Fallow and its relationship to forest recovery

In our study, sustainable agriculture did not contribute to fallow amount or duration and, therefore, had no effect on forest recovery.

Use of chemical inputs and contamination of the environment

The farmers included in our study used very little, if any, chemical fertilizers or pesticides. Because of these small numbers, there was no evidence that sustainable agriculture contributed to decreased contamination from chemical inputs. However, as sustainable agriculture use contributed to decreases in the use of fire to prepare fields, we can conclude that it reduces air pollution from smoke.

Attitudes about the environment

In general, farmers who used sustainable agriculture techniques were more aware of the importance of biological resources and their relationship to agricultural practices. In addition, sustainable agriculture programs proved to be crucial to building trust and confidence in the communities in which Defensores de la Naturaleza and Línea Biósfera work.

Community organization as a mechanism to contribute to conservation

Community organization played different roles in the sustainable agriculture projects at our study sites. In Guatemala, Defensores de la Naturaleza's sustainable agriculture program served as a mechanism to encourage farmers to participate in subsequent conservation activities. In Mexico, the highly organized nature of communities provided the foundation for the adoption and diffusion of sustainable agriculture throughout the project area.

THE CONVENTIONAL WISDOM ON SUSTAINABLE AGRICULTURE AND CONSERVATION

BSP, Línea Biósfera, and Defensores de la Naturaleza wished to test some of the major underlying assumptions related to the use of sustainable agriculture as a tool for achieving conservation. The assumptions that we include here come from our review of the available literature and discussions with researchers, project managers, and other professionals in the fields of conservation and development. Based on our review, we generated a list of key hypotheses that we have summarized into our list of *Conventional Wisdom* or presently held beliefs and assumptions related to the linkages between sustainable agriculture interventions and biodiversity conservation.

We have intentionally not included the literature review we conducted for this study in order to keep this publication as short as possible. If you are interested in the extensive literature available on sustainable agriculture, please refer to the many books and articles cited in the References section of this publication or go to ***www.BSPonline.org*** *for a copy of our literature review.*

We divide the Conventional Wisdom into two main sections: Conventional Wisdom related to the direct impacts of sustainable agriculture on biodiversity conservation and Conventional Wisdom related to its indirect impacts. We first define the main variable we wish to investigate and the Conventional Wisdom most associated with this variable.

Direct Impacts of Sustainable Agriculture on Biodiversity

The literature and conservation professionals generally assume that sustainable agriculture will have a direct impact on conservation by decreasing rates of deforestation through reduction of demand for new agricultural lands by farmers. This linkage seems simple enough: increase crop production per unit of land around areas of high biodiversity, and rural poor farmers will not need to deforest more land for agriculture to meet household demands. The belief is, in essence, that if you can attract farmers living around areas of high biodiversity to a development intervention that has such high economic returns to labor, then the conservation benefits will flow naturally. As a result of these sustainable agriculture interventions, it follows that project managers could expect to see a deceleration of the advance of the *agricultural frontier* into areas of high biodiversity and, therefore, decreased rates of deforestation. In addition to affecting rates of deforestation, the Conventional Wisdom holds that sustainable agriculture programs have a direct impact on forest regeneration and contamination of the environment.

Agricultural frontier *refers to the boundary that divides land that is devoted to agriculture and land that remains as intact natural area. Because of pressure from human populations living in adjacent areas, this frontier increasingly shifts into the natural areas.*

Rates of Deforestation

Definition: Deforestation is the loss of primary or mature secondary forest through cutting or burning. In the case of much subsistence agriculture — the target of the sustainable agriculture programs that are the focus of this study — farmers cut down and burn forests for agriculture. Once land is depleted of its nutrients and weed infestation becomes difficult to control after only a few years, farmers slash-and-burn more to open new agricultural fields. As population pressures intensify, or technologies, market forces, and policies change, this process of cyclical forest destruction leads to increased rates of deforestation.

Conventional Wisdom: Adoption of sustainable agriculture techniques for subsistence crops leads to decreased rates of deforestation because farmers need less land to feed their families.

Farmers often clear new agricultural lands either immediately adjacent to or within heavily forested areas.

Forest Regeneration

Definition: Forest regeneration refers to the extent of forest regrowth after land is no longer used for agriculture.

Conventional Wisdom: Adoption of sustainable agriculture leads to greater rates of forest regeneration because farmers intensify labor inputs on less land thereby allowing other land, once used for agriculture, time to return to a forested state.

Contamination of the Environment

Definition: Contamination of the environment from agricultural practices is evident in many forms, including pollution from chemical fertilizers and pesticides, erosion of agricultural lands that causes sedimentation of rivers and streams, and production of smoke from burning during field preparation.

Conventional Wisdom: Adoption of sustainable agriculture techniques leads to decreased contamination of the environment.

Indirect Impacts of Sustainable Agriculture on Biodiversity

Many project managers believe that sustainable agriculture's greatest value to biodiversity conservation is the indirect benefit it provides by functioning as a way for conservation organizations to win the trust and confidence of community members. Project managers believe that by focusing on issues that are most important to rural poor populations (such as agriculture), community members are more inclined to work with conservation organizations on future projects more directly linked to conservation (such as strict protection or environmental education). This approach has been recently classified as the *bridge strategy* for integrating conservation goals and development activities.

*For a complete analysis of the **bridge strategy** and other related strategies for integrating conservation goals and development activities, see Margoluis, R., S. Myers, J. Allen, J. Roca, M. Melnyk, and J. Swanson. 2001. An ounce of prevention: Making the link between health and conservation. Washington, D.C.: Biodiversity Support Program, or visit the BSP Web site at **www.BSPonline.org**. Adapting the definition from this publication, the bridge strategy involves undertaking an agriculture project with the intention of linking it conceptually (i.e., in the minds of project personnel and farmers) to conservation activities. Communities may initially only see the agriculture benefit of the project; however, in the future, they may realize the connection between their own agricultural needs and conservation. This perception, it is assumed, will prompt community residents to participate in other future conservation activities.*

The Conventional Wisdom holds that community members' attitudes will become more supportive of conservation activities and messages once a conservation organization wins the trust of the community. In addition, organization of the community around an issue unrelated to conservation will increase a community's capacity to organize itself for other conservation-related activities in the future.

Gaining the trust of local people – such as this village mayor in Guatemala – is key to conservation success.

Attitudes Concerning Conservation

Definition: Attitudes concerning conservation include perceptions by farmers related to the relationship between biodiversity and the quality of their agriculture, their family's health, and the environment in which they live, including water and air.

Conventional Wisdom: Farmers who participate in sustainable agriculture projects have attitudes about conservation that are more positive than those who do not participate. These attitudes leave them more open to participating in future conservation activities.

Participation in Community Organizations

Definition: In many rural communities, local organizations are an important part of the social structure and management of community affairs. Community members may participate on development, education, or infrastructure committees. Organizations such as cooperatives and religious groups also play a vital role in community life. In some countries, communities participate in broader regional or national organizations as well. Many conservation organizations view community organization as a mechanism to work efficiently with dispersed communities.

Conventional Wisdom: Farmers who participate in sustainable agriculture projects are more likely to be involved in other community and outreach activities than those farmers who do not participate.

This Conventional Wisdom serves as our basic framework to better understand the conditions under which sustainable agriculture is an effective strategy to reach conservation goals.

WHAT DID WE DO?

This study was designed primarily to determine the conditions under which sustainable agriculture is effective as a conservation tool and to determine principles for its implementation. But the study also was designed to determine the best way to promote learning within implementing organizations and how to effectively share lessons learned with the broader conservation community. Our approach to this project can, therefore, be divided into two main sections: (1) determining conditions and principles and (2) helping project partners to answer their own questions.

Partner Organizations and Study Sites

This study included two sites from Guatemala and Mexico managed by local NGOs. In Guatemala, Defensores de la Naturaleza manages the Sierra de las Minas Biosphere Reserve. In Mexico, Línea Biósfera works in the El Ocote Biosphere Reserve. (For the complete case studies, including more detailed information about both of these sites, go to ***www.BSPonline.org****.)*

The Sierra de las Minas Biosphere Reserve

The Sierra de las Minas is located in northeastern Guatemala between the Polochic and Motagua valleys. It includes about 240,000 hectares of mostly mountainous terrain that extends across five departments. In 1990, the Guatemalan Congress declared the Sierra de las Minas a protected area and resolved that Defensores de la Naturaleza would be primarily responsible for its management. The core area of this biosphere reserve is rich in plant and animal species and is home to the beautiful quetzal bird, howler monkeys, harpy eagles, and jaguars. The Sierra de las Minas is also home to numerous communities scattered throughout the Reserve's multiple use and buffer zones. Much of Defensores de la Naturaleza's sustainable agriculture efforts have focused on the north side of the Reserve, which is inhabited primarily by the Q'eqchí indigenous people. This study took place in two watersheds on the north side: Río Pueblo Viejo and Río Zarco.

The Sierra de las Minas stretches from lowland tropical forest to high mountain cloud forest and harbors a wealth of plants and animals.

The El Ocote Biosphere Reserve

El Ocote encompasses some 50,000 hectares and was declared a protected area in 1982. The Reserve is located in the northeastern zone of the state of Chiapas in Southern Mexico and is part of the larger Selva Zoque ecoregion. El Ocote is considered one of Mexico's most important centers of biological diversity and is home to some 570 species of terrestrial vertebrates. This Reserve contains 45% of all vertebrate species in Chiapas and 23% of all vertebrate species in Mexico. El Ocote also is culturally diverse and is home to Tzotzil, Zoque, Tzeltales, and mestizo groups. Línea Biósfera has been working in the El Ocote Biosphere Reserve for more than 10 years to find a balance between the socioeconomic needs of the people who live in the Reserve and its conservation needs. Since 1993, Línea Biósfera has been working with farmers who are part of la Unión de Ejidos Triunfo de los Pobres — the focus of this study in Mexico.

Water produced by the El Ocoto Biosphere Reserve helps maintain the Nezahualcóyotl reservoir.

Determining Conditions and Principles

Determining the conservation effects of sustainable agriculture projects was a much more difficult task than we originally expected. Because proponents of sustainable agriculture argue that adoption of sustainable agriculture techniques slows the advance of the agricultural frontier and, therefore, slows rates of deforestation, our initial response was to examine this relationship at a broad geographical or regional level.

When we mention broad geographical or regional scales in this publication, we refer to a unit of area that is larger than that which a single family or community affects through its agricultural practices. This unit necessarily encompasses many communities and the land they use for agriculture and it may cut across municipal, county, state, or departmental boundaries.

At first, it all seemed to be pretty easy. All we had to do was determine where farmers were using sustainable agriculture techniques, measure the changes in the movement of the agricultural frontier, and presto! we would be able to measure the effects of sustainable agriculture on deforestation! But unfortunately, the puzzle of determining causality is much more complex.

We had to look for a different approach to making the link between sustainable agriculture and deforestation. Trying to do it on a broad geographical scale was impossible for a variety of reasons, including the following:

- **Precise rates of deforestation are difficult to calculate and the information did not exist for our sample.** In the two sites that were a part of this study, no reliable data existed to calculate rates of deforestation either before or after the sustainable agriculture projects began. Therefore, there was no way we could measure how rates changed over time. Although some aerial photography existed for one of the sites, it was incomplete for the years included in the project. Finally, on a regional scale, the mechanism through which the expansion of agriculture leads to deforestation is a relatively slow process. Although the immediate effects of clearing of forest for agriculture are readily seen on a scale of a couple of hectares, rates of deforestation are much more difficult to calculate and measure over short periods of time (for example, two or three years) when examining large geographic areas.
- **Determining control or comparison groups is difficult.** Some adoption of sustainable agriculture techniques by farmers occurred in many of the communities across both study sites. Finding comparison communities, or areas in which there was no sustainable agriculture but that were otherwise similar enough to those sites included in our study, proved nearly impossible. In other words, we could not control for differences between communities — something we would have had to do if our unit of analysis was the community.
- **The proportion of farmers who adopted sustainable agriculture varied over space and time.** In some communities in our two study sites, only a handful of families used sustainable agriculture techniques. In other communities, adoption was close to 100%. Likewise, in some communities, adoption rates increased over time while in other communities, adoption rates decreased over time. This variability made it challenging, if not impossible, to link adoption of sustainable agriculture at the community level to changes in deforestation rates.
- **Many other variables affect deforestation.** Although expansion of subsistence agriculture is a direct cause of deforestation, it is not the only cause. Deforestation may also occur because of clearing of land for pasture, construction of homes and new communities, and commercial logging. In addition, many underlying or indirect factors influence the relationship between agriculture and deforestation, including market, sociodemographic, political, and cultural factors (Kaimowitz and Angelsen 1998). We had no way to control for these factors across communities and regions in order to look at the sustainable agriculture-deforestation link on a broad geographic scale. This particular issue proved to be the biggest hurdle to overcome — one that in the end was insurmountable.

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So, if we could not look at how sustainable agriculture influenced rates of deforestation on a regional level, how then could we measure this relationship? How could we precisely and specifically measure causality between sustainable agriculture and conservation if we could not do it by looking across a large region where sustainable agriculture is practiced? The answer required a fundamental shift in the way we had conceived the study.
We decided that, if we could not measure the effects of sustainable agriculture on deforestation at a regional scale, then perhaps we could measure this relationship at a different scale.

The Conventional Wisdom we outlined in the previous section is clear about the mechanism through which sustainable agriculture influences conservation. Although the expected impact is regional in nature, it starts with individual farmers and their families making decisions about land-use management — where and how they carry out agricultural activities. In its most basic form, therefore, the effects of sustainable agriculture on conservation should be detectable in individual household-level plots of agricultural lands.

As the need for new farmland expands, the agricultural frontier increasingly shifts into previously untouched areas.

Understanding deforestation attributable to subsistence agricultural expansion at a regional scale can be simplified by understanding deforestation from agricultural expansion at a family farm scale. In essence, regional deforestation attributable to subsistence farming is the sum of all deforestation that occurs at the household level for agricultural purposes, assuming no changes in other variables that affect the number of farmers or their behavior. Deforestation at the household level is a reflection of the amount of land farmers need to clear to plant crops to provide for their families. It is relatively easy to measure changes over time in area planted and, thus, the demand for new land, at the household level.

Similarly, it is difficult to accurately measure regional rates of forest regeneration. We can, however, measure the extent to which individual farmers allow forest recovery to take place. We can measure this by looking at the amount of land farmers have in *fallow* and the length of time they leave the land in fallow. The reasoning is similar to that for the relationship between rates of deforestation and household area planted: the greater the amount and duration of land left in fallow by a farmer, the greater the contribution to forest regeneration.

***Fallow** refers to agricultural land that is left inactive for a period after harvest so the soil can recuperate some of its nutrients. During the time land is left in fallow by farmers, natural regeneration of forest generally occurs (this type of regeneration is often referred to as "secondary forest").*

Decisions regarding land use in rural subsistence societies occur principally at the household level. It is also at this level where the myriad factors that affect land-use patterns have their greatest impact. For these and the above reasons, our best option for measuring the association between sustainable agriculture and conservation outcome proved to be at the household level. At this level, we could compare the conservation outcome of those farmers who used sustainable agriculture techniques with those of farmers who did not use such techniques. For some of our analysis, it was necessary to disaggregate the household-level data even further into agricultural plot units, because some farmers had more than one plot of land and their agricultural practices sometimes varied between plots. This approach allowed us to compare plots in which farmers used sustainable agriculture techniques with plots in which farmers did not use sustainable agriculture techniques. These scales — household and plot — enabled us to deduce the impacts of sustainable agriculture on conservation at a regional scale.

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FOCUSING THE CONVENTIONAL WISDOM

Based on our analysis of the challenges of measuring deforestation and forest regeneration on a regional scale and the advantages of measuring them on a household scale, we have rephrased the Conventional Wisdom that we outlined in the preceding section.

Measuring Deforestation

Area Planted to Subsistence Crops

Definition: Sustainable agriculture is based largely on the assumption that farmers destroy intact forest to open new agricultural lands for subsistence crops. Sustainable agriculture also is based on the assumption that it will decrease the amount of land that a farmer needs to feed his or her family as crop yields increase. Area planted is the amount of land (in acres or hectares) that farmers have under cultivation to specific crops — in the case of our sample, primarily maize and beans. The amount of area planted is often a function of available inputs such as land, labor, seeds, fertilizers, pesticides, and other technologies. It also is a function of demand such as that caused by family size or the need for cash.

Conventional Wisdom: Adoption of sustainable agriculture techniques for subsistence crops leads to a reduction in the area of land farmers need to have under cultivation to meet household demands. Reduction in demands for new agricultural lands decreases the need to deforest new lands, thus reducing rates of deforestation.

Measuring Forest Regeneration

Fallow Area and Duration

Definition: Fallow area refers to the amount of land that farmers have in fallow. Fallow duration refers to the length of time a plot of land is left in fallow by a farmer.

Conventional Wisdom: Adoption of sustainable agriculture leads to increases in fallow area and duration, thereby allowing for greater recovery of forested areas.

Our Sample

The sample for this study was determined, in large part, by the organizations that were involved with BSP in the initial conceptualization of this research project. Línea Biósfera and Defensores de la Naturaleza have historically worked in two protected areas that, in many respects, are very similar. In addition, since about 1991, they have been involved in promoting sustainable agriculture as a conservation tool in and around protected areas.
The two organizations were, in fact, two of the original NGOs in Central America and Mexico that were involved in a World Wildlife Fund (WWF-US)-supported project designed to promote sustainable agriculture as a conservation tool. Additionally, organizations from Brazil, Peru, and Honduras were originally involved in this WWF-US

project that lasted until about 1998. Serving as the primary trainer and facilitator for the project was a Honduran NGO, COSECHA, founded to promote sustainable agriculture in Latin America and around the world.

To address the first two goals of this study, we had to carefully select the sites and farmers to include in our sample. If we had selected wildly different sites, with completely different environmental, social, and cultural factors influencing sustainable agriculture adoption and conservation, then it would have been virtually impossible for us to determine useful guiding principles for project managers working under similar conditions. If we had selected sites that were very similar to each other in many respects, then we would have run the risk of producing principles that were applicable only to those sites and not generalizable to other sites. The challenge was to come up with a sample of sites and households that were similar enough to control for some of the major confounding factors that could influence the sustainable agriculture-conservation relationship, but different enough that we could compare the influence of specific factors and conditions between sites.

The trade-off was clear. We could either include a wide range of projects under widely varying conditions and generate very general guiding principles, or work with a small, focused subset of projects to establish precise and specific principles that could also be applied to other projects under similar conditions. We decided to pursue the latter because there is little concrete guidance that project managers can use to select and implement various interventions under different conditions. In addition, we thought it prudent to test our assumptions and methods on a smaller sample, and then possibly include other sites in a subsequent study. Finally, for reasons related to available budget and staff time, working with a limited number of sites that were close to each other was the best option.

In order to strike this balance, we developed the following list of criteria that we used in selecting sites for the study:

Environmental and Geographic Factors

- **Project is located in Mesoamerica.** Primarily for logistical reasons, we needed to find projects that were relatively close to each other. By selecting only projects in Mesoamerica, we also controlled for a variety of social and cultural factors.
- **Project takes place in a mountainous area.** Different sustainable agriculture techniques have different uses depending on the environmental conditions in which they are applied. Many techniques are used solely to combat some of the challenges to farming in mountainous areas, such as erosion. Selection of techniques and their utility is thus often dependent on slope.
- **Project is located in tropical moist forest.** Selection of sustainable agriculture techniques is also dependent on rainfall and other climatic conditions. The techniques most used in arid conditions, for example, are often different from those selected for areas that receive much rain.

Social, Cultural, and Economic Factors

- **Farmers live in communities that are rural and agrarian, situated next to or in a protected area.** Land-use patterns often are determined by the socioeconomic situation of the people who live in a given region. People living in urban areas will use land differently from people living in rural areas. As sustainable agriculture use is related to agricultural practices in general, it is important to select farmers who are similar in this respect. Location near a protected area is important because, for our purposes, sustainable agriculture must be implemented as a tool to achieve biodiversity conservation goals.

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Families included in this study live in or near biosphere reserves – often very close to the core areas.

- **Farmers own small family farms.** Farmers who plant crops almost exclusively to feed their families are different from farmers who plant crops for primarily commercial reasons. In addition to employing different agricultural practices, amount and types of inputs are usually different between these two types of farmers, as is the area of land that they cultivate. Only *subsistence farmers* whose primary crops were maize and beans were included in the study because the planting of these crops has been the primary focus of sustainable agriculture projects in the past.
- **Farmers are relatively poor and have access to limited resources.** Socioeconomic status has some bearing on how farmers work their fields and on their willingness to try the sustainable agriculture techniques that are promoted in these types of projects. Likewise, access to resources will have some bearing on adoption rates and conservation outcomes.

Management Factors

__Subsistence farmers__ in our study include those farmers who plant maize and beans primarily to feed their families. These farmers may, however, sell some of their harvests to earn cash income to buy household items and services needed by family members. In addition, these farmers may plant cash crops for additional income.

- **Sustainable agriculture is used as a biodiversity conservation tool in and around a protected area.** For our study, the goal of the sustainable agriculture intervention must be conservation. Because sustainable agriculture is believed to have both socioeconomic and environmental impacts, the outcome of these two factors would probably be different depending on the primary goal of the implementing organization.
- **Project is managed by an NGO and is implemented in multiple communities.** Implementation of a sustainable agriculture project by different types of institutions will influence outcome as well. For example, the conservation impact of implementation by a national agriculture agency focused on family production will probably be different from that of a local NGO focused on biodiversity conservation.
- **Implementing NGO has worked in the relevant sustainable agriculture extension program for five years.** The effects of sustainable agriculture projects do not happen overnight. Time is needed to determine how adoption of sustainable agricultural techniques influences factors in both the socioeconomic and conservation realms.

After an extensive search, we found three sites that fit these criteria. In the end, we included only the El Ocote Biosphere Reserve and the northern side of the Sierra de las Minas Biosphere Reserve described above.

Because we wanted to measure the conservation impacts of sustainable agriculture and we had decided to use households and agricultural plots as our units of analysis, we needed to compare farmers who used sustainable agriculture techniques with farmers who did not use these techniques. We were particularly careful to define precisely what it meant to be included in the study as a farmer who uses sustainable agriculture (referred to here as “SA User”) and what it meant to be a farmer who did not use sustainable agriculture (“SA Non-User”). If farmers used any of the sustainable agriculture techniques that had been promoted by the participating NGOs, then they were classified as SA Users.

In addition to classifying farmers, we also classified individual plots because some farmers had more than one plot (although most had only one plot) and SA Users did not necessarily use sustainable agriculture in all of their plots. If any sustainable agriculture technique was used in a plot, we classified it as an "SA Plot." If no sustainable agriculture techniques were used in the plot, we classified it as a "Non-SA Plot." During preliminary interviews with candidate farmers, we determined user status in order to immediately classify each household. We classified plot status later during farmer interviews.

It turned out that not all the techniques initially promoted by the implementing NGOs were adopted by participating farmers. Of the 10 techniques originally promoted by Defensores de la Naturaleza in the Sierra de las Minas, 3 were used by farmers: planting a cover crop known as velvetbean (*Mucuna pruriens*), minimum tillage, and live barriers. Línea Biósfera originally promoted more than 15 techniques and then focused its efforts on 6. In the end, farmers in El Ocote adopted primarily three of these, including planting velvetbean, minimum tillage, and integrated pest management. In both sites, the technique used most frequently by farmers was planting velvetbean.

The Attraction of Velvetbean

Velvetbean is a leguminous climbing plant that has been used in agriculture for many centuries. Originally from India and China, velvetbean has found its way to Africa; South, Central, and North America; and the Caribbean. Farmers in Mesoamerica have been using velvetbean since the 1920s. It is believed that velvetbean was introduced into Guatemala from the United States by the United Fruit Company to control weeds on banana plantations. The use of velvetbean in maize fields on the north side of the Sierra de las Minas, Guatemala, and in Chiapas, Mexico, was first reported in the 1950s.

Like most legumes, velvetbean has the potential to fix atmospheric nitrogen and store it in its leaves, vines, and seeds. This important nutrient becomes available to other surrounding crops such as maize and beans as leaf litter decays, after the plant has been slashed with a machete, or when the velvetbean plant is turned into the soil. For this reason, in many parts of Mesoamerica, velvetbean is known as frijol abono *or "fertilizer bean" in English.*

Velvetbean helps control weeds and provides mulch and nitrogen — all-important for the cultivation of maize.

In the 1970s, development organizations incorporated velvetbean into their suite of sustainable agriculture techniques for a variety of reasons. In addition to its ability to fix nitrogen, it is extremely effective at controlling weeds in agriculture plots. It is also a hardy plant that grows quickly, is easy to cultivate, and is drought-resistant. Regular use of velvetbean decreases labor requirements to prepare, plant, and weed agricultural plots, making it very attractive to farmers.

Adapted from Buckles, D., B. Triomphe, and G. Sain. 1998. Cover crops in hillside agriculture: Farmer innovation with mucuna. Ottawa, Canada: IDRC/CIMMYT.

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In each site, we selected communities in which the implementing NGO had promoted sustainable agriculture for at least five years. From each of these communities, we selected our sample of SA Users and SA Non-Users. We used a sampling technique called *quota sampling*, which required the selection of a predetermined number of individual cases (in this case, SA Users) and an equal number of comparison individuals (in this case, SA Non-Users) to provide sufficient statistical power to discern a difference, if in fact one exists, between the two groups. The accepted practice is to collect at least 100 representatives in each group, giving a sample of at least 200 at each site. In fact, both Línea Biósfera and Defensores de la Naturaleza exceeded this minimum, with Línea Biósfera sampling 300 and Defensores de la Naturaleza sampling 308. The even split between SA Users and SA Non-Users can be seen in the following table. With these samples, we were able to analyze the data for each site separately, and then combine the samples to do analysis across our two sites.

Number of SA Users and SA Non-Users Included in the Study – Guatemala and Mexico

SITE	SA USERS	SA NON-USERS	TOTAL
Guatemala	*154*	*154*	*308*
Mexico	*150*	*150*	*300*
TOTAL	*304*	*304*	*608*

We selected the two groups for our quota sampling using a technique called *frequency matching*. This step in the data-collection phase was extremely critical because it provided us with a sample that made it possible for us to isolate the effects of sustainable agriculture use. Using a sheet that profiled a typical household found in the study site — including household, demographic, and socioeconomic factors — we matched SA Users to Non-Users to ensure that the two groups were as similar as possible, except for their user status. We controlled for the following potentially confounding variables: gender of primary farmer in the family (all primary farmers in the study were men), family size, access to goods and services, and family wealth. If an equal number of families could not be selected from the same community, SA Non-User families were selected from another community that was most similar to the SA User community with respect to environment, infrastructure, socioeconomic status, and access to goods and services.

Results of Matching SA Users and SA Non-Users – Guatemala

FACTOR	SA USERS (%)	SA NON-USERS (%)
Family's principal crop is maize	*154 (100)*	*154 (100)*
Family has 4-6 children	*86 (55.8)*	*86 (55.8)*
House has tin roof	*94 (62.7)*	*90 (59.6)*
House has wooden walls	*96 (63.2)*	*99 (66.0)*
House has dirt floor	*149 (99.3)*	*154 (100)*
House has no electricity	*146 (98.6)*	*154 (100)*
House has potable water	*84 (55.6)*	*86 (57.3)*

Data Collection

Field teams that spoke the local languages (Q'eqchí in Guatemala and Tzotzil in Mexico) were recruited and organized by the two implementing NGOs and trained by BSP. All data-collection instruments were developed and field-tested jointly by the three participating organizations. In this way, we were able to standardize the instruments so that both quantitative and qualitative data were collected using the same questionnaire or topic guide at each site. All field data collection took place during the fall of 1998. We developed the following four instruments to collect quantitative data:

For copies of the data-collection instruments we used for this study, see ***www.BSPonline.org****.*

Direct Observation Checklist. This checklist allowed interviewers to quickly assess the socioeconomic status of the interviewee and ensure that the family fell within established general selection criteria.

Family Matching Sheet. This instrument allowed the interviewers to appropriately match SA Users and SA Non-Users. On each form, a profile of the SA User was filled out and an SA Non-User was then sought that matched this profile, except for user status. We matched (and therefore controlled for) the following variables: primary occupation of father, observed socioeconomic status, family size, and access to electricity and a potable water system.

Household Questionnaire. Interviewers asked each farmer a series of questions from this form to determine his (all interviewees were men) knowledge, attitudes, and practices related to agriculture and conservation. In addition, interviewers recorded household characteristics, including socioeconomic status, level of education, age structure of the family, and sources of income.

Plot Survey. Some farmers had more than one plot of land. For each plot, the interviewer recorded the size and age of the plot, what crops were being planted; techniques used, including sustainable agriculture; inputs; problems with agricultural pests; and yields. This instrument also was used to collect historical data on each plot. In addition to answering questions about the year in which the survey was conducted (1998), farmers were asked about area planted, production, and inputs for the three previous years (1995-97).

Qualitative data were collected using two types of instruments: focus group topic guides and key informant interviews. The results of these sessions were used primarily to complement the quantitative results.

Focus Group Topic Guides. These topic guides were developed primarily to explore the knowledge, attitudes, and practices of farmers in the study sites. The guides covered general agricultural practices, use of sustainable agriculture techniques, and perceptions of the relationship between agriculture and the environment. Focus groups were conducted only with male farmers who were actively engaged in subsistence agriculture. At each of the two sites, focus group interviews were conducted with both SA User and SA Non-User groups.

Key Informant Interviews. Informal interviews were conducted with key informants in each of the two sites. These interviews were used primarily at the beginning of data collection in the communities to help orient the interviewers and to serve as an "ice breaker" with community leaders. The questions asked included many of the same topics covered in the focus group topic guides.

WHY STUDY SUSTAINABLE AGRICULTURE? | THE CONVENTIONAL WISDOM | WHAT DID WE DO? | WHAT DID WE FIND? | FINDINGS IN PERSPECTIVE | TO HELP YOU ON YOUR WAY | TO LEARN MORE

Helping Project Partners to Answer Their Own Questions

To address the third goal of this project, BSP worked with Defensores de la Naturaleza and Línea Biósfera to design and implement this research project and analyze and communicate the results. One of the coauthors of this publication, a representative of the Center for International Forestry and Research (CIFOR), provided additional assistance in the conceptualization and design phases of the project. In October 1997, BSP facilitated a meeting of experienced researchers and practitioners to discuss the concept of investigating the conditions under which sustainable agriculture works as an effective conservation tool. The project was formally launched with a design workshop in June 1998 that included members of BSP, Defensores de la Naturaleza, Línea Biósfera, CIFOR, and WWF-US. This meeting provided us the opportunity to develop a learning framework that included the specific operational questions we wished to address and the process we would use to answer those questions.

In August 1998, BSP facilitated a training workshop during which the data-collection instruments were finalized and field-tested. At the same time, BSP trained project staff in data-collection techniques and interviewing. Fieldwork continued through the fall of 1998 at each of the two sites.

In early 1999, BSP hired a statistician to assist in analyzing the data. Once data were collected, BSP worked with Defensores de la Naturaleza, Línea Biósfera, and the statistician to clean the data and input them into a database. In August 1999, we conducted the first in a series of analysis workshops to develop the findings from each site and to begin cross-site comparisons. BSP staff worked with both organizations as they interpreted and began to write up their results.

In August 2000, we had a final meeting to discuss findings. The purpose of this meeting was to look across both sites to determine the conditions under which sustainable agriculture works, develop guiding principles for practitioners around the world, and document our analysis of the learning process.

Some Things to Keep in Mind...

As you read through our findings, please keep in mind the following caveats to help you interpret our results as accurately as possible:

- **Association is not the same as causality.** Our research design is cross-sectional, and our sampling is not random. We can, therefore, say that there is an association between two variables, but not a causal link. If we had wanted to more accurately identify causality, we would have needed to conduct a randomly sampled longitudinal study. Nevertheless, the associations we see in the results provide a fairly compelling description of the possible association between sustainable agriculture and conservation.
- **Our research design does not allow us to quantify the regional impacts of sustainable agriculture.** For the reasons we mentioned above, our best option to test the relationship between sustainable agriculture and conservation outcome was at the household level. Using the household unit, we were able to study direct effects of sustainable agriculture use on conservation. But we did not attempt to quantify the total impact of sustainable agriculture on a regional scale. To do so, we would have had to spend precious time to determine accurate prevalence rates of adoption, control for myriad additional confounding factors, and ascertain variation in