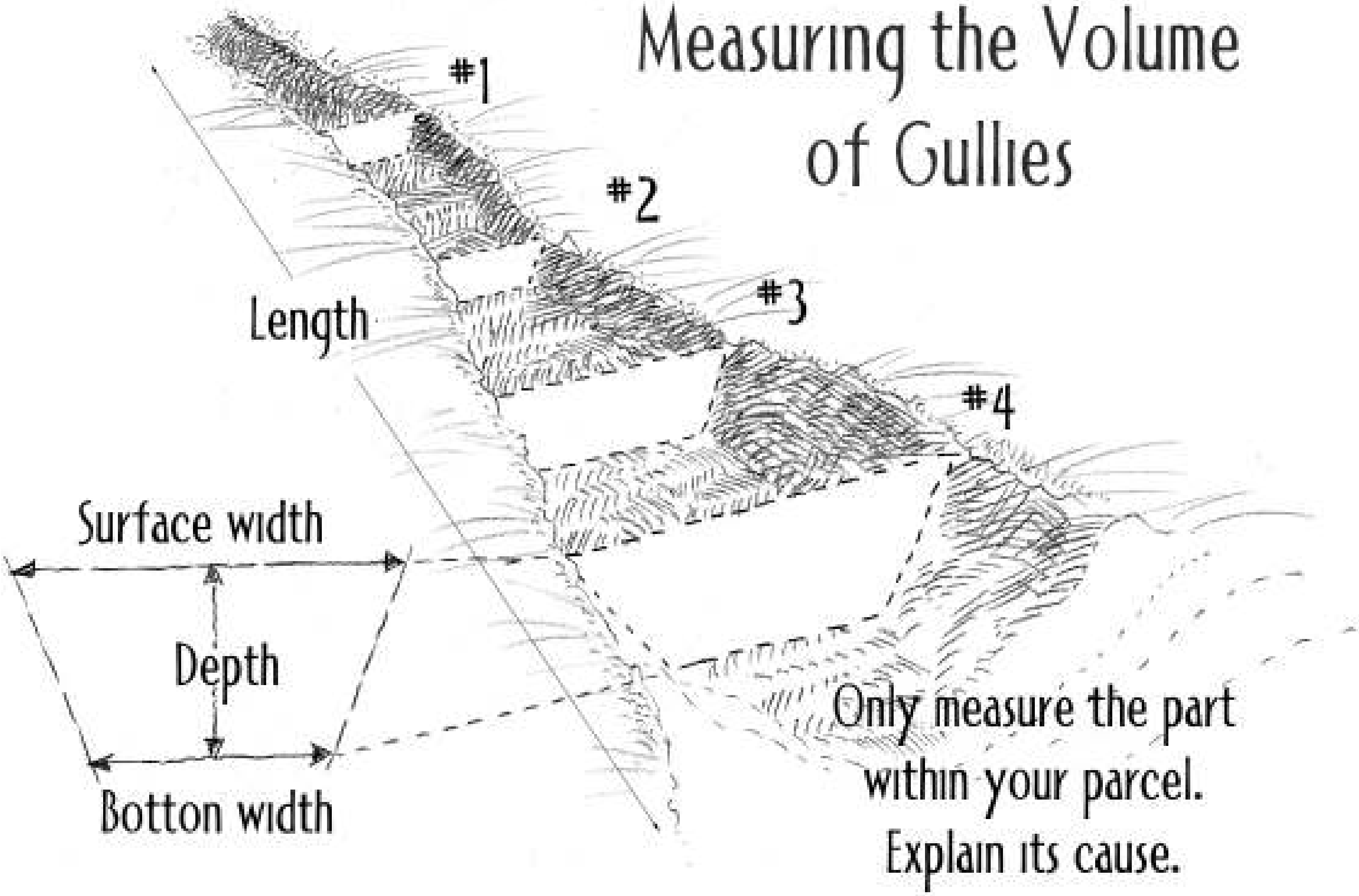
In this way, the Farmer to Farmer methodology goes beyond agricultural technology. The shift in farming techniques is part of a deeper change in consciousness. Farmer to Farmer promoters are respected as community leaders, and are guiding processes of transformation in the lives of Central American farmers.

This movement has profoundly changed the lives of many people. The methodology used by Farmer to Farmer empowers community members to participate, and takes as a starting point the farmers, their families, and their communities.

The 10,000 farmers practicing sustainable agriculture in Central America are but a tiny fraction of the more than four million hillside farmers in the region. Nonetheless, Farmer to Farmer has become a well-established and respected movement with potential for growth.

Hurricane Mitch revealed how fragile agricultural and environmental systems really are in Central America. But the storm's differential impact emerged as a silver lining in this disaster. Sustainable agriculture could be put to the ultimate test, and measured for its potential resistance and resilience to natural disasters.

Measuring the Volume of Gullies



Action Research

Overview

In January 1999, a team of development workers and researchers experienced in the Farmer to Farmer movement embarked on a participatory action research project to compare the impact of Hurricane Mitch on agroecological and conventional farms.

The project was designed to include farmers, promoters and local organizations as full partners in the research process, from beginning to end, and to stimulate reflection and action based upon the lessons learned. In addition, the project aimed to inform decision makers and donors, and to influence recovery priorities and policies.

World Neighbors agreed to sponsor and facilitate the research, and helped obtain support from foundations

Time was of the essence, because vital agroecological data would be lost once the next seasonal rains began in May. The network of Farmer to Farmer organizations was instrumental in mobilizing research teams and involving farmers in the process.

By March 1999, forty local and international organizations were involved in the project, and 96 local research teams were formed to carry out field work in Honduras, Nicaragua and Guatemala. All were organizations already working in communities affected by Mitch.

> *It was hard to locate the two types of plots, because we were meticulously searching for plots that filled all of the requisites and conditions needed. It was not easy to find a conventional plot neighboring one where soil conservation practices were used.*
>
> **Arturo, Promoter**
> Langue, Valle, Honduras

These institutions were also familiar with horizontal methods of training and farmer-led agricultural research and extension. This experience made possible the inter-institutional cooperation needed to carry out a regional study (please see the Appendix for a full list of participating institutions).

Plot Selection

The study examined paired plots of farmland that were selected for their similarities in nearly every respect. They needed to share the same topography, angle of slope, location on the watershed, intensity of the storm, type of crops, etc. The only variation was that one should be agroecologically farmed and the other conventionally farmed.

The plots were chosen through an intentional sampling process in affected regions where the participating institutions were already promoting sustainable agriculture. To ensure consistency, specific common criteria were used in selecting the pairs of plots:

- Proximity of the plots
- Intensity of rains and damage
- Slope of the plot
- Geology of the soil
- Location in the watershed and micro-watershed
- Cardinal orientation of plot
- Vegetation around the plot
- Type of permanent crop

A total of 1,804 plots were selected (902 agroecological and 902 conventional) in 360 communities spanning 24 departments of Honduras, Nicaragua and Guatemala. Of these, 1,738 were later considered to have valid data and were used in the data analysis.

Research Teams

Each of the 96 local research teams was made up of at least one technician and two farmer-promoters, who were directly responsible for gathering data on approximately ten paired plots (20 plots altogether per team). A total of 98 technicians and 208 farmer-promoters participated in the research teams.

The local research teams took part in intensive 1-2 day training workshops, where they learned about the project's objectives, the criteria to be used for selecting plots, and the methods for gathering and interpreting data. They practiced taking measurements, gathering data and filling out the forms designed for the study.

Local coordinators in each institution were given additional training to help them ensure a common understanding of the objectives and consistent application of the research methods. A National Coordinator in each country facilitated the trainings, made follow up visits, produced the final country report, and linked local institutions to one another and to the regional effort.

The regional team was made up of the Regional Coordinator, who designed the methodology, training materials and data collection instruments, an Associate Coordinator, and a Methodologist who compiled and synthesized the qualitative results. Professional database design and processing was also contracted in Nicaragua and Honduras.

Field Work

Each local research team systematically selected the ten pairs of plots to be studied in their region, based on the defined criteria. An entire day was spent studying each pair of plots. Both farmers (agroecological and conventional) helped to survey both plots – a practice which proved to be catalytic for many of the conventional farmers.

The agroecological indicators and biophysical damage assessed included:

- thickness of topsoil
- depth at which subsoil began
- depth at which moisture began
- soil texture and color
- vegetation cover (at 3 levels of height)
- organic matter in soil
- agroecological methods used
- crop losses and yields
- surface erosion
- gully erosion
- landslides

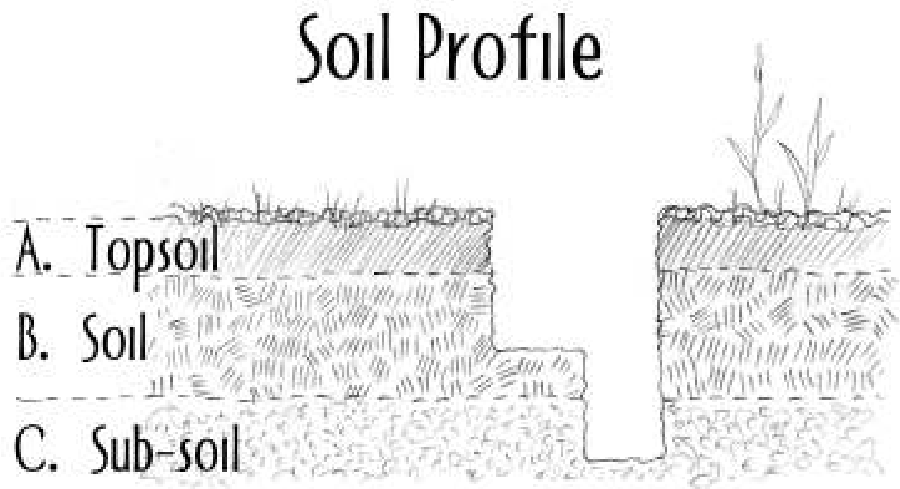
As the teams worked, the national coordinators made follow-up visits to clarify any misunderstandings and minimize mistakes. While it was not possible to accompany each team during the gathering of information, forms were checked thoroughly for errors.

Participating farmers were also interviewed about their farming practices, economic and labor investments, crop types and yields, crop losses and observations of the hurricane's impact.

Both tasks, the field work and filling out the forms, took up a lot of our time. We began the field work at 7:30 in the morning and stopped at 2:00 in the afternoon. Then we filled out the forms individually, following the instruction that asked to consider first the data on the conventional farmer, and then the data of the farmer that practiced sustainable agriculture.

Arturo, Promoter
Langue, Valle, Honduras

The researchers used open dialogue and a two-way communication style. Farmers were involved subjects and took an active role in the data collection, using and developing their own knowledge and abilities.



Data Synthesis

A database for each of the three countries was created by the national research teams and processed by Geodigital, based in Nicaragua. After review of the preliminary results, some errors were found in the data from Honduras and Guatemala. Further data processing, correction of the errors and elimination of invalid data was done by a support team from the Panamerican School of Agriculture at Zamorano, Honduras.

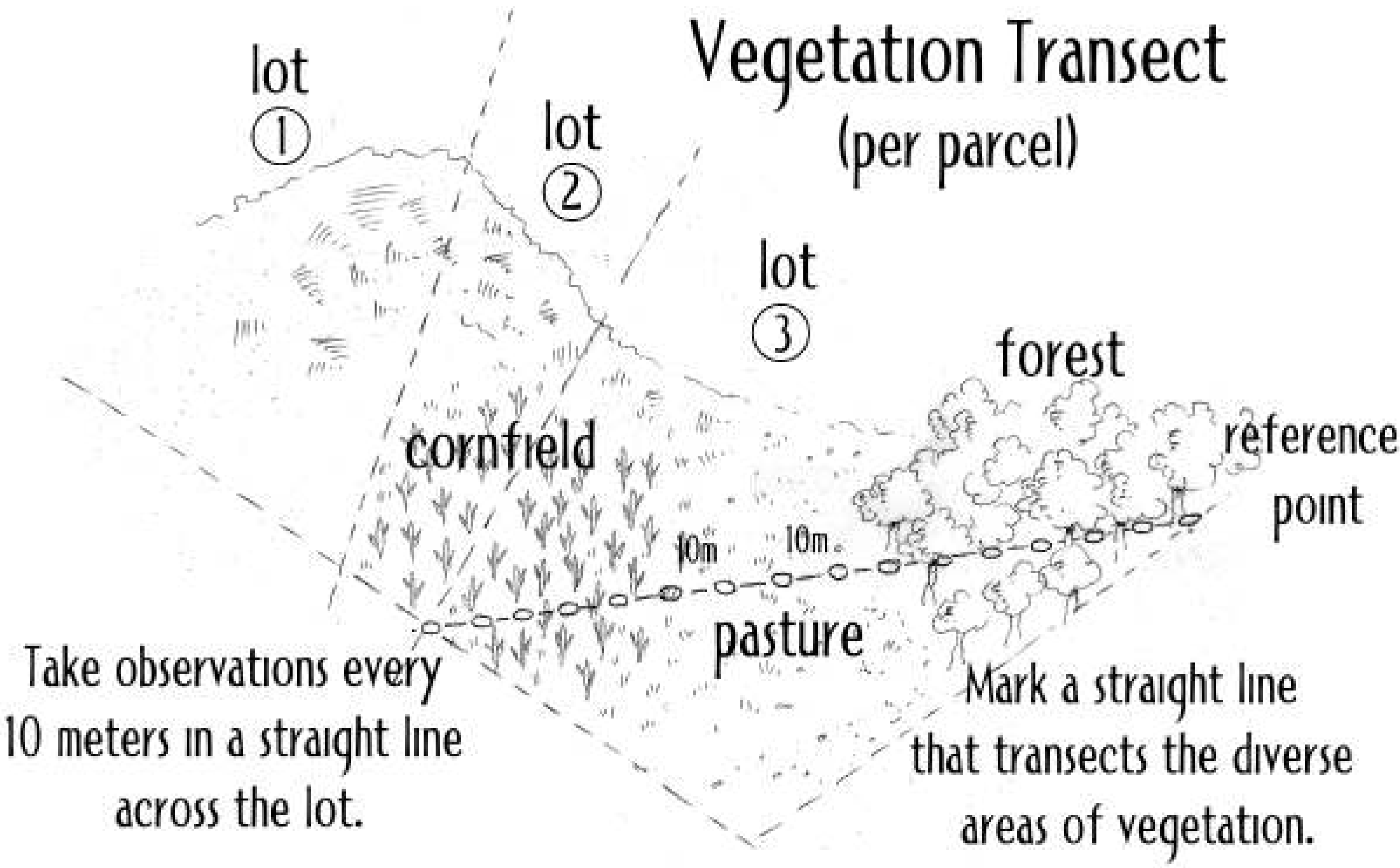
Given the sampling method used for plot selection, and the variability of some of the data, the research team was reluctant to apply overly rigorous tests of statistical significance. However, visible trends clearly emerged from the percentages, frequencies and media analyses done. These findings were then confirmed by the extensive testimony gathered from farmers (on both types of plots) and promoters. The testimony was collected through key informant interviews and during workshops.

Feedback Sessions

Once the data was processed, feedback sessions were held on three levels: with the local research teams; with groups of trained farmers; and with local and national organizations and government leaders. Fifteen meetings were held at the local level and three at the national level (Honduras, Nicaragua and Guatemala).

These meetings provided a forum for comparing and validating the findings from multiple sites, and for developing a more rigorous set of conclusions. Participants were able to confirm or correct the patterns they had observed, and to better understand the causes and consequences of the disaster. Attention was given to the role of agroecology in creating resilience and shaping a sustainable recovery process. Recommendations were made for future action and, in some cases, commitments and action plans were developed.

A documentary video was filmed during the field work in all three countries, and produced in both Spanish and English in time to be screened and distributed at the local, regional and national meetings. Copies of the video *Changing Course(Cambiando el Rumbo)* are available from World Neighbors.


lot
1
lot
2
lot
3
Vegetation Transect
(per parcel)
forest
reference point
cornfield
10m
10m
pasture
Take observations every 10 meters in a straight line across the lot.
Mark a straight line that transects the diverse areas of vegetation.

Technical Results

Overview

Analysis of the data collected in all three countries demonstrated that sustainably farmed plots fared better than conventionally farmed plots on the most vital indicators of agroecological resistance, such as topsoil depth, moisture content and erosion.

The sustainable plots had 28-38 percent more topsoil and 3-15 percent more soil moisture than their conventional neighbors. Surface erosion was 2 to 3 times greater on conventional plots than on agroecological plots, which suffered 58 percent less damage in Honduras, 70 percent less in Nicaragua, and 99 percent less in Guatemala.

Some indicators varied notably among the three countries. Landslides were 2 to 3 times more severe on conventional farms than on agroecological farms in both Honduras and Guatemala, but were worse on the agroecological farms in Nicaragua. Gullies (ditches deeper than 20cm) were much less pronounced on the agroecological plots than on conventional plots in Honduras. But in both Nicaragua and Guatemala, gullies were more severe on the agroecological plots.

> *You can see the difference between the plots with regards to management and to crop traditions. In the conventional plot we could see that the soil was poorer, its coloration more red, the topsoil shallower. While in the agroecological plot, the profile of the soil was darker. The coloring was dark brown.*
>
> **Juan Ramón Alvarez, Promoter**
> San Ramón, Nicaragua

Possible explanations for these findings and variations are explored below, in the analysis for each of the key agroecological indicators.

Soil Profiles

Soil profiles were conducted by making a vertical cut of about 60 cm long, 30 cm wide and 50 cm deep at specified locations on each plot. These samples were used to examine the soil characteristics and to measure the soil layers.

The thickness of the topsoil and soil, and depth of the subsoil were measured, as was the depth at which moisture began. To determine soil texture and coloration, a small sample of soil was mixed with water and observed through a series of steps.

Topsoil

Topsoil is a combination of minerals and decomposed organic matter. The available nutrients and consistency of topsoil make it capable of sustaining plant life. A thick layer of topsoil helps retain water and promote healthy plant development. It offers more nutrients, reduces the need for chemical fertilizers, and can be highly productive.

As shown in Table 1, agroecological plots had an average of 1.5 – 2.5 cm greater depth of topsoil than

Table 1. Average depth of topsoil (cm)

	Agroecological Plots	Conventional Plots	Difference	Percentage*
Honduras	9.03 cm	6.52 cm	2.51 cm	38.5%
Guatemala	6.88 cm	5.35 cm	1.53 cm	28.6%
Nicaragua	9.11 cm	6.56 cm	2.55 cm	38.9%

* Percentage of additional topsoil depth in Agroecological vs. Conventional plots

When comparisons were made between the paired off-plots, the thinner topsoil seen in the conventional plots indicates that this year we have lost great amounts of topsoil. Earth's blood is leaking into the rivers.

Lucas Camposeco, Promoter and Technician
Jacaltenango, Huehuetenango, Guatemala.

conventional plots. This difference was even more pronounced in areas of more intense rainfall and storm damage.

To visualize the effect of this difference, an additional 2 cm of topsoil on one hectare of land is equivalent to 3,388 bushels of soil. In Nicaragua, some farmers quantified the value of their topsoil at US$0.85 per bushel, for a value of US$1,440 per hectare for each centimeter of topsoil.

This difference is most likely the product of years of soil conservation work by the agroecological farmers, and not to a variation in the original condition of the land. The agroecological farmers simply had smaller losses under similar conditions, due to their preventive measures.

Moisture Content

Moisture plays an important role in dissolving minerals in the soil which allows plants to absorb these nutrients. Soil conservation measures, combined with other agroecological practices, improves fertility by increasing the soil's capacity to absorb water.

Agroecological methods can reduce vulnerability by retaining and filtering more water, thereby limiting runoff and erosion and at the same time recharging water tables. Greater moisture is also beneficial for crop yields, especially during prolonged dry weather.

Research teams recorded the depth at which moisture began to appear in each of the excavated soil profiles, using both tactile and visual observations. The depth was greater (i.e. less moisture) in conventional plots than in agroecological plots. Again, this difference was more pronounced in areas of more intense rainfall.

Even small differences in moisture depth of between 3-14 percent, such as the averages of 0.3 – 1.9 cm shown in Table 2, contribute to agroecological resilience. Greater moisture retention correlates to lower levels of potentially damaging runoff. And for a farmer, one extra centimeter of moist soil can prevent crop loss during a drought.

Vegetation Cover

Vegetation cover on agroecological plots may include cover crops, agroforestry crops, live contour barriers, and shade trees used to protect the soil, fix nitrogen and provide biomass. Organic material from such vegetation helps restore the natural fertility of the soil and can also provide a source of animal fodder and firewood. A wide vegetation cover helps to diminish the force of rain

Table 2. Average depth at which moisture begins (cm)

	Agroecological Plots	Conventional Plots	Difference	Percentage*
Honduras	9.98 cm	10.28 cm	-0.30 cm	-2.9%
Guatemala	2.44 cm	2.99 cm	-0.44 cm	-15.3%
Nicaragua	15.81 cm	17.80 cm	-1.99 cm	-11.2%

* Percentage of additional moisture in Agroecological vs. Conventional plots

drops hitting the soil, thereby decreasing the risk of topsoil being loosened and washed downhill. Root systems of grasses, bushes and trees further protect the soil from erosion.

A promoter in Matagalpa, Nicaragua observed that in forested areas, soil was retained better than in exposed areas. He also noted that in areas where soil conservation practices had been used,

In those areas where the forest was scarce, the disaster hit hardest. The forest disperses water, it dilutes it, it makes it go in different directions. This allows water to fall softly on the crops. And if the plot has been worked using conservation techniques, so much the better.

Pedro Zavala González
El Aguacata farm, Buena Vista, Nicaragua

Table 3a. Vegetation Cover (percentage of plot covered)

	Agroecological Plots	Conventional Plots	Difference*
Honduras			
ground	56.11%	96.63%	-40.52%
bush	11.61%	25.11%	-13.5%
tree	14.07%	9.21%	4.86%
Guatemala**			
ground	66.51%	62.82%	3.69%
Nicaragua			
ground	51.69%	44.07%	7.62%
bush	10.56%	10.25%	0.31%
tree	14.41%	11.89%	2.52%

* Percentage of additional vegetation cover on agroecological vs. conventional plots.

** In Guatemala, only ground level vegetation cover was measured

Table 3b. Vegetation Density (height or thickness)

	Agroecological Plots	Conventional Plots	Difference	Percentage*
Honduras**				
ground	18.00 cm	17.05 cm	0.95 cm	5.6%
bush	62.62 cm	59.05 cm	3.57 cm	6.0%
tree	3.35 cm	2.88 cm	0.47 cm	16.3%
Guatemala				
ground***	3.62 cm	1.92 cm	1.70 cm	88.5%

* Percentage of additional height or thickness on agroecological plots vs conventional plots

** Average height of vegetative cover for ground vegetation (cm), bushes (cm) and trees (mt)

*** Average thickness of ground cover (cm)

there seemed to be less "washout." These conservation measures included live and dead barriers, and windbreaks. "There was less damage in those plots than in the conventional plots that had no vegetation cover; these plots washed out fast."

Research teams measured and compared the percentage of vegetation cover at three levels of height on a transect across each plot: ground level, bushes, and trees. They also measured vegetation height and density. In Nicaragua and Guatemala, agroecological plots had more vegetation cover than conventional plots (Table 3a).

In Honduras, agroecological plots had less vegetation cover than conventional plots at the lower levels, but more (and higher) tree cover. Both Honduras and Guatemala had higher levels of density (height or width) in all of the vegetation measured (Table 3b).

Biophysical Damage

Biophysical damage refers to a range of effects on the soil profile. Research teams measured three types of biophysical damage: surface erosion, gullies and landslides.

Surface erosion is the washing away of surface topsoil. On hillside farms, it is the most common cause of degradation and declining productivity. Gullies are ditches running down the hillside of 20 cm or greater in depth. Landslides are a complete dislodging of soil, vegetation and rocks.

During the study both surface erosion and landslides were measured by surface area (square meters), and gullies were measured by total volume (cubic meters).

Surface Erosion

Surface erosion was two to three times greater on conventional plots than on agroecological plots in Honduras and Nicaragua, and was almost nonexistent on agroecological plots in Guatemala. Land farmed sustainably suffered 58 percent less erosion in Honduras, 70 percent less in Nicaragua, and 99 percent less in Guatemala than land farmed conventionally.

This data, presented in Table 4, is fully consistent with the findings on thickness of topsoil. Surface erosion is the most common type of soil erosion, and is also the most easily controlled by soil and water conservation practices.

Gullies and Landslides

In Honduras, as shown in Table 5, agroecological plots suffered less gully damage than conventional plots. In Guatemala and Nicaragua, however, agroecological plots suffered greater damage than conventional plots.

A similar observation was made for landslides (Table 6). Agroecological plots in Honduras and Guatemala suffered less damage from landslides, but those in Nicaragua suffered from more.

There were some weaknesses in the collection of data related to both gullies and landslides. In the field, this was a more complex task than expected, compared to the other indicators. Many gullies and landslides were larger than the sample plots and the teams failed to estimate relative values. This limited the validity of the data.

Table 4. Average area of Surface Erosion (m2)*

	Agroecological Plots	Conventional Plots	Difference	Percentage**
Honduras	7.85 m2	18.95 m2	11.1 m2	58.6%
Guatemala	0.12 m2	19.47 m2	19.35 m2	99.4%
Nicaragua	130.88 m2	444.98 m2	314.10 m2	70.6%

* Averages for Honduras and Guatemala are per plot, and for Nicaragua per *manzana* of land

** Percentage of additional area eroded on Conventional vs. Agroecological plots

Table 5. Average volume of Gullies per plot (m3)

	Agroecological Plots	Conventional Plots	Difference	Percentage**
Honduras	31.80 m3	102.26 m3	70.46 m3	221.6%
Guatemala	29.95 m3	9.38 m3	20.57 m3	-68.9%
Nicaragua	97.54 m3	73.51 m3	24.03 m3	-24.6%

* Percentage of additional gully volume on Conventional vs. Agroecological plots

Table 6. Average area of Landslides per plot (m2)

	Agroecological Plots	Conventional Plots	Difference	Percentage**
Honduras	102.17 m2	221.93 m2	119.76 m2	117.2%
Guatemala	15.18 m2	62.03 m2	46.85 m2	308.6%
Nicaragua	508.83 m2	391.11 m2	117.72 m2	-23.1%

* Percentage of additional landslide area on Conventional vs. Agroecological plots

However, when checked against visible observations and testimony at the farm level, the damage from gullies and landslides seems to have been equally severe on both types of plots. This was an important lesson, indicating that agroecological methods may not have added to resilience in some conditions.

A likely reason is that much gully and landslide damage covered an area greater than the plot being measured. Much of the damage originated uphill or upstream from the test site, on slopes or watersheds with poorly managed or degraded lands. Deforestation was observed uphill from a number of landslides and gullies.

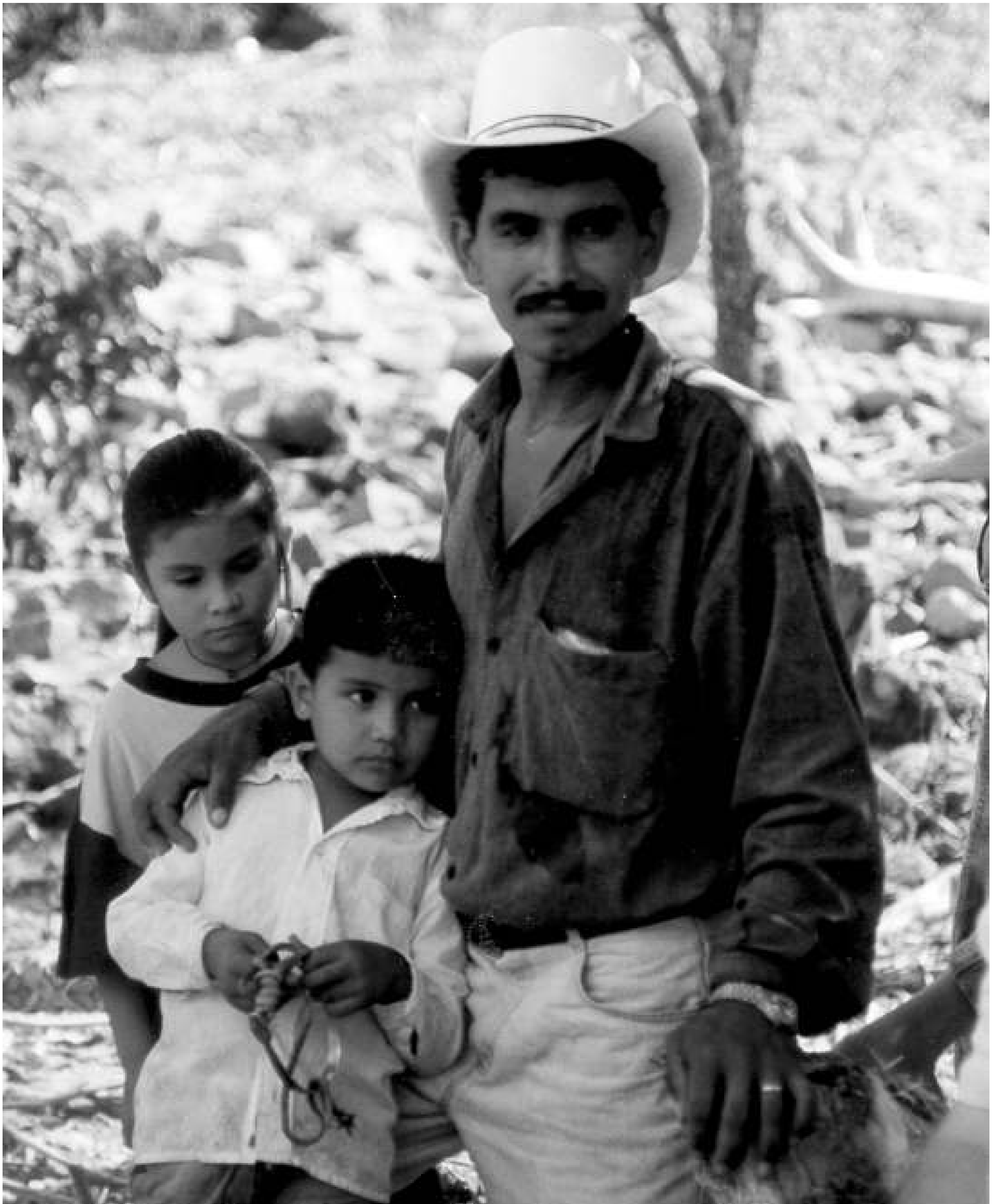
Monday, when everything was over, I had the courage to come and inspect my land. I was happy because the erosion was minimal. What erosion you can see here, to me is nothing. I can fix it easily. Other brothers suffered great loss of land, and they will no be able to plant anything on them. In other words, they have no land left to work.

Vladimir Briones Sosa
El Aguacatal, Buena Vista, Nicaragua

One lesson learned is that, when promoting agroecological systems, conservation of the entire hillside and watershed must be considered. Protecting the upper areas of the watershed can help reduce damage in the lower elevations, where extreme water runoff can cause landslides and gullies. Working at the farm level alone is not enough.

Another possible explanation is that landslide damage is more directly related to the geological characteristics of the soil and subsoil than to types of agricultural practices. Therefore, faced with a phenomenon of Mitch's strength, any intervention, including agroecological methods, has its limitations.

It may be that certain areas such as land with high degrees of slope, or other geological conditions such as soil structure, should not be cultivated at all. Instead, such highly vulnerable slopes may be better protected as forests. If true, this has implications for both land reform and reforestation efforts. Farmers on high-risk hillsides would need access to better land, and/or be encouraged to grow and manage forests instead of farming.



Social Impact

Overview

The technical findings demonstrated that lands farmed sustainably are more resilient to erosion and runoff, and retain more topsoil and moisture, than lands farmed conventionally. They also revealed that the conservation of forests and watersheds is vital regardless of farming methods, and that some land may be unsuitable for cultivation.

These results were made all the more powerful by the fact that they were arrived at through a participatory process. The action research approach had a direct impact on the more than 2,000 people and 40 institutions involved. The study became a dynamic process of learning, sharing and validating knowledge and methods. Relations among technicians, promoters and farmers were strengthened, institutional networks were broadened, women and indigenous people were engaged in the process, family and community bonds were enhanced and local decision makers were influenced.

The testimonies and opinions expressed by participants in interviews and during local and national meetings attest to these effects.

Participation

Broad and genuine participation in the project helped to extend its impact in the communities. Whole families, including children, were involved in the field work, accompanying the teams to the plots to conduct the research. Many farmers expressed the desire to share what they had learned with neighbors and relatives.

Today we had the satisfaction of learning more from what our colleagues have said. Now we will go and communicate this to our family, so that they learn new things, and how to plant better in our plots.

Farmer at a local meeting
Linaca, Choluteca, Honduras

Although more men than women participated in the study, the women involved enhanced their technical skills and gained the respect of other farmers. Several women commented that participating allowed them to break out of their traditional roles, since their agricultural experience was mainly limited to family orchards. All of this helped to raise their self-esteem, and earned them recognition in their communities.

In Guatemala, ten indigenous technicians and 27 indigenous promoters participated in the field teams, which allowed for cross-cultural exchange, sharing of knowledge, and the strengthening of understanding among people of different ethnic groups and cultures.

In all three countries, ties between neighbors were strengthened, as were relationships between the

I think that this research project will be more beneficial to the farmer. The most important factor of this process is that the farmer participates directly. Other research projects have always been done by technicians, or more educated personnel. In this case it is not so. The promoters themselves are participating in the survey. They are doing the whole process, they are doing the counting, the profiles, they are observing the slopes, and the differences between plots. Both the conventional and agroecological farmers will really see the differences that exist between plots that are conserved and those that are not.

Juan Ramón Alvarez
San Ramón, Nicaragua

research teams and the farmers. Both the promoters and technicians agreed that one of the aspects of the study that they enjoyed the most was the time for dialogue and building friendships.

In this way, the research process served to strengthen the transfer of knowledge about sustainable agriculture among and between families and communities, making it more likely that these methods will be advanced by future generations.

Farmer Awareness

Many farmers were convinced that they would lose more land and soil if they continued practicing conventional agriculture, and they recognized that sustainable agriculture could prevent or diminish future damage.

Those who practice conventional agriculture did not feel good while we were conducting our survey in their plots, and they realized that they had sustained more damage, maybe because the plot was not taken care of properly. Everything that is not taken care of properly has its price.

Roberto Avila
San Marcos de Colón, Choluteca, Honduras

This means that we have to go beyond that work. As a community we have to make sure that water sources are sufficiently protected, that our plots, and those of our neighbors have trees. We have to have barriers, not only low, but also including fruit trees. As long as we have adult forests, we will have the means to resist forces like Mitch. We must achieve a more global change.

Participant at a local meeting
Güinope, Honduras

For Roberto Avila, a promoter in San Marcos de Colón in Choluteca, the greatest impact of the study was that several conventional farmers affirmed that they would begin soil conservation practices on at least a small plot of land. Some have already begun to do so.
After observing the differences between the plots, participants were encouraged to broaden their knowledge, and to adopt new agricultural practices.

One Nicaragua, farmer, Carlos Cruz, said that he used to collect leftover cornstalks and burn them. Because of the study he understood that he was killing the organisms in the soil, and that it is best to chop leftovers up and leave them on the soil to enrich it.

Many farmers also realized that agroecology alone is not enough to protect their farms. In the local meeting in Güinope, Honduras, participants concluded that they were not prepared for another phenomenon like Mitch, and they realized that the soil conservation work already undertaken was not sufficient to resist the fury of the storm.

Now we are thinking of reforestation, contouring the land, and setting up windbreaks to give more protection to the soil. Because of the study, we are thinking about improving the environment to help us keep our land. With this study we are learning how we can cover our land so that it won't wash away, or dry out.

The sea is rich with the flowers of our earth, but will no longer do this work. With time, the flowers of the earth will be enriched. Burning corn stalks impoverishes the land. A good rain falls, and it washes away.

Carlos Cruz, Nicaraguan farmer

Social Impact

A Learning Process

The study was also a practical learning opportunity for those involved. Farmers were trained to take measurements and analyze the condition of their soil and farms. They learned to make sketches and maps of their plots and to identify their positions in relation to the valleys and other topographic characteristics. They also became more familiar with both types of agricultural practices.

> *It is a great experience for me, and we have all taken this experience as an additional tool, because it is a simple process that we can teach others. It is a process easy to understand, and people like it because it is dynamic and no one falls asleep.*
>
> **Promoter**
> Santa Barbara, Honduras

In Tocoa in the north of Honduras, participants stated that they had learned about levels of deforestation in the zone, and about the types of crops being cultivated. They also affirmed that the study helped them become more aware of the economic, social, and cultural situation of farmers in the surveyed areas.

Those who participated in the survey teams also learned and adopted new techniques. The success of this methodology lies in the participation of farmers at all stages of the research, and the harmonious balance between theory and practice.

Institutional Effects

The study's influence on the institutions and organizations involved, at all levels, was also clear from the testimony. Farmer groups and non-governmental organizations at the local and national levels gained important insight and skills through their involvement. The links between these groups were strengthened.

At the local level, many organizations and farmer groups had mobilized themselves already in response to the humanitarian emergency. Farmer to Farmer groups helped to motivate self-help efforts in their communities, rather than simply waiting for outside assistance. This local leadership was then carried over into the research process.

This capacity for self-mobilization among farmer groups indicates that resilience has a social as well as a technical dimension. While not explored in this study, the dynamic social and organizational fabric of the Farmer to Farmer movement was observed throughout the research process.

The Farmer to Farmer movement was itself strengthened through the exchange of knowledge among farmers, promoters and technicians. Participating institutions improved their capacities to evaluate the impact of their work, and to

> *There was a great difference between people who were organized, not only in the Farmer to Farmer Program, but also in other organizations. People that were organized received help faster than those that were on their own. And that is a result of being united, working for the good of the community.*
>
> **Nicaraguan Promoter**

Social Impact

People who only learn for themselves, and are not capable of sharing their knowledge with a colleague, cannot participate in this process of sustainable agriculture. When you help others, you see with satisfaction that you are not alone when you progress. Your neighbor and colleague is also progressing. I think that every farmer should see their plot as a school where others can learn and share experiences. This will be more productive, because if we were able to develop the research, we will also be able to do other work with our neighbors from the community.

Honduran farmer in a local meeting
Siguatepeque, Honduras

reach out to new communities and farmers. Many farmers involved expressed their wish to become volunteer promoters of sustainable agriculture.

In the three countries, the number of participating institutions exceeded World Neighbors expectations, indicating the high potential for broad inter-institutional coordination in the region when the challenge of promoting sustainable agriculture and land use is of general interest.

Many organizations pooled their resources and provided mutual support during the research. This collaboration broadened each institution's vision and motivated some to move towards more sustainable practices.

In Guatemala, students from Rafael Landívar University felt that the experience helped them to understand the reality of farmers displaced because of the internal armed conflict in Corozo, Izabal, and the suffering caused by Mitch.

The National Coordination of Indigenous Peasants (CONIC), a Guatemalan farmer organization working for land rights, has made known their decision to institutionalize sustainable agriculture within their organization for the area of Livingston.

Similar outcomes were observed in Honduras. In Santa Bárbara, at the end of the local meeting, the authorities of the High School Institute expressed their wish to include agricultural and environmental protection in their curriculum.

The hurricane awoke the organizations that were asleep. Now all local organizations are functioning, including women's groups, who are doing community work, like building roads and orchard planting projects.

Lucrecia Martínez, Promoter
San Juan of Linaca, Choluteca, Honduras

Social Impact

World Neighbors staff and program leaders were influenced to adopt a broader, natural resources management approach. All projects now consider the watershed or micro-watershed as a basis for planning agricultural development activities, while continuing to give priority to the needs of the poorest farmers.

Local Government

Many actors not directly involved in the research were also influenced by the study. This was true with municipal authorities who, in some municipalities of Choluteca and Francisco Morazán in Honduras, made a commitment to take measures to protect natural resources and to support sustainable agriculture.

The commitment of several of them went beyond that. For example, an Auxiliary Mayor in Linaca, Choluteca made the decision to become a member of the local Cooperative after participating in one of the meetings. Local authorities have become aware of the needs of communities that had been previously forgotten.

This research helped us to reflect. Together, we will now write a different story. We will, as promoters, together with institutions and the municipal government, carry out a conscientious work so that we no longer have to regret.

Participant in a local meeting
Choluteca, Honduras

Local capacity to influence state policies was strengthened through the wide diffusion of the results of the study. For example, in Guatemala, the Minister of Agriculture showed interest in the study and stated that for the year 2000, sustainable agriculture will be one of the components of agrarian policies.

In Yuscarán, where World Neighbors and Zamorano worked in the past, there was a very successful project in the lower part of the watershed, but not so in the upper part. During Mitch, the lack of conservation practices in the upper part provoked landslides that devastated several years of soil conservation work in the lower part.

If you work blindly in regard to nature, nature can wipe out your work in a second. Now we are raising our heads and considering watersheds and the wider environment in our everyday decisions.

Raúl Zelaya
World Neighbors Area Representative for Central America

Conclusion

Summary of Findings

In all three countries, agroecological plots withstood the impact of Hurricane Mitch better than conventional plots, according to the most vital indicators of agroecological resistance: depth of topsoil, depth of moisture and surface erosion.

The sustainable plots had 28-38 percent more topsoil and 3-15 percent more soil moisture than their conventional neighbors. Surface erosion was 2 to 3 times greater on conventional plots than on agroecological plots, which suffered 58 percent less damage in Honduras, 70 percent less in Nicaragua, and 99 percent less in Guatemala.

Other indicators varied notably among the three countries. Landslides were two to three times more severe on conventional farms than on agroecological farms in both Honduras and Guatemala, but were worse on the agroecological farms in Nicaragua. Gullies were much less pronounced on the agroecological plots than on conventional plots in Honduras. But in both Nicaragua and Guatemala, gullies were more severe on the agroecological plots.

Overall, the damage from gullies and landslides seems to have been equally severe on both types of plots, indicating that agroecological methods may not contribute to resilience in all conditions. Many gullies and landslides originated uphill or upstream from the test sites, on poorly managed, degraded or deforested slopes.

One lesson learned is that when promoting agroecological systems, conservation of the entire hillside and watershed must be considered. Protecting the upper areas of the watershed can help reduce damage in the lower elevations, where extreme water runoff can cause landslides and gullies. Working at the farm level alone is not enough.

It may be that steeply sloping or vulnerable lands should not be cultivated at all. Such areas may be better protected as forests. If true, this has implications for both land reform and reforestation efforts. Farmers on high-risk hillsides would need access to better land and/or incentives to grow and manage forests instead of farming.

These results were made all the more powerful by the fact that they were arrived at through a participatory process. The action research approach had a direct impact on the more than 2,000 people and 40 institutions involved. The study became a dynamic process of learning, sharing and validating knowledge and methods.

In the course of the research process, relationships among technicians, promoters and farmers were strengthened; institutional networks were broadened; women and indigenous people were engaged in the process; family and community bonds were enhanced; and local decision makers were influenced. The study demonstrated the validity of participatory action research as a tool of social impact that contributes to the strengthening of local capacities, and that generates changes in the participants' attitudes.

Recommendations

These recommendations were derived from research findings and observations, from the opinions and demands of farmers, promoters and technicians participating in the project, and from local, regional and national meetings held in each country.

Conclusion

1. Mitch brought worldwide attention to the social and environmental vulnerability of Central America, and to the interconnected nature of economic injustice and ecological degradation. Governments in the region should formulate and implement **policies that lead to sustainable development,** including all sectors of society as stakeholders.

2. This sustainable development strategy should give **priority to addressing both social and environmental conditions in the mountain regions,** where most of the rural populations live, where the lowest poverty indicators are found, and where ecological degradation threatens the livelihoods of not only the rural poor but of vast urban populations downstream.

3. A fundamental part of these policies should be the **equitable distribution and legal titling of farmland.** The majority of small farmers do not have title to the land they cultivate, and this is widely recognized as a disincentive for the use of sustainable agricultural practices. Farmers without property titles also have limited access to credit or financial services.

4. Economic and social costs derived from environmental degradation are high and impact society as a whole. Therefore, **it is urgent to develop policies aimed at providing incentives for the conservation of the environment.** Such policies must go beyond sustainable agriculture, to include the restoration and protection of forests and watersheds.

5. **Incentives could be provided to hillside populations for environmental conservation efforts,** such as providing financial compensation for the maintenance of watersheds, reforestation, biodiversity conservation, protection of topsoil or prevention of runoff.

6. **Sustainable agricultural methods should be promoted** through national research and extension programs and agrarian policies. Incentives to farmers could include the **reduction or deferment of taxes** on land where sustainable agriculture is practiced, as well as on the agricultural and forest products derived from this system. In addition, mortgage rates could be decreased and estimated land values increased where sustainable agriculture is utilized.

7. Mechanisms must be developed to **guarantee local and international markets for organic produce** and other products from sustainably managed farms, at fair prices to producers. For this it is necessary to create a certification system and to educate consumers in the region.

8. There is a need for an **agroecological farming research network**, which can establish research priorities, promote learning and exchange, manage an information and resource center, and maintain a database on sustainable agriculture.

9. Finally, sustainable development in Central America requires support for **stronger local institutions and initiatives** aimed at agroecology and community self-development.

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Appendix

List of Participating Institutions

Honduras

Aldea Global
CASM
Cooperativa COMUCAMEL
Cooperativa COMVICOL
Grupo GUIA
Pastoral Social Juticalpa
PROCONDEMA
PRODELCAS/Pastoral Social, Trujillo
SERTEDESO
Vecinos Mundiales

Nicaragua

ADAA-UCA
ADDAC
Asociación Tierra y Vida
CARE
CITES
CIPRES
FIDER
INPRHU-Somoto
NITLAPAN
OCTUPAN
PAS-Omotepe
PCAC-Boaco
PCAC-Masaya
PCAC San Dionísio
PCAC-Somoto
PRODESSA
UNAG-Managua
UNICAM

Guatemala

ASEDE
ASOAGRO/KOLWAL
CONIC
Defensores de la Naturaleza
FUNDAECO
FUNDATEP
INTERN
Pastoral de la Tierra/San Marcos
Universidad Rafael Landívar/CONDEG
Vecinos Mundiales

World Neighbors is a people-to-people, non-profit organisation working at the forefront of worldwide efforts to eliminate hunger, disease and poverty in Asia, Africa and Latin America.

World Neighbors' purpose is to strengthen the capacity of marginalized communities to meet their basic needs. By strengthening these primary resources, people are helped to analyse and solve their own problems. Success is achieved by developing, testing and extending simple technologies at the community level and training local leaders to sustain and multiply results.

We affirm the determination, ingenuity and inherent dignity of all people. Working in partnership with people at the community level since 1951, World Neighbors is recognized as a leader in participatory community development.

Programme priorities are food production, community-based health, family planning, water and sanitation, environmental conservation and small business.

World Neighbors is a non-sectarian, self-help movement supported by private donations. World Neighbors does not solicit nor accept U.S. government funding.

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