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experiences in success

CASE STUDIES IN GROWING ENOUGH FOOD THROUGH REGENERATIVE AGRICULTURE

EXPERIENCES IN SUCCESS

Case Studies in Growing Enough Food Through Regenerative Agriculture

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ABOUT THE COVER

Bahunepati, Nepal has changed during the past 10 years. There has been an improvement in the lives of farmers, because of increased production and betterment of their environment. The smaller photo shows Alice Gubbels, West African Regional Director, OXFAM, U.K. Photos by Ken Tull.

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DEDICATION

This publication is dedicated to all the small farmers in the world who, in the midst of difficulty, have succeeded rather than failed. They can teach us so much, if we are but willing to look carefully at what they do and try to understand why they do it. Working with and building upon their knowledge, it will be possible to help grow enough food in ways that enhance, rather than damage, the environment.

Foreword

Since we began publishing State of the World in 1984, we have in numerous articles tried to alert readers to the importance of moving toward a world society that balances the short-term needs of people with the long-term need to sustain the economy's environmental support systems. There are too few examples of success in achieving this, but there is enough rethinking underway to give one a sense of hope. "Experiences in Success" represents not only a rethinking, but gives examples of such thinking put into action.

In 1986, my associate, Edward C. Wolf, wrote in Beyond the Green Revolution: New Approaches for Third World Agriculture, "A new strategy of efficiency and regeneration could help meet the needs of subsistence farmers, and begin to address the environmental and economic problems linked to more intensive cropping practices as well. Such a strategy would stress the efficient use of fertilizers, chemicals, water, and mechanized equipment. As a supplement to efficiency, farmers would blend biological technologies and traditional farm practices to increase the contribution that the land's natural fertility makes to food production."

Each of the case studies represented in this publication, does just that and more. In each instance, the agricultural technology is carefully woven into the cultural framework of the people. This has been done by building upon traditional practices, rather than destroying them. Perhaps the greatest contribution this publication renders is to show that a diverse range of agencies, international and indigenous, can initiate programs in cooperation with the people they serve, so that the programs can, through the adaptive and innovative spirit of those people, be sustained over time.

This issue reaches beyond good intentions and human ideals. The majority of the world's farmers are subsistence farmers and, as Ed Wolf correctly states, for them ". . . the issue is economic survival. Only by husbanding their scarce resources, regenerating their land, and raising their yields can these farmers improve their economic prospects. The reorientation of agricultural research and development assistance to meet their needs has begun, but deserves more attention and support."

"Experiences in Success" helps focus attention on the necessity of that reorientation.

Lester Brown
Worldwatch Institute
Washington, D. C., USA

"Regenerative agriculture – the practice of improving the resource base of a farm while improving productivity and profitability, characterized by the increased use of abundant and renewable internal resources and the reduction in use of external inputs."

Robert Rodale

Introduction

We who have been working in agricultural development have made more than our share of mistakes over the years, but there have been, and continue to be, successes. The purpose of this series of short case studies is to look at a few successes in the hope that we can learn something about the ingredients for success. The successes we are looking at have been carried out by a host of agencies, from very small ones to large ones, from governmental to non-governmental.

At Rodale we have chosen this particular set of case studies from a group of many possible candidates. The studies have not been selected because they are the best projects, but because they represent achievable ones from which we all can learn. Each project places its emphasis on what we refer to as "regenerative agriculture." We believe it is a regenerative approach that places agriculture within the context of environmental and economic realities of the world today.

Some of the agencies involved in the projects refer to their activities as regenerative, whereas others choose to call their activities alternative, sustainable, or low input. Although what people call their activities is important to us, the name is not as important as the action. We are concerned that the project be committed to achieving food security through what Charles Francis and Richard Harwood, in the opening chapter of "Enough Food," referred to as:

". . . food production systems that use local, renewable resources and human creativity while combining successful farmer's practices with the potentials discovered through science."

This publication complements the challenges described by Francis and Harwood in "Enough Food." We expect that these case studies will be the first of many, because since the publication of "Enough Food" in 1985, more and more agencies have begun to recognize that we must have a new agenda for agricultural development. For some, that agenda includes the genetic manipulation of plants and pests; for others, it means changing the way we look at our world.

In the 40 some years since the end of World War II, there has been a tremendous amount of time and money spent telling farmers of the world what their problems are and how they can solve them. Too little investment has been made in understanding why farmers have survived in the midst of adversity rather than why some did not. Each of the case studies has several things in common that we address in the conclusion, but a common factor I want to emphasize here is that the people, the clients with whom the agencies are working, are not bystanders, but, participants. They are not just learning about technologies, they are discovering their capacities, capacities to change the world in which they live. And those of us who work with these people have the opportunity to learn what already works, and how we can work with them to help build upon their "experiences in success," rather than seeking to replace their successes with what has often proven to be our own miscalculated failures.

Kenneth Tull
Executive Director
Rodale International

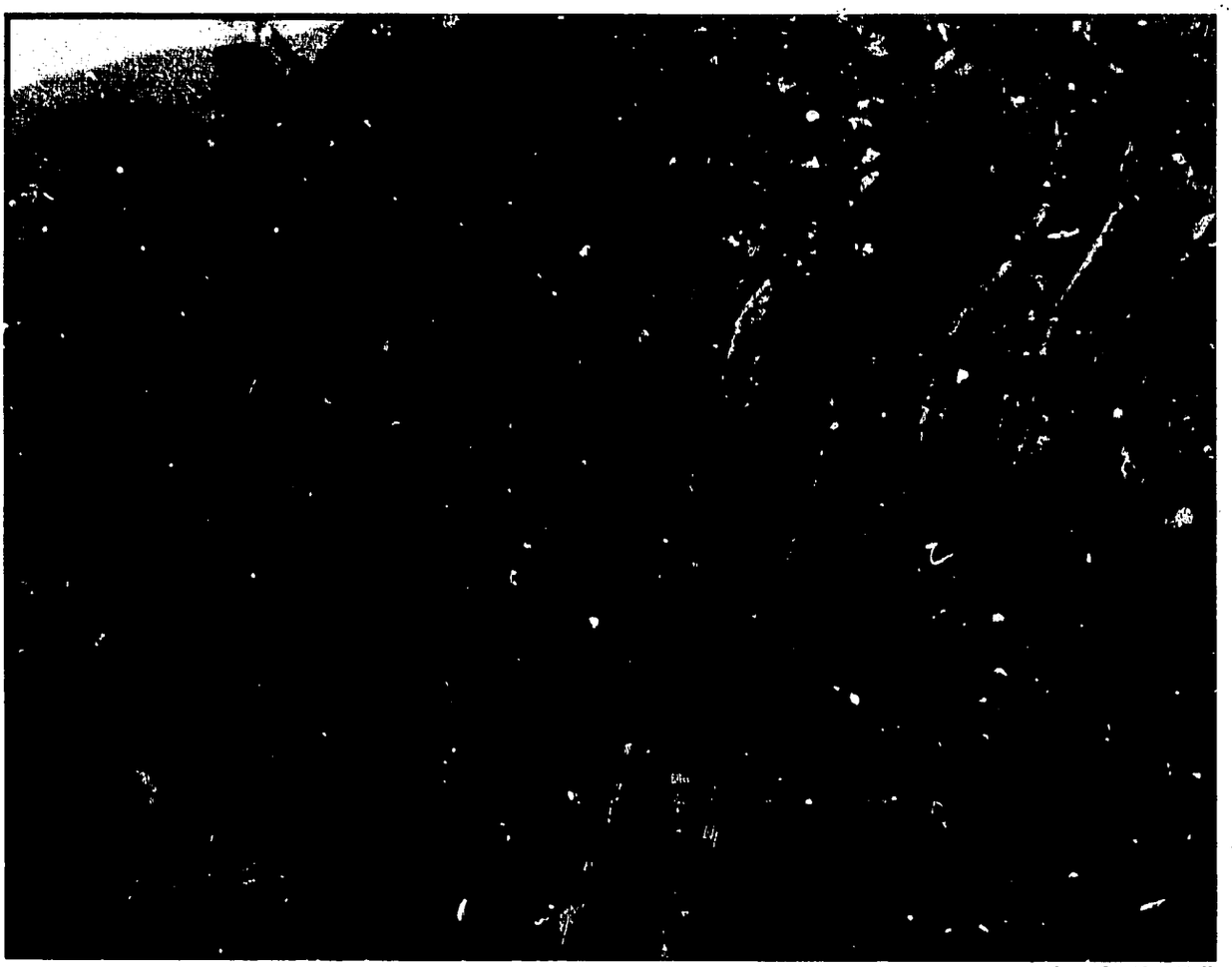
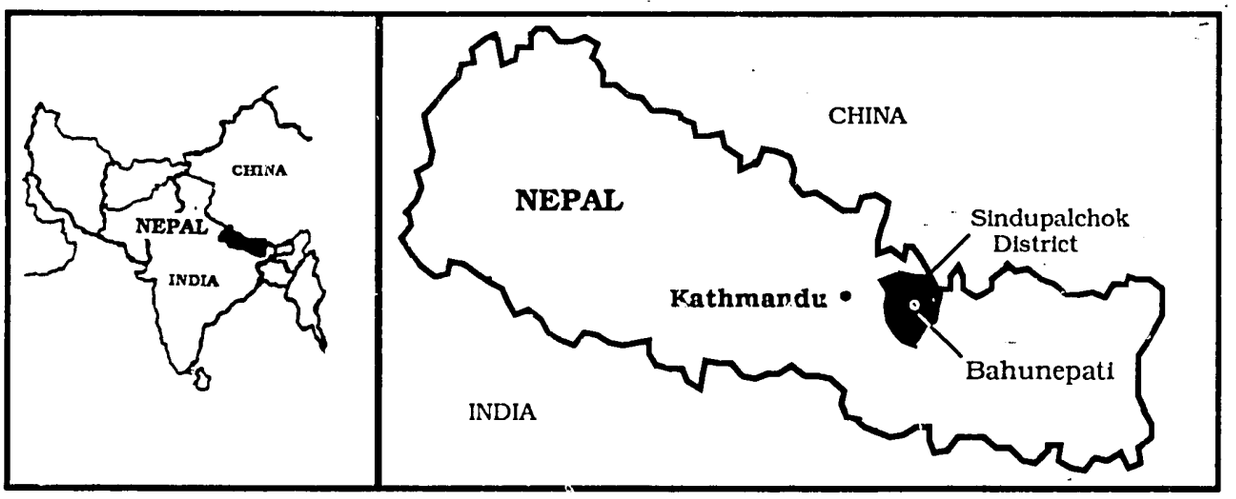


photo by Ken Tull



AGROFORESTRY IN NEPAL

Baudha/Bahunepati Family Welfare Project

Kenneth Tull

Nepal is known for its mountains, particularly, Mt. Everest, but for most of us, little else is known about this landlocked country, sandwiched between India and China. Over 90 percent of her people are rural. For those families fortunate enough to have fertile land in the valleys and along the river banks, life is good. For the poorest of her people, those pushed high up the hillsides, trying to grow crops on terraces less than 3 meters (3m) wide and with 2-3m difference in height between terraces, life is very difficult. Most people in these circumstances survive by carrying other people's loads or working other people's fields. Like most rural people, they want the opportunity to grow their own food, on their own land, and a chance to earn enough cash to buy the things they cannot produce themselves.

The Beginnings

In this case study, we look at some of those people and the impact they are having, not only on their own lives, but on the lives of others. The project they are part of is the Baudha Bahunepati Family Welfare Project. It is referred to as an integrated development program, a family planning project, with support activities in public health, curative medicine, agriculture, animal husbandry, and horticulture. Because of our concern with agro-forestry, we will look at the agricultural part of the program. However, for the sake of history, we should understand the program's beginnings. It started with a small health clinic in Baudha, close to Kathmandu, which opened in 1971. At that time, Baudha was still a small village outside the grasp of Kathmandu's beginning urban sprawl. The clinic, begun with local initiative, was, in those early years, manned by both American and British volunteers, because there were few trained Nepali health personnel.

In 1972, a British male nurse was managing the Baudha Health Center. He and the other clinic staff saw the need to expand the program, with an emphasis on family planning services. He approached the International Planned Parenthood Federation (IPPF) for funding. The Family Planning Association of Nepal (FPAN) is the local affiliate of IPPF. With the IPPF funding, FPAN became the program's local institutional parent. Under FPAN, the scope of the program expanded and reached across the hills into the neighboring Sindupalchok District. In 1973, one of the small communities reached was Bahunepati, a small village nestled along the Indrawati River. A primary health clinic was opened in the village bazaar.

As the people involved in the program realized that villagers problems were more than health and family planning, they approached other agencies for both technical and financial support. The year was 1975, and one agency, World Neighbors, combined its financing with that of Oxfam, U.K., to assist the program activities. As integrated development is central to World Neighbor's philosophy, a new program approach was initiated. The program supporters and managers wanted to determine if an increase in agricultural productivity, combined with a provision of maternal child health assistance and curative services, would influence the number of family planning acceptors.

To learn about the villagers' problems, baseline surveys were conducted in new administrative areas or "panchyats" brought into the project. Each panchyat has a population of between 2,000 to 9,000 people. By 1976, the project reached 33 panchyats, with a population over 127,000. At the time of the baseline surveys, it was decided, based upon the conclusions of the workers, that an integrated approach was not only desirable, but would be accepted by the people in the project area.

Program Goals and Design

Currently, the project involves 44 panchyats and reaches over 161,000 people. The following goals have stayed the same over the years:

- Reduce birth rate and improve health of children and mothers.
- Increase small farm agricultural productivity and family income.
- Increase community participation in program design, implementation, and management.
- Improve basic curative and preventive health services.
- Integrate project activities with other agencies and government for better use of available resources.
- Discourage permanent out-migration of people by promoting income-producing activities and better health care.
- Demonstrate the program's cost effectiveness to governmental agencies.

While all of these goals are important, the second is of most importance to this case study. How the program approached and solved the agricultural productivity problem is significant.

Primary Audience

The focus point for beginning agricultural outreach of the program was the community of Bahunepati. The primary group that the program decided to assist was the poorest part of the community, the Majhi's. Formerly fishing families, these people, like most poorer farm families, occupy the worst land, high on the side of the hills. Through blasting of the rivers, most fish are gone, and now these people need new sources of cash and improved ways to produce food. Almost all of the Majhi's farming is done on "dryland," land that is rain-fed. Few have "wetland," land that can be irrigated.

Wetland terraces are used for growing rice and wheat. This is prime land, cleared of all trees and grass to promote maximum production. Dryland is mostly farming land claimed from the forest. Those trees which produce fodder for the livestock are allowed to stay on the terraces, if they do not interfere with the crops of maize and millet fed by rainfall. The larger the farmer's land holding, the more fodder trees can remain. Fodder availability and people to cut it

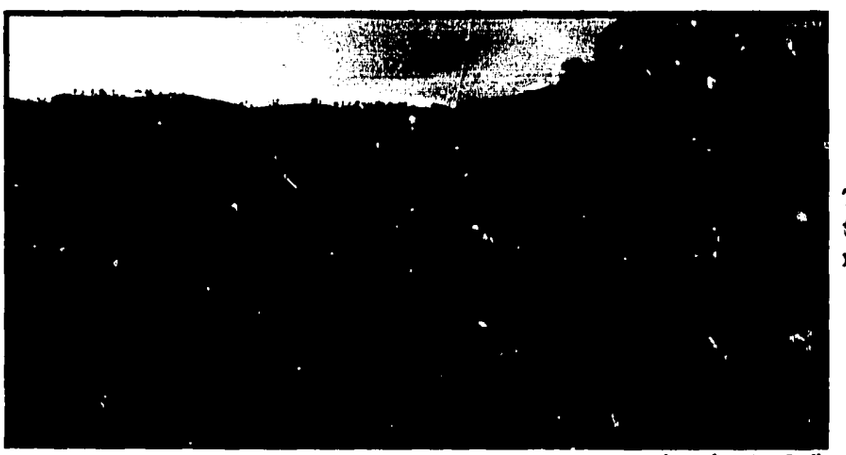


photo by Ken Tull

The poor most often farm the least productive and most fragile land.

Farming in Nepal has remained productive over thousands of years because compost added to the soil has been an important part of the farming system.

photo by Ken Tull

determines the number of animals farmers have. Livestock is raised primarily for manure, composted for fertilizing the fields. Male buffaloes and goats, are sold for cash.

The second source of fodder for the marginal farmers is the forest, but forests are shrinking. A national population growth rate of 2.4 percent has put incredible pressure on a limited amount of land that is cultivatable. The estimated cultivatable land area of Nepal is less than 50 percent of the total land area. Every year thousands of acres of valuable forest are claimed as farmland.

Identifying the Problem

During 1975-76, when project workers, most of whom are from the local area, began meeting with poorer farmers, particularly the Mahji's, to explore income-generating activities, availability of fodder was always an important issue. Women often spent six hours per day gathering fodder during the dry season, when it was in least supply. With the supply becoming more limited every year, animal mortality increased, particularly during this dry fallow season. Farmers said 60 percent of their animal deaths took place during the dry period, because of poor forage and malnutrition. Availability of improved crop varieties, which demand more nutrients to be productive, meant that manure was insufficient. A vicious cycle of less forest meant less fodder, less animals, less manure, and, consequently, production of less crops became the norm.

Searching for a Solution

By 1977, a small clinic was being built on a hillside outside the village. A farmer donated the land. While the building was taking place, the project began to experiment with several varieties of fodder trees on a steep bank to the side of the clinic. Among these varieties was *Leucaena leucocephala*, now known locally as Ipil-Ipil. Both Peruvian and giant varieties were planted from seed in small plastic bags. Several years earlier, an Ipil-Ipil tree had been grown at a government research farm in Khumaltar. The soil from around this tree provided the inoculant needed for the new seeds. When the early

monsoon rains came, the seedlings were transplanted around the clinic. No one knew if the trees would survive, or if the fodder would be acceptable, as well as sufficient.

By the end of the rains, it was apparent that the trees would grow. They averaged 2m the first year. Two varieties of Ipil-Ipil, K-28 and K-6, from Hawaii did the best. Fodder cut from the trees was mixed with local grass and fed to buffaloes. At first, the buffaloes sorted out the grass, ate it, and then, the Ipil-Ipil. Soon, the buffaloes pushed the grass out of the way and ate the Ipil-Ipil first. Keeping the goats away from the trees was the biggest problem for the watchman at the clinic.

Ipil-Ipil appeared to be an appropriate fodder tree for further testing. The initial test showed it could grow on the terrace face, and about 25 percent of the cultivatable land in Nepal is unused terrace face. It was shown that Ipil-Ipil could be cut to prevent shading, and the cutting stimulated the production of more fodder leaves. The tree's deep root system, prevented it from competing with crops for moisture and nutrients. In addition, the tree could draw nutrients up from deep in the soil. As a tree that fixes nitrogen, some nitrogen could be available to crops growing nearby, and any leaves not needed as fodder could be used as green manure in the fields. The cut branches could become valuable sources of fuelwood.

When the pods matured, the seeds were collected, and a small nursery for seedlings was started at the Bahunepati Clinic in 1978. The K-8 variety was added to the other varieties, and the first seedlings were produced for on-farm trials in the surrounding area.

On-Farm Trials

Five farmers were selected for on-farm trials. These farmers could both test the appropriateness of the trees, and if there were potential for further extension of the idea, they could provide

photo by Ken Tull

Once it was determined that Ipil-Ipil would grow and produce usable fodder for livestock, a small nursery was established on a hill at the side of the clinic to provide the trees for on-farm trials.

Each of the demonstrator farmers agreed to plant at least 400 trees on his or her plots of land. Most trees were planted along the terrace edge, or on the terrace face.

photo by Ken Tull

Because farm families were directly involved in early trials, necessary adaptations took place. Rather than cutting the trees low to the ground as recommended, the trees were allowed to grow over 1m, a height beyond the reach of grazing animals. A special fodder grass, N.B. 21, was planted between the trees.

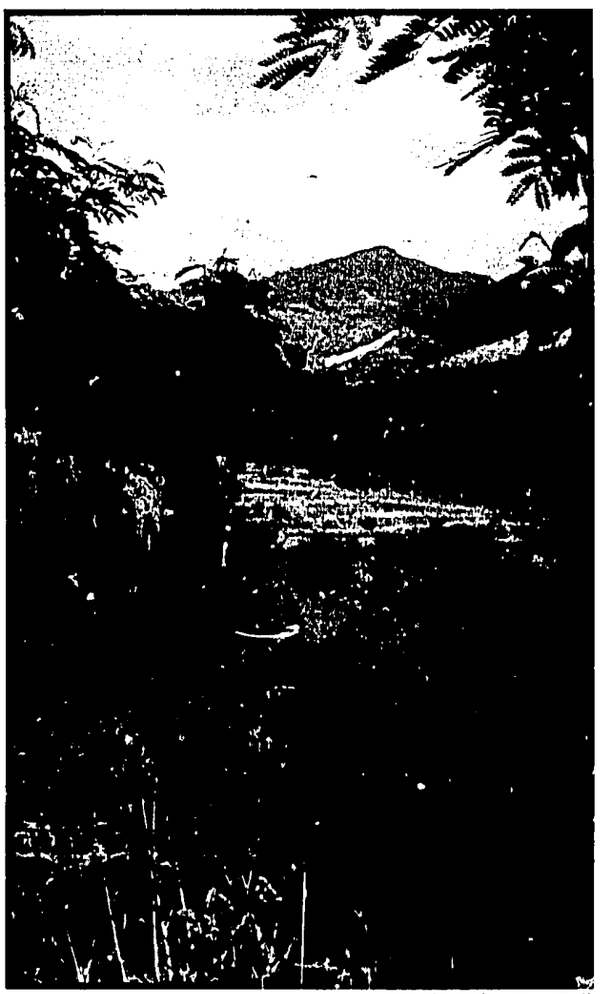


photo by Ken Tull

additional seeds for production of seedlings. Each of the farmers had some livestock and need for fodder. The farmers' lands were rain-fed, and the average soil pH was between 5.5 and 6.0. Each farmer agreed to plant 400 trees along the terrace crest or face. It was determined that it would take 400 trees to provide 50 percent of the forage needed for one large animal. Because Ipil-Ipil contains mimosine, an amino acid, it is recommended that it not exceed 50 percent of the forage for animals. The seedlings were provided to farmers free of cost.

Three of the five farmers were very successful, with an average seedling survival rate of 80 percent. Two of the farmers were not considered to have been successful enough to be good demonstrators, even though they continued to grow Ipil-Ipil.

The trees grew out of reach of livestock within six months. This was important so that the trees were not destroyed when the animals were allowed free-range grazing. During the following year, the farmers were encouraged to cultivate the area where some trees died. In addition, they started to test the planting of grass variety brought in from India. The variety NB-21 is a sterile cross of Napier *(Pennisetum purpureum)* and Pearl Millet *(Pennisetum typhoides)*. The grass was transplanted by slips into the space between the trees and did very well on both the terrace face and the crest. This practice helped conserve the soil of the terrace crest.

Experience showed the farmers that the trees could be cut back or lopped once or twice a month during the trees' second monsoon growth period. Because the Ipil-Ipil can be cut back and coppices, or re-grows a heavy supply of new leaves and branches, each tree began to produce an ample supply of fodder leaves and twigs for cooking fuel. A very important practice learned from farmers during the trial period was that the recommended height of 30 centimeters (30cm) for cutting back the *Leucaena* trees was not appropriate. Local farmers found

photo by Ken Tull

Enthusiasm spread from farmer to farmer, and more and more farmers joined the home nursery courses.

this encouraged animals to browse. Instead, they discovered that when the tree was cut at about 1 meter (1m), an ideal height for the women to do regular cutting, the coppicing was as good, and the tree too high for animals to eat. With the side branches between the ground and the crown were cut, the trees did not shade the crops growing in the fields beside them.

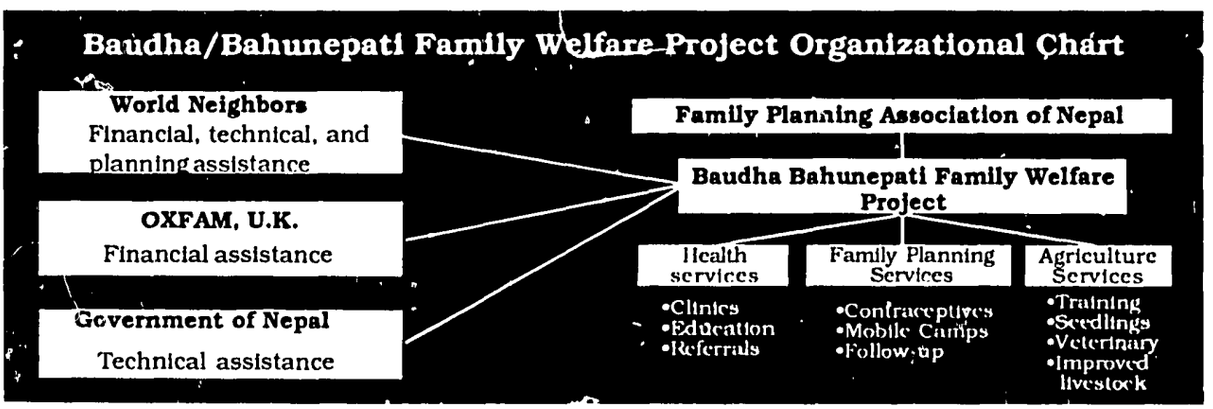
Based upon their own successes, farmers who conducted the first trials tried to convince the project staff that the idea should be immediately promoted to other farmers. At the same time, other local farmers who had observed the trials began to request seedlings for planting on their own farms.

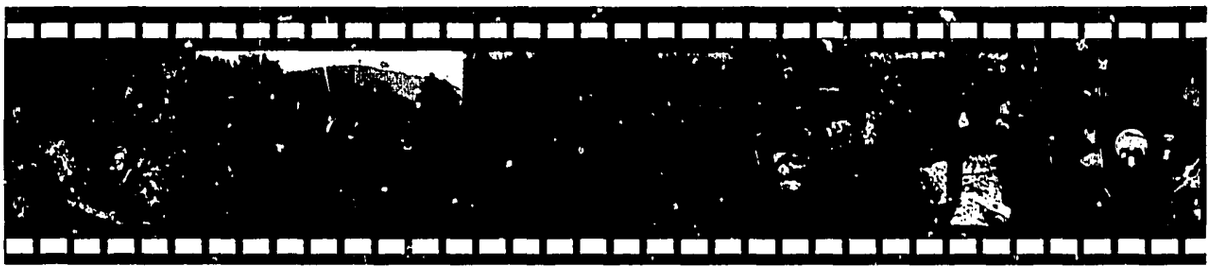
Multiplication

The enthusiasm of the test farmers and requests by other farmers encouraged the project management to start an extension program. The specific objectives for the extension program were to demonstrate that Ipil-Ipil:

- can be grown on farmers' lands in sufficient amount to supply animal fodder,
- will not, unlike most local varieties of fodder trees, compete with crops for moisture or sun, and
- can be cut in the dry season, when forage is in short supply.

Additional long-term objectives of the program are to help farmers to increase the quality and the quantity of livestock. It was hoped there would be a growing acceptance of stall feeding of animals and, therefore, decreased pressure upon remaining forests. Finally, there would be a decreased demand for forest wood for fuel as Ipil -Ipil branches could be burned. A filmstrip was developed emphasizing these points.





The filmstrip, along with a poster, were united with good demonstration for the extension program. The emphasis was on working with a few successful farmer demonstrators. This ensured quality control. Program staff provided follow-up once a month. By 1980, field days were organized where additional farmers from Bahunepati Panchyat and then other panchyats and districts came to visit the farms of the demonstrators. The successful farmers performed the extension role of teaching other farmers what they themselves had learned.

In Nepal, diseases of Ipil-Ipil have not been a major problem. There has been a minor problem with the fungal disease, gummosis, but it has affected only .0005% of the trees, and they have been eliminated. The tree louse, *psyllid cubana*, which has been a major problem in Indonesia and the Philippines, has not been a problem, but to prepare for that possibility, emphasis has shifted to the resistant species, *Leucaena diversifolia*, most specifically, K-156, which is also more altitude-tolerant and can be grown to altitudes of 1,000 meters.

As more and more farmers began to stall feed and grazing patterns changed, a few farmers conducted trials with direct seeding. By planting 20-50 plants per meter on the contour with a row distance of 2-4 meters within the terrace, it was found that considerable erosion could be controlled. The 1983 trail planting on one farm showed a soil buildup of 10-300cm in one year. In 1984 the number of farmers participating in the direct seeding trials was up to five. These farmers are incorporating the leaves into the soil as green manure. The most appropriate place for the direct seeding is on the terrace face rather than in the fields.

As of June 1987, 30% of the 102 Majhi families in the community area of Bahunepati have become self-sufficient in fodder and fuelwood. A critical mass of the target audience has adapted the planting of Ipil-Ipil. It is believed that this technology has proven itself through the adaptation process, and that even without further project activities, the program will continue to expand. The key to this expansion can be found in the demonstration process which was used.

Extension Methodology

The methodology selected for moving the growing of Ipil-Ipil out to other panchyats and districts is the use of home nurseries. Farmers from other panchyats are told of training dates and invited to participate. They go on a motivational tour and are given practical training in making a nursery for 1,000 seedlings. They receive plastic bags, seeds, innoculant, a booklet in Nepali and a poster. Follow-up is provided through several visits by project staff, 90 percent of whom are from the local area. The most successful of the trainees are invited back for an additional day of training on transplanting and management of trees. The training is organized by project staff, but the training discussions and the practical activities are conducted by local farmers. A woman tree planter is always included in the training sessions. Two of the outstanding demonstration farmers in Bahunepati are women. One, Laxmi Majhi has

planted over 5,000 trees on both her and her husband's land. In 1986, 86 farmers were trained. They produced, transplanted, and grew 58,000 trees. During 1987, an additional 150,000 fodder trees are being planted on private land. Most of the seedlings produced come from farmers' home nurseries. These nurseries are an effective extension strategy, because they teach nursery skills to people and enable them to be local resources for seeds, inoculant, and training. In 1987, 15 panchayats are projected for training and support.

In addition to the formal training which is conducted, over 25 organizations and hundreds of farmers from other parts of Nepal have visited the project. There has been no formal follow-up of these visitors to determine what effect their visits have had upon activities in their villages. It is assumed that because the level of casual visitors continues to increase, so much so, that the project staff have considered designating one individual just to manage these visitors.

Timing of Major Extension Events

1977 First seedling planted at clinic.

1978 Nursery started at clinic.

1979 Project staff train five farmers to conduct first on-farm trials.

1980 NB-21 fodder grass introduced and first field day held at demonstrators' farms.

1981 Training of farmers for home nurseries is introduced with planning by project staff and training task shared with demonstrator farmers.

1982 Training continues and livestock upgrading begins with introduction of improved buffaloes and goats.

1983 First trial with direct seeding begins at one farm.

1984 Four additional farmers commence direct seeding trials.

1985 Extended program trials to two other districts, one in Ramichamp and one in Pokhara.

1986 Training conducted in cooperation with the Social Services National Coordination Council for 15 non-governmental organizations in Nepal.

Related Developments

As was stated at the beginning of this case study, the Bahunepati project is an integrated one, therefore, there have been agricultural developments besides the planting of Ipil-Ipil which have occured. A goat, buffalo, and swine up-grading program has been carried out and veterinary services are now available. It seems that better quality animals and the increased income they have generated have been an additional incentive for farmers to grow more fodder trees and to stall-feed their animals. Since 1983, livestock numbers have increased 40 percent and livestock sales have increased from U.S. $900 in 1983, to over U.S. $5,000 in 1986. These sales have been an important source of cash to poor farmers. During the same time period, the animal up-grading program has seen an increase in upgraded stock from 5 percent to 54 percent of the total livestock in the community. There has been coordination and sharing between the project and the government's livestock and fodder program and its reafforestation program. This exchange has included the supply of seeds, livestock breeding animals, research, training, and technical information.

A local farmer who attended middle school received government training in livestock and veterinary care. He receives a part-time salary from the project, but two-thirds of his income comes from the sale of services and veterinary drugs. Because this individual is available for veterinary services, animal illness reporting has increased; however, animal mortality has decreased by 25 percent since 1983.

An important outgrowth of this project's direct involvement of farmers in both testing and training is an increased level of community action in projects such as irrigation and drinking water supply. Thirty-four Majhi farmers

constructed a 3-kilometer (3km) long irrigation canal which provides light irrigation for a summer crop. The canal provides water to about a third of the village's dry land. In addition to a 25 percent increase in food availability as a result of the irrigation, the construction of the canal demonstrated to farmers what community participation can achieve. With the inspiration of the irrigation canal, another group of families constructed a protected drinking water system for a section of the village. The project provided the pipes, cement and fittings, but all other costs, including a monthly household tax for maintenance of the water system, are paid by the community.

From the project's perspective, a most important development has been the level of family planning acceptance. Sindupalchok district now has the highest rate of acceptance of contraception among fertile couples in all of Nepal. The 1986 statistics show that 27 percent of all fertile couples have adopted family planning. Simultaneously, infant mortality rates have declined to 29 per thousand compared to the national average of 41 per thousand.

The Future

While they believe that the project is strong enough to maintain itself, the project staff and key demonstration farmers believe that the project should receive the support of FPAN and the donor agencies for two more years. If the project withdraws before that, the people who have been trained and the skills they have acquired will continue to be important resources for the community. Two additional years of project support will allow the people who have been trained and have become trainers themselves, to continue their outreach and follow-up to other panchayats and districts. Though the intensive demonstration and extension work in Bahunepati has taken eight years to accomplish what it has, the multiplication to other panchayats has taken place mostly in the last three years.

photo by Ken Tull

Increased fodder production from both Ipil-Ipil and N.B. 21 grass means more food for the buffaloes which, combined with better breeds, means more milk for both sale and home use.

PROJECT ANALYSIS

The success of this program is attributable to the following:

- Farmers were involved in both research and training.
- Program workers are from the area.
- Technologies are adaptable to the individual farm family's situation.
- Efforts are coordinated with the government's activities.
- Program management is decentralized and follow-up is regular.

This case study is based on information provided by Tom Arens of World Neighbors, Gopal Nakarmi of FPAN, and on information gathered during site visits by the author.

photo by Alfredo Cruz

COMMUNITY LAND USE MANAGEMENT PROJECT IN ECUADOR

Soil Conservation Extension on Hillside Farms

Michael Sands

Ecuador qualifies as a middle-income country, although when looking at both economic and quality-of-life statistics, we see that half of the 8.5 million population lives in absolute poverty as defined by The World Bank. Fifty-five percent of the population lives in rural areas where agriculture represents the most important economic activity. Crop production grew at an average rate of only 2.9 percent during 1970-1978, whereas population increased at 3.3 percent. Added to the problem of a static or, at best, sluggish increase in agricultural production, the combined effects of rapid population growth and a lack of other viable economic alternatives have resulted in a subdividing of already marginally sized farms. The total number of "minifundistas," or small farms, has increased from 252,000 in 1974, to 346,000 in 1984, and fully 145,000, or 45 percent, of this group possesses less than 1ha of cultivatable land (average 0.42ha).

Andean Hillside Farm

For the marginal Ecuadorian farmer, diminishing crop yields and environmental degradation have become a vicious circle. Many minifundistas must practice continuous annual crop cultivation on hillside farm plots of up to 70 percent slope. Poor tillage and agronomic practices, which expose soil to unchecked forces of wind and rain, have accelerated soil loss and diminished the soil's water-holding capacity and fertility. Soil loss on most sloped fields in highland Ecuador is 20 times greater than the maximum acceptable soil loss as defined by the United States Soil Conservation Service.

Despite the difficult situation faced by the small-scale hillside farmer, agricultural production from his lands is vitally important to feed Ecuador. Sixty-five percent of the country's national territory, 25 percent of its national population, and 40 percent of its agricultural population is located on steep lands, on slopes above eight percent, or in intermontane valleys and highland plateaus. Sloped land agriculture is responsible for almost all the country's domestic food production and for many of its export crops, especially, coffee. Most of Ecuador's production of beans, corn, barley, wheat, cassava, and potatoes is grown on small parcels of sloped land.

Farm sizes are very small. The typical smallholder is farming between 1-2ha. The principal crops grown on hillsides include barley, potatoes, fava beans, onions, and quinoa, an indigenous herbaceous grain. At the lower altitudes, corn is also grown, as well as alfalfa and, occasionally, lupins and vetches are grown. The majority of farmers own a small number of livestock, typically, guinea pigs, rabbits, a cow, or a few sheep.

Traditional farm communities in the Ecuadorian highlands have created a set of strategies to cope with the problems caused by rising population and diminishing availability of land for crop production. Notable among these strategies are the following:

- Subdivision and ownership of available lands over a wide range of altitudinal zones.
- Utilization of a wide variety of crops adapted to specific microclimates.
- Reliance on local resources, communal land control, and reciprocity of labor sharing.

The result of this adaptive process is an agriculture characterized by high labor intensity, low-

energy use, great crop and animal diversity, and low productivity. However, the increased population has forced farmers to make other changes that have had negative impact:

- Elimination of fallow periods.
- Clearing of hedgerows, brush, and pasture lands for crop cultivation.
- Inappropriate tractor cultivation and intensive input increase production in the short term, but accelerate soil erosion and fertility loss over the long term.

Identifying an Appropriate Response

In an attempt to reverse the process of environmental degradation to benefit the marginal farm community, the Ministry of Agriculture (MOA) and CARE sponsored the Community Land Use Management Project initiated in 1985. This pilot project was designed to assist up to 40 communities on the hillsides of the Ecuadorean highlands in the development of soil conservation and agronomic practices necessary to stem the degradation of their natural resource base. The project is a collaborative program, with substantial participation of the MOA, National Soil Conservation Department, Cooperativa El Sagrario, and the Peace Corps, which provides two forestry volunteers as technical advisors.

Cumulative Totals of CARE/MOA Activities, January 1985-June, 1987

Mechanical practices (area treated, ha)	445
Agronomic practices (area treated, ha)	652
Agroforestry practices (area treated, ha)	404
Forest seedlings plants (1,000)	256
Extensionists training seminars (seminars)	14
Community promotion events (events)	247
Conservation/Credit Committees formed	22
Community loans disbursed (loans)	5
Individual loans disbursed (loans)	421
Amount of loans disbursed (million sucres)	8.2

photo by Alfredo Cruz

With intercropped bench terraces, farmers can improve their soil conservation, soil fertility, and pest management.

The Soil Conservation Department's two-person team extension agents have been trained and equipped to promote soil-conserving land use practices, to organize and train community leaders and farm family members, and to provide farm-level technical assistance. Cooperativa El Sagrario, a local credit union, provides crop input loans to participant landowners who comply with prescribed soil conservation and crop plans prepared jointly with a project extensionist. The primary clientele of the program is the small farming communities high on the slopes of the Ecuadorean Andes. Thirty farm communities in the provinces of Cotopaxi, Tungurahua, and Chimborazo are primary target areas. Work has recently begun in Loja province to the south. CARE/MOA extensionists are presently working with approximately 2,300 farm families.

Changing inappropriate agricultural practices is justifiably viewed as more of a social problem than a technical problem. Emphasis was placed on the existing agricultural community structure. Questions that needed to be answered were: What community organizations already exist among the project population?

photo by Alfredo Cruz

Long-furrow irrigation, rock walls, and grass and tree plantings are complementary conservation practices.

How can soil conservation systems be incorporated into the program activities of these organizations? How can important soil conservation efforts be made attractive to members of these organizations?

Before initiating the project, an assessment of factors influencing the agricultural system was undertaken. These factors included: existing cultivation tools and techniques; existing soil conservation practices and attitudes concerning those practices; and the availability of labor, including patterns of migration for wage labor and the traditions of organizing labor on the household and community levels. A number of studies indicated that off-farm wage labor produced more income for sloped land farms than did agricultural activities themselves. As a result, any successful program of soil conservation had to take into account the time farmers spend away from their own agricultural parcels and what additional labor, if any, substituted for the farmers' labor.

Building upon traditional practices, the primary assumption in determining strategies and approaches was that farmers would not adapt soil conservation practices as their own, unless the practices were seen as increasing agricultural production and income. The project's task, therefore, was to demonstrate to farmers the viability and applicability of soil conservation and other appropriate practices within the small-scale farm system as a means of improving their own lives.

The assessment revealed that several traditional customs and practices, indeed, serve as soil-conserving measures. Subdividing sloped land, through the inheritance custom of leaving some part to every son, has created a matrix of small parcels of varying crops and vegetative cover that provides some protection. Horizontal field boundaries are often maintained by placement of debris or planting of grass, brush, or trees. Crop rotation and fallow periods were practices recognized by tradition as necessary to conserve soil fertility, although the pressure to produce has decreased their use. Farmers also realize the value of maintaining land in pasture or woodlot but, again, use is dictated by the more urgent needs of immediate day-to-day food production.

New practices that needed to be introduced had to be presented as adaptations to existing traditional methods. Although this process of adaptation is not detailed here, the net result has been that several innovations have proven applicable. Initial soil conservation measures of bench terracing, contour ditches, graded-channel terracing, contour furrowing, live barriers, and strip planting have received acceptance. To help improve the productivity of the newly conserved soil, other production practices, such as agroforestry, were also emphasized. The agroforestry practices included planting of fruit trees and native tree and brush species on field borders and planting of small woodlots for production of fuelwood. Crop management interventions encompassed strategic use of organic fertilizers, animal and green manures, appropriate pesticide use, and improved seed varieties.

photo by Alfredo Cruz

Loans are processed by the Community Credit Committee. This approach is appropriate because the committee is close to the community, knows its needs, and can apply the necessary pressure to ensure payback.

Extension Strategy

Time is required for farmers to realize the production benefits of soil conservation measures. While short-term incentives, such as access to credit and workshops, have some impact, it is crucial that programs be structured in such a way as to have farmers take ownership of the innovations as soon as possible. To maximize the probability of success, a strategy for extension was developed to include several key factors:

- Maximize community participation and responsibility.
- Identify role of women.
- Hire appropriate extensionists.
- Intensify use of appropriate education methods.

Maximize Community Participation and Responsibility

A common difficulty for many government-managed agricultural extension efforts is the inclusion of farmers in planning, research, training fellow farmers, and evaluating project progress. As a result, many projects are designed and implemented without the farmers' input. In traditional cultures, such as the indigenous communities of the highlands, distrust has resulted from imposition of outside development schemes that too often do not speak to the farmers' views of their problems.

To avoid pitfalls of past experiences, this program focused on generating the greatest degree of community involvement possible. Planning for activities was carried out between the community and the extension team staff. Specific responsibility to promote and organize local courses and work groups, plan for communal work activities, screen requests for crop loans, and manage a seed bank of improved seed were held by local "conservation and credit committees," consisting of community-elected representatives. These local committees often organized farmers into "mingas," reciprocal work groups, for the construction of demonstration bench terraces or community irrigation channels. This methodology generated support for soil conservation by building on the existing capacities and traditions of the small-farmer community.

Direct involvement has reinforced traditional organization and resulted in identification and

ownership by leaders and community members of project-promoted objectives. Decision-making at the community level prevailed from the initial planning stages through the application of conservation measures and over the entire crop cycle. Farmers do much of the training in the use of simple tools, such as the A-level. Cultural identification and pride are now associated with conservation objectives.

Identify the Role of Women

An important challenge in marginal agricultural communities is the incorporation of women into soil conservation activities. The farm economy is dependent on the labor of women and older children, since the heads of family must seek off-farm employment to supplement a subsistence agriculture inadequate to meet family needs. The significance of women's labor is reflected in studies that place their contribution at greater than 50 percent of the total farm labor input. The role of women was taken into account to develop strategies that encouraged their active participation.

To address this matter, the attitude of women toward agriculture and soil conservation, and

One Farmer Then and Now

José and his family live in the community of Llantantoma in Tungurama province. With assistance from the CARE/MOA program, they have been able to regenerate their land into a small, but healthy economic farm.

1983

- Farming two cuadras on extreme slopes.
- Harvesting one crop of barley and potatoes per year during the long rains.
- Worked off farm to meet cash needs.

photo by Alfredo Cruz

1986

- Has completed narrow (2m) bench terraces over entire farm.
- Each terrace is stabilized with grass and trees.
- Water-holding tanks and irrigation furrows supply water to all terraces on a year round basis.
- A system of crop rotations, including potatoes, barley or wheat, vegetables, alfalfa or vetch, is used on each terrace.
- Manure from rabbits, guines pigs, and a burro supplement the green manures used.
- Sales of surplus vegetable production now satisfy cash needs, eliminating need to work off the farm.

photo by Alfredo Cruz

Local trainer explains the use of A-frame level to local farmers. The A-frame is easy to make, and is an appropriate way to mark the contours on a hillside.

how these attitudes affect the success of conservation practice assimilation were analyzed with the community. The response was that women should receive training and assistance, but only close to home and only through a female extensionist. A bilingual woman extensionist was hired to promote and teach soil conservation, home vegetable gardening, and preparation of vegetables for improved family nutrition to village women. As a result of her work, several women's groups are now active in applying conservation practices in combination with home vegetable gardening.

Hire Appropriate Extensionists

Problems are frequently encountered in the ability of technical agronomists to effectively communicate the purpose and application of new technologies to rural inhabitants. In Ecuador, many rural people are of an indigenous Quechua-speaking or mixed-blood (mestizo) origin. Although most adults understand and use Spanish, they do not understand the technical vocabulary or colloquialisms used by the mostly urban-oriented Spanish-speaking, white Latin professionals. To compound the problem, most agronomists lack training in non-formal teaching methods to prepare them for communication with rural people.

An important strategy of this project has been to hire and train agronomists who are culturally and linguistically adapted to the particular nature of the communities. Therefore, extensionists originate from the same socioeconomic zone and are selected by the communities they serve. The significance of this strategy cannot be overstated as the degree of extensionists' success is largely based on their understanding of how "campesino" families view agriculture and how effective extensionists are at communicating the benefits and applicability of a new technology to rural clients.

Appropriate Education Methods

A program based on the continuous presence of extension personnel within the community has been essential. A two-tier approach to extension addresses group activities and extensionist-to-farmer contact that incorporates the three other strategies mentioned.

The project encourages interested farmers to teach courses and conduct field days on their farms. Leaders, among farmers, who volunteer to teach others play an indispensable role in training and facilitate multiplication.

Specific non-formal teaching methods include: practical field exercises, demonstrations and field days, small group discussion, sociodrama, puppetry, slide shows, and farmer-to-farmer discussions. These methods have proven most effective with clients of little or no classroom education. The saying "seeing is believing" is commonly expressed by participants as a reaction to observing first-hand the in-

creased yields obtained by a fellow farmer's having applied the new management practices. Visits to fellow farmers' hillside plots to observe and question the new ideas add realism and justification to activities promoted by extension staff in communities where conservation measures have not previously been applied.

The Future

The CARE/MOA program continues to expand this particular project and impacts on other Ecuadorean projects. An additional 10 communities, consisting of 3,000 farm families, have been targeted for inclusion this year. In addition, as a result of this program, soil conservation measures are now major components in several other projects. In Quimag, Chimborazo, community adaptation of soil conservation measures will be critical to the success of a small-farmer sprinkler irrigation project. Continued smallholder access to resources and markets will be critical to the continued success of soil conservation programs in the Ecuadorean highlands.

Conclusion

This project's success is that increased harvests and income from use of new practices have proven sufficient incentive to encourage farmers to maintain and expand activities over time. Average crop harvests have increased an estimated 49 percent for eight principal crops and average increases in farmer income for these crops by approximately 56 percent.

Other encouraging changes have resulted. The variety of crops farmers can cultivate on steep slopes with shallow top soils and densely compacted subsurface layers, once regenerated through conservation measures, has increased significantly. Vegetable and tuberous crops have been sown on sloped fields that before only supported small grains because of the limited soil depth. Farmers have purchased highly eroded land from surrounding larger farms to apply their knowledge of soil conservation in returning the steep slopes back into production. Other farmers have even applied conservation measures on rented land. Communities which possess irrigation water have begun to apply soil-conservation measures to maximize efficient use of water, a valuable resource.

The accomplishments may seem insignificant compared to the expansive dimension of environmental degradation in highlands Ecuador. However, the viability of the project's model to encourage small farmers to undertake activities necessary to attain sustainable land use of sloped land has been well-founded. The MOA and CARE are optimistic that the number of participating communities and farm families can be increased appreciably.

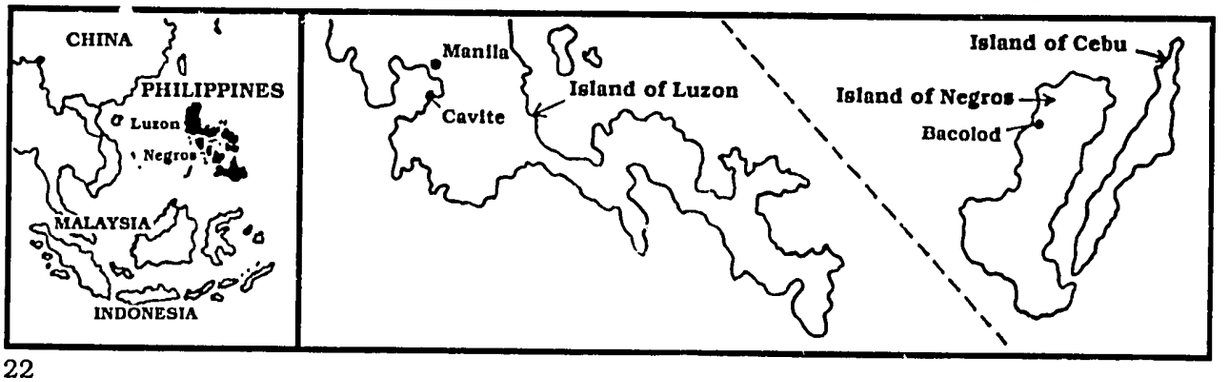
Program Analysis

Successes in the CARE/MOA program, in the short time since its inception, are primarily attributed to:

- The active involvement of the targeted communities in the design, planning, and management of the program.
- The use of farmers as equal partners in the extension.
- The concerted effort to involve and strengthen the existing MOA extension service.
- The aggressive development of a variety of non-formal extension educational materials.

This case study is based on material and information provided by John Mosher, Frank Sullivan, and Alfredo Cruz, and on information collected during a site visit by the author.

photo by Julian Gonsalves



BIO-INTENSIVE GARDENING IN THE PHILIPPINES

An International Institute for Rural Reconstruction and UNICEF Project

Kenneth Tull

There is more to the Philippines than Marcos, Aquino and the recent turbulent struggle for democracy. A long history of Spanish, then, American rule was followed by Independence in 1946. For many Filipinos, the promise of a better life that came with Independence has been illusive. As with the many other clusters of islands which dot the expanses of the Pacific Ocean, and make up nations, the governments have problems trying to establish transportation and communication links among the islands and to create a national identity among the diverse cultural groupings living on the various islands of any single nation. These factors alone make development a difficult task, but when combined with a population that has grown too quickly, in excess of 55 million, a cash-crop oriented agriculture, a stagnant or declining economy, and political turmoil, life remains caught on a treadmill of poverty for too many Filipinos.

As with most developing countries, there are two kinds of poor in the Philippines, the rural and the urban poor. This case study looks at how some of these people, struggling to feed themselves, have used an innovative approach to gardening as a way to grow more food.

Background

In 1984, the Philippines was hit with economic chaos. Inflation reached 52 percent, as compared to 7 percent for 1983. In July, 1984, 60,000 urban workers were laid off and official unemployment reached 21 percent. By 1985, the cost of agricultural inputs, such as fertilizers and vegetable seeds, had increased 100 percent over the previous year. Some islands were more severely hurt than others. One of the country's most important export crops, sugar, had fallen on particularly harsh times. There was a time when the sugar industry accounted for 25 percent of the country's total export earnings, but by 1984, the industry was at a standstill. Most severely affected was the island of Negros. With 64 percent of the cultivated land devoted to sugar cane, about 20 percent to coconut and corn, only about 4 percent of the land was used to grow vegetables and fruits. About 60 percent of the population of the island works in agriculture, largely, in the sugar industry. There were, according to the Philippine press, about 250,000 displaced sugar workers.

The International Institute of Rural Reconstruction's (IIRR) analysis concluded that, as a result of these prevailing economic factors, the following effects were identifiable at the household level:

- Higher food costs.
- Reduction in harvests because of reduced input use.
- Reduced consumption of meat, fruits, and vegetables because of increased costs.
- Selling of most backyard home consumption food, usually fruits and vegetables, to earn money.
- Reduced quantity and quality of food consumed.
- Long-term health implications for pregnant and lactating mothers and children 0-6 years.

With 25-30 malnourished children dying every month, statistics verified this final point. It was

estimated that there were between 150,000-300,000 malnourished children on this one island. Within this context, the United Nations Children's Emergency Fund (UNICEF) came up with its Quick Action Plan. Through this program, relief supplies for supplemental feeding of malnourished children began through a group of local agencies in Negros. In 1986, there were 1,500 feeding centers throughout the island. At the same time, UNICEF, collaborating with IIRR, initiated a long-range development activity, the Family Food Production Program. The focus is bio-intensive gardening (BIG), a regenerative gardening approach.

Why Gardening?

Most traditional cultures have had some kind of gardening and, in this sense, the Philippines does not differ. The garden may not have been geometrically planned and planted, but, nonetheless, gardening has been an important part of the traditional food production system. The garden's produce complemented the grains and tubers that were traditionally grown as the staple foods. However, a number of factors have, over the years, undermined that traditional system. In urban areas the poor either do not have land, or have sold what little they had for desperately needed cash. In some rural areas, the traditional garden structure exists but has undergone changes. As with the intensification of high-input, chemical-intensive farming, gardening, too, has become more regimented, less diverse, and more dependent upon chemical inputs for its survival. In a time of inexpensive inputs, this seemed to pose less of a problem for the people. In today's economy, that is not true.

On islands such as Negros, where the majority of the land is devoted to a primary cash crop, and where a small percentage of the population, about 1.5 percent, owns 41 percent of the land, gardening became almost non-existent.

The only people having gardens were those living in the small communities dotting the island. While these families were certainly badly affected by the economic disaster facing the island, the sugar workers and their families were most severely affected. The sugar workers

Because of the termination of the United States sugar quota contract in 1974, the price received by the Negros sugar industry dropped from 65.4 U.S. cents per pound to 3.51 U.S. cents per pound in 1984. This price collapse, combined with the mishandling of the industry which occurred during the Marcos administration, devastated the island's people.

photo by Ken Tull

photo by Julian Gonsalves

Since no vegetable seed companies exist in the Philippines, one of the most important early activities of the bio-intensive gardening programs was to identify either indigenous or adapted varieties of plants and to multiply the seeds. This aquisition work was started at the International Institute for Rural Reconstruction headquarters in Silang, Cavite, on the island of Luzon.

are mostly laborers, with no farming or gardening experience.

Bio-intensive Gardening

The Food Production Program on Negros has two major objectives. The first is **increased and better balanced nutrition,** and the second is **increased food availability at the family level.** The feeding program of UNICEF and a follow-up program supported by the United States Agency for International Development (USAID) continue to address the first objective. The second objective is the target of UNICEF and IIRR's BIG program.

Only four years old, the BIG program began not on Negros, but with experiments at the headquarters of IIRR in the province of Cavite, not more than 30 miles from Manila.

Several bio-intensive programs were examined before testing began at IIRR's headquarters. The technical advisor had first-hand experience in India and Tanzania. In addition, there was literature available on related programs in the Philippines. A particularly valuable resource was the "Samaka Guide," a smallholder farming and gardening guide used in the late 1950s. The BIG program has tried to learn from both successes and failures of such programs.

Studies at IIRR showed that a bio-intensive garden can maximize production on a small piece of land less than 50sq m. It is a biological form of agriculture that uses nature's own ingredients to rebuild and maintain soil productivity. Soil fertility is maintained through the constant recycling of nutrients and maintenance of soil moisture and microbial conditions. It is dependent on cropping diversity for reduced pest problems, and intensive planting in a limited space helps to control weeds. By emphasizing the use of indigenous or pre-adapted varieties of plants, insect problems are less of a problem. Organic matter is returned to the soil in the form of compost, and additional organic material is made available through the use of plants with different rooting lengths. When plants are pulled out of the ground, the rootlets and root hairs remain in the soil, and as they decompose, they add humus to the soil.

photo by Julian Gonsalves

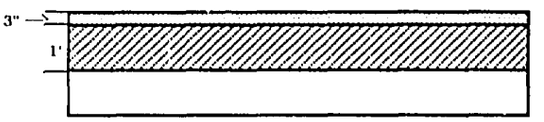
Promoters establish their own bio-intensive gardens. Most choose the labor-intensive, double-dig method, adding a lot of compost.

Before starting the program on Negros, over two years of testing at the IIRR research and demonstration garden showed that a 46sq m bio-intensive garden can supply a family of six with year-round vegetables that provide

- 30 percent of their protein needs,
- 60 percent of the vitamin A needs,
- 100 percent of their vitamin C, and
- 100 percent of their iron needs.

The IIRR chose the bio-intensive approach to gardening because it was aware, through its studies, that poor farm families could not afford inputs such as pesticides and fertilizers. Also, it was concerned about: the excessive and improper use of those inputs and the adverse effect they can have on the soil, such as rising acidity, and on the environment through pollution of the water table; the destruction of predators; and the problem of increased pesticide resistance. Finally, it was concerned about the human factor, the effect of residues on health and the impact of dependence on externally produced resources upon people's control over their own lives. It is this final point that fuels the IIRR engine. The project is committed to helping the poor discover that there are resources existing within themselves, their land, and their communities, and that they can manage those resources.

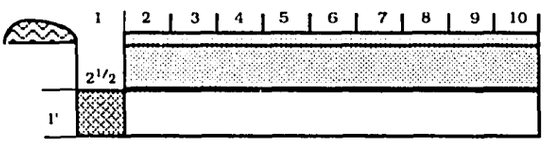
BED PREPARATION FOR A



1. a. Dig the bed to a depth of 1 foot (1'). (Standard beds are 4' wide and 25' long, but, length can vary.)

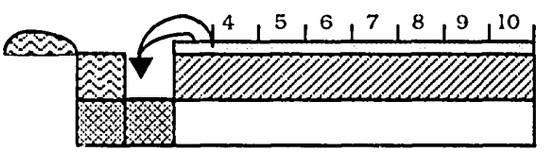
b. Level the bed using a rake. Remove large stones or stubbles. Pulverize big dirt clods.

c. Evenly spread a 3-inch (3") layer of compost or decomposed animal manure over entire bed.



2. a. Divide the bed temporarily into sections 2 1/2' wide using wooden stakes as guides. Initiate the second digging. Dig a trench 1' deep and 2 1/2' wide at one end of the bed. Place the soil from this trench on one end of the bed.

b. Loosen the soil in the trench another 1' using a crow bar. (Please note that the soil is not removed.)

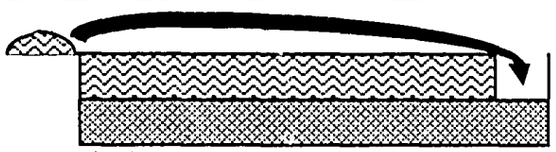


3. Dig a second trench, covering the first trench with the soil from this trench. Loosen soil.

Gardens provide promoters' families with food and multiply seed for distribution, demonstration, and teaching.

photo by Julian Gonsalves

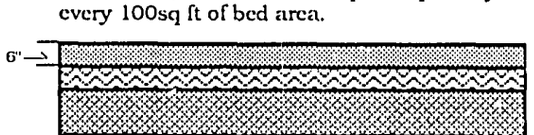
BIO-INTENSIVE GARDEN



4. This leaves an open trench at the other side of the bed. Fill this with the soil previously dug from the first trench.

5. The double-digging process is complete. The bed is now levelled using a rake. (Never walk on the bed!)

6 Add to the bed the nutrients that the plants are going to need. Apply the following in layers: 1" compost or decomposed manure, 2 lbs. wood ash, 2 lbs. bone meal, 1-3 lbs. fish meal or leucaena/ipil-ipil leaves, and 2 lbs. of any of the following—crushed egg shells, mussle shells, snail shells, etc. This is the required quantity for every 100sq ft of bed area.



7. Mix the plant foods thoroughly into the top 6" of soil. Level the bed to prepare for planting.

Since initiation of the work at the research garden, over 300 indigenous or adapted varieties have been identified and propagated for seed. The value of this approach is that there are no Philippine seed companies; the varieties are appropriate to the locations; people are familiar with the produce; and the varieties produce without dependence on expensive inputs. A steady supply of seed is ensured through seed multiplication at the center and through extension activities of the program. Considering that the Philippines imported U.S. 47 million dollars of vegetable seed in 1984, this local approach makes good economic sense.

Implementation

The goal of the Family Food Production Program is to ensure the health and well-being of 85,000 malnourished children coming from some 50,000 families. The program's objectives are:

1. Increase food availability for home consumption.
2. Conserve cash resources.
3. Reinstate people's sense of control over their own lives.
4. Extend period of food availability.
5. Reduce malnutrition in children.
6. Reduce morbidity.

To meet these objectives, four levels of activities have been implemented in this program.

Level One

The first level involves the 150 indigenous garden promoters, located in every municipality of the island, which have been trained and are being followed up by IIRR. These promoters, many of whom are selected sugar workers, participated in at least four training sessions during 1986. They are teaching their colleagues the gardening technology. IIRR's past experience shows that indigenous trainers have many advantages. They can increase the manpower availability at a lower cost. They are on a social par with their neighbors, and they reside in the communities in which they work.

The IIRR serves as technical consultant to over 45 local agencies. These agencies select trainees and provide day-to-day guidance. The criteria for selection of trainees, agreed to and promoted by the agencies and IIRR, state that the trainees should:

- Have malnourished children.
- Be based in a community with a feeding center.

photo by Ken Tull

A 400-500-sq-ft plot is capable of yielding 3-6 lbs of vegetables per day for 300 days.

photo by Ken Tull

The key to successful extension is adaptation of technologies, not adoption. The double-dig approach is too labor-intensive for many people, and they choose to build raised beds for their gardens.

- Be selected by a cross section of the parents in the community.
- Be functionally literate.
- Be able to devote time to project.

As with most programs, there is never 100 percent success, but it is important to note that about 50 percent of the promoters were parents of malnourished children themselves (with 50 percent of promoters women), and 70 percent of the promoters have established their own gardens. They were provided with seed kits containing 20-25 varieties of indigenous or adapted vegetable seeds. The promoters are not only providing food for their families and being a good example to their neighbors, but they are multiplying seeds for use by the people whom they train.

An important difference between this program and many agricultural programs is that while a basic approach is recommended, three options, double dig, deep dug, and raised bed for gardens are given. The program staff is aware that all aspects of the technology are not suit-

photo by Ken Tull

Successful multiplication of the BIG approach to gardening is as much a product of the follow-up given to the technicians, trainers, and the gardeners they train as it is to the technology itself.

able to all places. The emphasis is on adaptation of the gardening technology to both the ecological zone and the cultural and economic conditions, rather than on adoption of a set package of practices.

To provide follow-up to the Garden Promoters, an IIRR agricultural technician is stationed in each of the four districts of Negros. District technicians visit the Garden Promoters in their respective districts once a month.

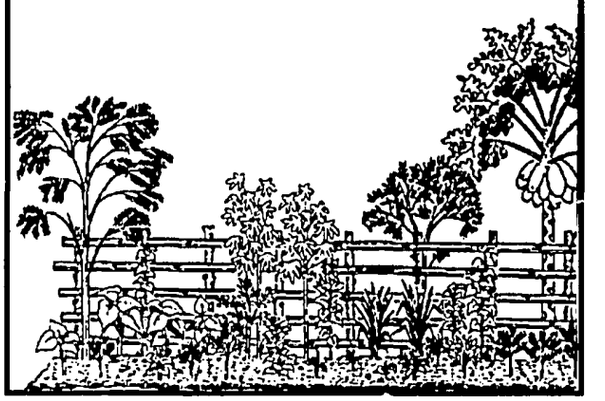
Level Two

The second level of training is that given by the promoters to their neighbors. Their objective is to share their skills and knowledge with 3,000 families of malnourished children, or about 20 families each. To compensate for the time the promoters must spend teaching their neighbors, they are paid two days' wages per week. In the training they do, the promoters are encouraged to teach the basics of BIG, but also to teach the importance of adaptation and not adoption. This adaptive approach is not restricted to construction of the beds, but includes the choice of fruits and vegetables to be planted. Gardeners are taught that each plot should contain one each of the following categories of plants: root, leaf, legume, and fruit. In deciding which plants to use from each category, new gardeners are taught how to take the nutritional values of the plants into consideration. IIRR has produced a complete package of educational materials containing visuals, such as slides and flash cards, and brochures as handouts. As of June, 1987, over 1,611 families were growing vegetables in over 6,000 garden plots as a result of this program.

Level Three

The third level of program activity concerns consulting service and training for other local agencies interested in BIG. IIRR provides necessary seeds, but, the local agency is expected to provide follow-up to the individuals with whom they work. An example of such an agency is the Victorias Milling Corporation. IIRR is also cooperating with the Department of Agriculture and Food by providing training in BIG to Municipal Agriculture Officers and technicians. The Department of Agriculture, with UNICEF support, is setting up community gardens in every municipality on the island.

Utilizing the fenceline for planting annual and semi-annual crops



B I G AND THE URBAN POOR

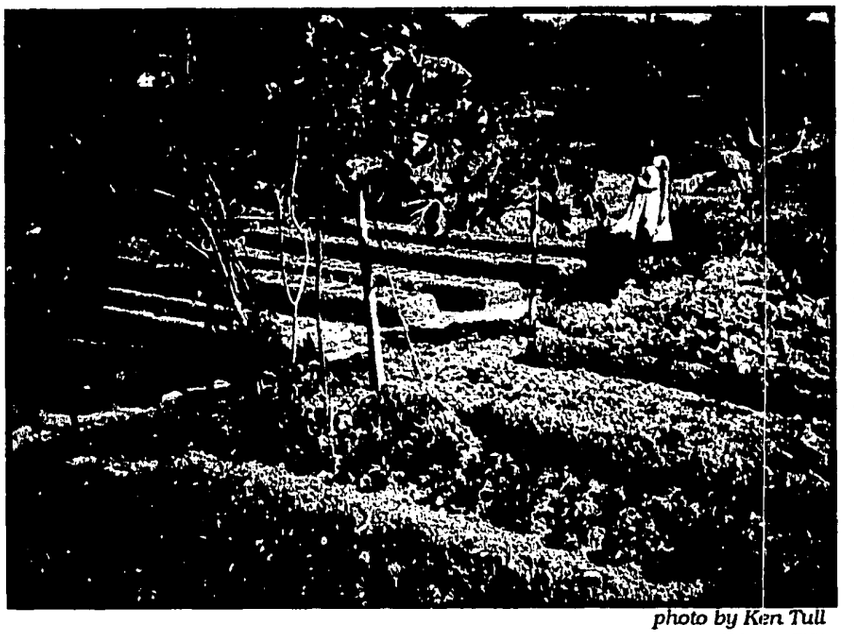


photo by Ken Tull

Because of the scarcity of land, gardening is particularly difficult for the urban poor. In the Dasmarinas Bagong Bayan Project, people have acquired the right to use the access land under the power lines leading to Manila. Innovative gardeners, using the BIG approach, are growing vegetables for both home consumption and sale for badly needed cash.

The Dasmarinas Bagong Bayan Project is a membership organization in Cavite Province near Manila. The people occupying this land were urban poor moved here by the Marcos government and given small house plots. The objective of the relocation program was to keep the urban poor out of Manila, and to provide labor for a projected industrial area that never materialized. The program goal is to increase the economic well-being of the members by:

1. Reducing the need to use cash income to purchase needed vegetables on a year-round basis by providing chemical-free fresh vegetables for home consumption.

2. Providing high-value vegetables, harvestable at appropriate market times so as to maximize potential income from sales.

The program involves 132 families in BIG. The lead agency responsible for the program is the Philippine Countryside Development Center, which is working in cooperation with the National Housing Authority. IIRR is the technical support group.

photo by Ken Tull

An important part of the urban gardens is the raising of Japanese Golden Snails. They are prolific and can be fed left-over vegetative matter from the garden. They are a valuable source of protein.

When the technologies of BIG are taught in the schools, and students work with them in the school gardens, it is expected that students will carry this knowledge home and plant gardens of their own.

photo by Ken Tull

Level Four

Working through the educational system represents the fourth level of activity. In collaboration with the Department of Education, Culture and Sports, training is being conducted in 50 schools. Using a training of trainers approach, the "echo system," 105 trainers were trained and they have, in turn, trained 1,120 school teachers. As a result, demonstrations have begun in 400 schools. These echo trainings are conducted using local funds. UNICEF provides the garden tools. Another aspect of the school system's part of the program is that schools are another way of both retrieving and multiplying the seeds of indigenous varieties of plants.

The Future

UNICEF's financial commitment to this program is for two years. In this time period, the objectives have consistently been exceeded. The challenge that faces the BIG program in the final months of UNICEF support is growth. The dilemma is like a two-edged sword--on the one side, there is a rapidly growing demand for this technology and the technical support that IIRR can give and, on the other side, is the limited capacity to respond to that demand. Program workers have noted some resistance to gardening land that does not belong to the gardener. What the Aquino government does about the issue of providing land to the landless will have a great impact on the continued multiplication of BIG.

PROJECT ANALYSIS

The keys to success in the BIG Program that we have identified are:

- Interagency cooperation.
- Flexible technology which involves the gardener in research.
- Regular and frequent follow up with gardeners.
- Use of local promoters who reside in area of work.
- Program uses indigenous or adapted plants.

This case study is based on information provided by J. Gonsalves, E. D. Monu, and J. Yudelman of IIRR, and on information collected during a site visit by the author.

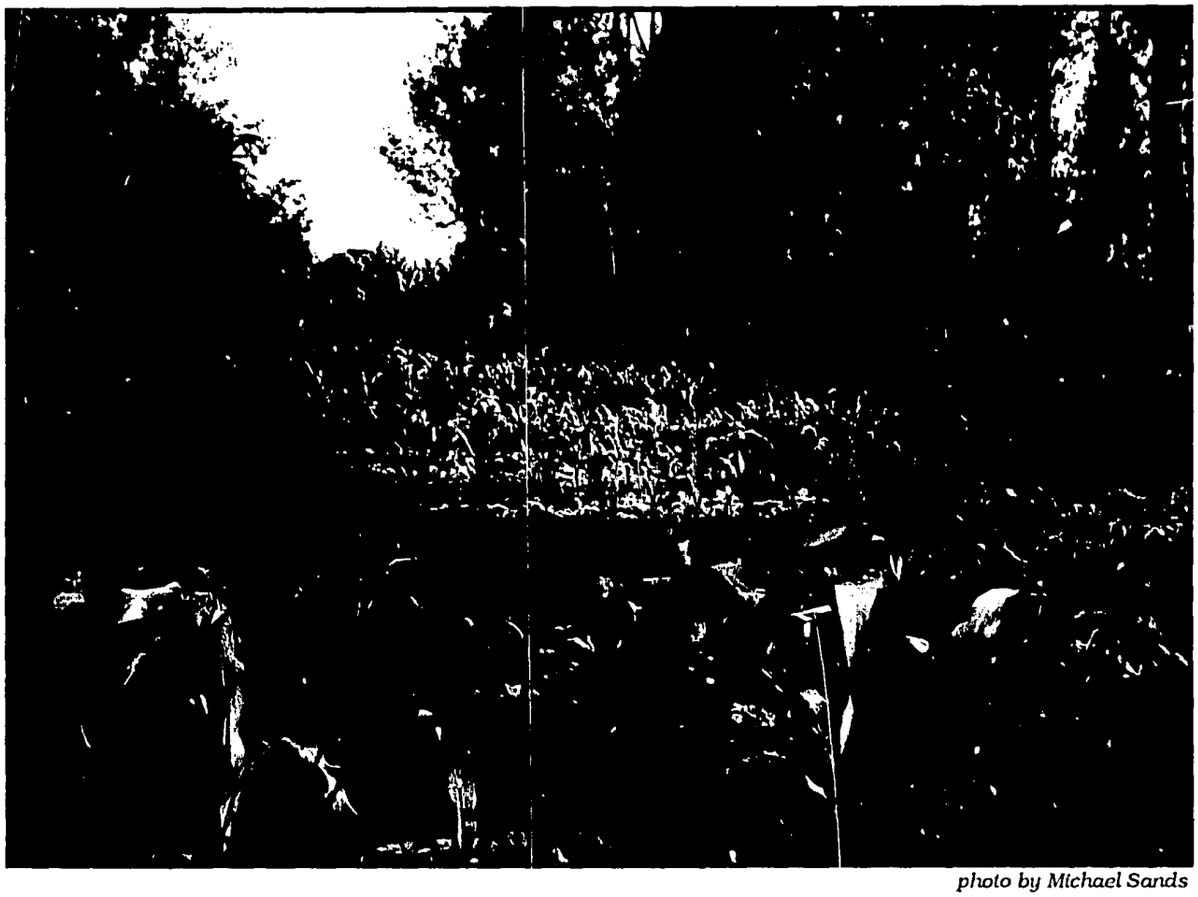
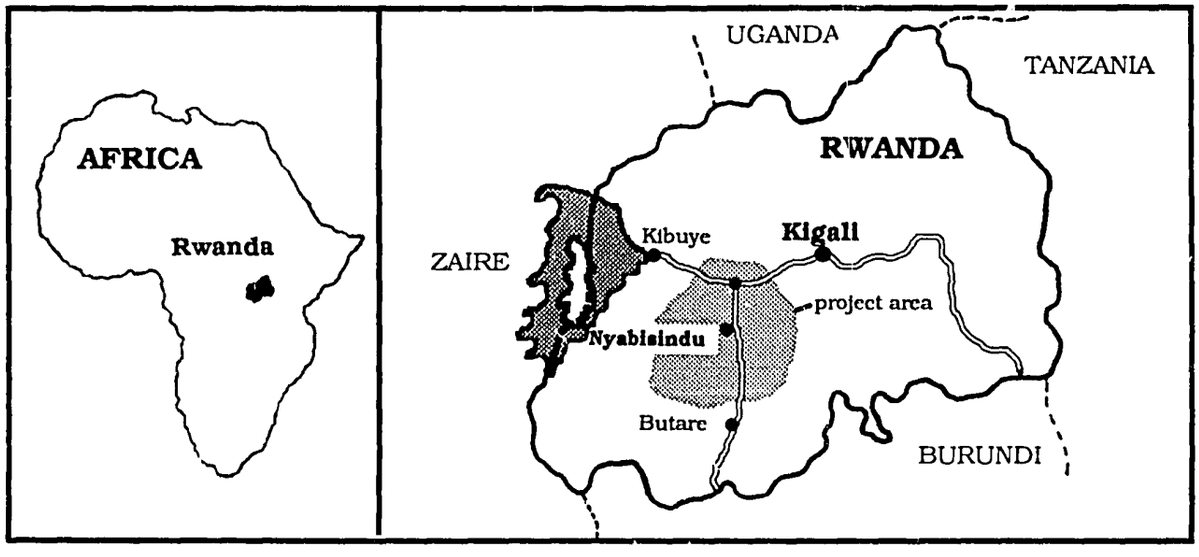


photo by Michael Sands



INTEGRATED SOIL REGENERATION IN RWANDA

Projet Agro-Pastoral de Nyabisindu

Michael Sands

The Setting

People in Rwanda, located in central East Africa, struggle like others around the world to provide enough food for their families. Landlocked in a mountainous region, 90 percent of Rwandans depend on the production of their small farms for food, fuel, and small amounts of cash. This case study explores the success of a regional development project, Projet Agro-Pastoral (PAP) in Nyabisindu, in the design and multiplication of low-input agricultural technologies that help improve the natural potential of farmers' fields.

With a population growth rate reaching 3.8 percent per year and 230 inhabitants per square kilometer (sq km), Rwanda must find a way to intensify its smallholder agriculture. Yet, this intensification is not easy, for reasons outlined below.

On the central plateau of Rwanda, the average annual rainfall is between 1,100-1,500mm, depending on the specific site. From 1978-1983, the average at the Gihisi/Kigoma weather station was 1,229mm. The dry season is during June, July, and August. During January, there is also a short dry spell.

Identifying the Problems

Poor Soils

The soils are shallow and very acid. The high daily temperatures speed up the decomposition of soil organic matter, typically, leaving less than 2 percent in the soil. This, in turn, reduces the water-holding capacity of the soil. With the intense rainfall and slopes of up to 45 percent, soil erosion continues as a very dramatic problem. This terrible soil loss, coupled with the poor soils, results in very low crop yields.

Yet, there is essentially no more land to cultivate. Farm sizes are very small--69 percent of the farmers have less than 1 hectare (1ha) from which they produce meager amounts of maize, sorghum, sweet potatoes, cassava, beans, and bananas for their families. Households typically consist of five to six family members.

Clearly, the Rwandans' need for food and fuel is pushing the natural resources to their very limit. To enhance the productivity of the land, the decline in soil structure and fertility must not only be slowed, but, reversed.

RWANDA	
Population, 1980	6 million
Total Area (sq km)	26,338
Farmland (sq km)	12,500
PROJECT AREA	
Elevation	1500-1900m
Average Temperature	19-21°C
Average Rainfall	1000-1250mm
Soil pH	3.8-3.9
Farm Size	
<0.5ha	47.6%
0.6-1.0ha	22.4%
>1.0ha	29.9%

Fertilizer Costs

The inland location, 1,800km from the nearest port, and the lack of basic materials, limit the potential of commercial fertilizers for improving harvest. Because of transportation costs, fertilizer in Kigali is between two and three times the world price. A metric ton of fertilizer, costing $200 on the world market, can cost upwards of

$600, including the shipping costs from Mombasa, Kenya. This means the small farmer cannot afford to buy the necessary inputs. Moreover, given the limited sources of foreign exchange, Rwanda can ill-afford to spend her precious foreign reserves on expensive production inputs.

Rwanda is not a unique case. The vast majority of people in the Third World live in similar conditions, trying to scratch out a living from eroded, acid soils.

Action Through Collaboration

In Rwanda, the challenge was to structure an agricultural system in such a way as to increase productivity, enhance the natural resource base, and minimize the purchase of external inputs. Responding to that challenge, in 1969, the Rwandan Ministry of Agriculture, Livestock and Forests, in collaboration with the German Agency for Technical Cooperation (GTZ), and the University of Heidelberg's Ecological Agriculture in the Tropics program, established PAP. The project has targeted the western and central communes of Nyabisindu, Ntyazo, Murama, Kigoma, Ntongwe, Rukondo, and Karama. The major part of the project area, the communes of Nyabisindu (7,740ha), Murama (10,720ha), and Kigoma (13,250ha), is on the central plateau, where the altitude ranges 1,600-1,850m above sea level.

photo by Michael Sands

Compost from crop residues is an important nutrient source for small farmer crops. A layered composting method is used.

Originally established as a dairy improvement program, PAP has developed into a multifaceted development and training project, focusing on livestock production, erosion control, soil fertility, and agroforestry systems. Early research and discussion with farmers identified the degradation of the primary resource, the soil, as the most critical problem. The degradation involved declining soil fertility and soil structure, as well as soil loss through water and wind erosion.

Project Goals

The primary goals of PAP today are to:

- Develop productive, ecologically sound small-farm production systems.
- Reduce deforestation caused by rural people cutting trees for firewood.
- Reduce the prevalent problems of soil erosion.
- Improve the capability of the Rwandan extension system to transfer information on low-input agriculture.

Primary Audience

From the beginning, PAP has perceived that its principal clientele is the small farmer of Rwanda. Contact with farmers is initiated

By incorporating green manures, such as *Crotalaria*, a legume, farmers are able to improve soil organic matter, structure, and fertility.

photo by Michael Sands

through a variety of extension workers (Moniteurs, MonAgris, AgriComms) and individual farmers selected by local farmers' groups. In addition, PAP is cooperating with non-governmental organizations, such as INADES-Formation, that are working directly with smallholders throughout the project area. These people are the principal audience trained through attending short courses and workshops conducted by the project.

The extension courses include a variety of topics: Soil Fertilization, Combatting Soil Erosion, Integrating Trees into Farms, Production and Uses of New Crops, and Livestock Production in Confinement. The people who complete these courses are given simple instructional materials, such as posters, flip charts, and flannelgrams, to use in basic training activities in their home communities. In addition, for those who are literate and serve as resource people in their community, there are more detailed Technical Reports that serve as reference materials. Currently available titles in French include "Erosion and the Fight Against Erosion," "The Confinement Stall," and "The Tree and the Hedge in the Peasant Farm."

Between direct participation in courses at PAP headquarters and in events coordinated by extension agents trained by PAP, it is estimated that between 10,000-14,000 farmers receive information generated by PAP.

Looking for Answers

Researchers and other staff started with methods based on local skills and resources and focused on using the whole-farm system for recycling nutrients. The value of mulches, animal and green manures, erosion control, and raised beds were already known to many Rwandan smallholders.

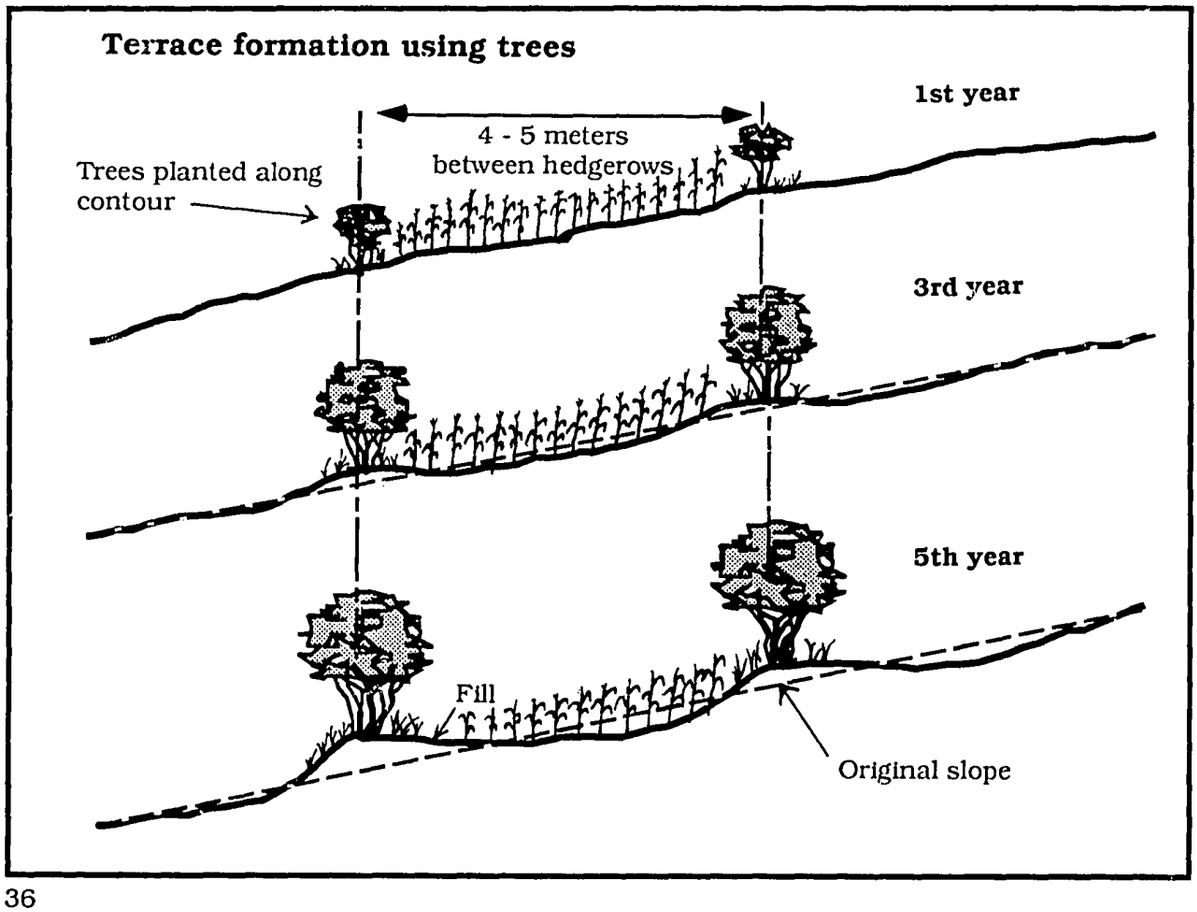
The development of new technologies and systems was based on ecological criteria. Highly diversified farming systems were promoted to take full advantage of the ecological interactions of polycultures and to reduce the vulnerability of smallholders to the vagaries beyond their control, such as markets, weather, and input availabilities. These production systems were based upon existing farming practices, including annual and perennial crops, livestock, and trees.

Soil Fertility

Research on the use of compost and animal and green manures to improve soil fertility was initiated. Early research showed that a legume fallow incorporated at 10 months, using *Crotalaria spp.*, *Tephrosia vogelii*, and *Cajanus cajanus*, increased maize yields by more than four times over controls with no addition of fertilizers. When yields were compared to treatments with 15 metric tons of stable manure, the legume fallow treatment produced just over twice as much maize. There was no significant difference between legume fallow and the addition of 120 kilograms of N (120kg N), 100kg P, and 100kg K. While *Crotalaria* and *Mucuna* species and *Sesbania* are now used fairly successfully as green manures, more research is needed in management of these crops to minimize labor requirements, particularly for incorporation into the soil. Farmers were encouraged to build and use above-ground compost piles in their fields. Crop residues were the principal materials composted.

The confinement of livestock in specially built structures that conserve and compost animal manures and discarded feed has also been promoted. Livestock feed is cut and carried from grasses and legumes grown on field borders and erosion-control strips.

In addition to the enhancement of soil fertility, through the use of compost and animal and green manures, control of soil erosion and improved water retention and absorption had



Diverse varieties of trees and forage grasses are used to help anchor newly formed bench terraces and prevent further soil erosion.

photo by Michael Sands

high priority. The incorporation of trees into the farmer's cropping systems was seen as a possible way to attack, simultaneously, many soil and water problems.

Agroforestry

The agroforestry component of PAP was based on the traditional farming systems in the area. Many tree species were included in the traditional system to produce diverse products, such as fruit, fodder, mulch, and fuel. Most of the trees that were used were multipurpose.

Trees potentially have many contributions to make in tropical agricultural systems. Many produce food for human consumption, such as the fruits of the avocado and *Castanea sativa*. These products make substantial qualitative differences in farm families' nutrition, because they supplement available field crops.

Wood and charcoal are the primary fuels for rural farm families throughout the tropics. In Rwanda, it is estimated that each person, on the average, uses 1 cubic meter of firewood annually. Presently, the vast majority of this wood comes from the cutting of forests. Crop residues are also used in some cases. Integrating trees into the farm can make a major contribution in meeting energy needs of the farm family. This, in turn, can relieve some of the pressure on nearby ecologically important forests and allows crop residues to be returned to the soil.

Systematic planting of trees along contours, together with grasses and shrubs, reinforce erosion control structures already in place. Over the course of several seasons, small terraces were formed with the edges being anchored by the trees.

The appropriate species selection, density of planting, spatial and temporal arrangement, etc., are dependent upon the environmental and socioeconomic conditions of the specific farm. Farmers' concerns are most generally related to the potential yield loss of interplanted annual crops caused by competition for light and nutrients from the trees. Indeed, poor agroforestry practices can drastically reduce yields of understory crops. Therefore, the sys-

photo by Michael Sands

Farmers are concerned that any tree used close to field crops should not shade those crops. Annual, dramatic tree pruning allows sunlight to reach the annual crops below.

tem must be structured such that the various components complement, instead of compete with, one another.

Several general recommendations have been developed for the integration of trees into the production systems. They should be planted in erosion-control strips, along the contours that define the fields. In most cases, where the majority of rain comes in short intense showers, the tree rows should be planted at right angles to the most common rainfall direction. This protects the soil and annual crops from the impact, and the trees also serve as a windbreak during hot, dry periods.

Where light, temperature, or fungal diseases are major constraints to crop growth, there is real advantage to orienting the tree rows in an east-west direction. In the tropics, this produces minimum shading in the area between the trees, which is where the crops are planted.

To further minimize competition for light, trees should be kept pruned. In Nyabisindu, *Grevillea robusta* trees are pruned at least once a year, at the beginning of the main planting season. Removing approximately 50 percent of the canopy still allows adequate growth by the tree, while allowing sufficient light to reach the understory crops. The pruned limbs also provide a valuable source of fuel. In one trial, with 196 *Grevillea robusta* trees, 2.2 cubic meters of stacked wood was produced annually.

The effect of the shading can be further minimized by planting crops requiring high light intensity, such as maize, in the center of the alleys between the trees. The areas closer to the trees can then be used for crops, such as soybeans and sweet potatoes, that do well in low light intensity environments.

Competition by the trees for water and nutrients is controlled by pruning back the roots annually under the annual crops. This is accomplished by cutting to a depth of 10 centimeters (10cm) below the normal digging depth with a heavy hoe at approximately 20cm from the base of the trees. In certain cases, a second deeper pruning is made farther out from the tree. It is important to initiate this pruning while the tree is still young to minimize the negative effect on the tree.

To maintain a consistent sustainable production from the tree rows, PAP encourages the

SOME TREES RECOMMENDED BY PAP IN NYABISINDU REGION

Acacia melanoxylon
Cedrela serrulata
Grevillea robusta
Eucalyptus gummifera
Cypressus lusitanica
C. torulosa
C. bennthamif
Cassia spp.
Acrocarpus fraxinifolius
Entada abyssinica
Podocarpus milanjianus
Markhamia platycalyx
Maesopsis eminii
Albizia gummifera
Milletia dura
Sesbania sesban
Leucaena leucocephal
Persea americana
Psidium guajava

farmers to maintain both species and age diversity in each row. This allows farmers to harvest mature trees without disrupting the other positive benefits of an established tree intercrop.

The integration of small-scale livestock production with the cropping practices of mulching, green manuring, intercropping, agroforestry, and the development of anti-erosion terraces has provided farmers in the project area with real hope for their future.

Multiplication

For any project to be truly successful, it must be able to move out from its initial target location to influence a larger audience. The PAP has undoubtedly had this effect. In addition to a small site at Mugusa, where the University of Heidelberg is working, the majority of subsequent projects by other agencies reflects the influence of PAP. Based on the successes of the low-input, regenerative technologies adapted by PAP, Rwanda has made development and adaptation of productive, environmentally sound technologies its primary agricultural priority.

Conclusion

People of the tropics have been victims of a widespread environmental degradation caused, largely, by the use of unsuitable agricultural technologies and elimination of forest vegetation. Among other factors, the development and promotion of these extractive agricultural technologies among smallholders underlie this process. The development of biologically structured systems, using the resources available on the farm, offers hope. In particular, integrated agroforestry, as demonstrated by PAP, offers the potential to increase productivity of agricultural land, while meeting the energy needs of the farm family. The opportunity to adapt these technologies is high because, in many cases, they build upon traditional agricultural practices that only recently may have been abandoned.

Program Analysis

Primary factors that have contributed to success of PAP in Nyabisindu are:

- The program has had a sufficiently long-term horizon.
- The technologies have built upon traditional agricultural practices.
- The information generated has been successfully presented in a variety of media.
- The program has worked through and strengthened existing governmental and non-governmental extension services.

This case study is based on materials and information provided by I. Neumann, U. Breitschuh, and P. Keller, and on information collected during a site visit by the author.

photo by Miguel Altieri

SELF-RELIANCE AND THE SMALL ORGANIC FARM IN CHILE

The Centro de Educación y Tecnología Food Self-Sufficiency Project

Miguel Altieri
Michael Sands

While the large commercial-scale agricultural sector, in particular export fruit production, has grown consistently over the years in Chile, the smallholder sector has not fared as well. The expansion of the commercial fruit production has also resulted in a systematic loss of food self-sufficiency among the rural poor, who usually end up working as wage laborers on the large farms. Despite using considerable resources, development projects rarely achieve expected production goals or dramatically improve the quality of life for the peasant family.

The high-yielding varieties and their all-important chemical inputs, capable of improving net returns, were seldom available to those farmers without access to capital or credit. Those who were successful in obtaining production credit often gave up traditional varieties and cropping systems. This, in turn, reduced the genetic diversity at their disposal and made them more vulnerable to the vagaries of a market they had no control over. As the subsidized credit and public technical assistance was eliminated over the past few years, the peasant farmer has been further marginalized. If farmers could no longer turn to the government, how could they find ways to improve their lives? In many cases private institutions have begun to answer those needs.

Since 1980, the Centro de Educación y Tecnologia (CET), a Chilean private non-governmental institution, developed a food production technology program adapted to the socioeconomic and ecological conditions and resources of the small farmer in Chile. CET's approach was to establish three experimental, demonstration small farms of 0.5ha (a typical size for a campesino farm) near the cities of Santiago, Temuco, and Concepción. These farms were structured such that most of the food requirements of a family with little income and a small amount of land could be met. In this farm system, diversity was the critical factor in efficiently using existing resources.

The efforts of CET have been complemented by the Comisión de Investigación Agricultura Alternativa (CIAL), a group of university professors, professionals, and students who have established a research program in organic agriculture. The primary goal of this program is to develop agricultural technologies appropriate for small farmers with limited resources. In their work they are extracting as much information as possible from modern science and relating it to the traditional knowledge base of the people. CIAL wants to develop a truly interdisciplinary approach, one that would not only focus on the ecological impact, but also on the social conditions in which each new technique would be applied.

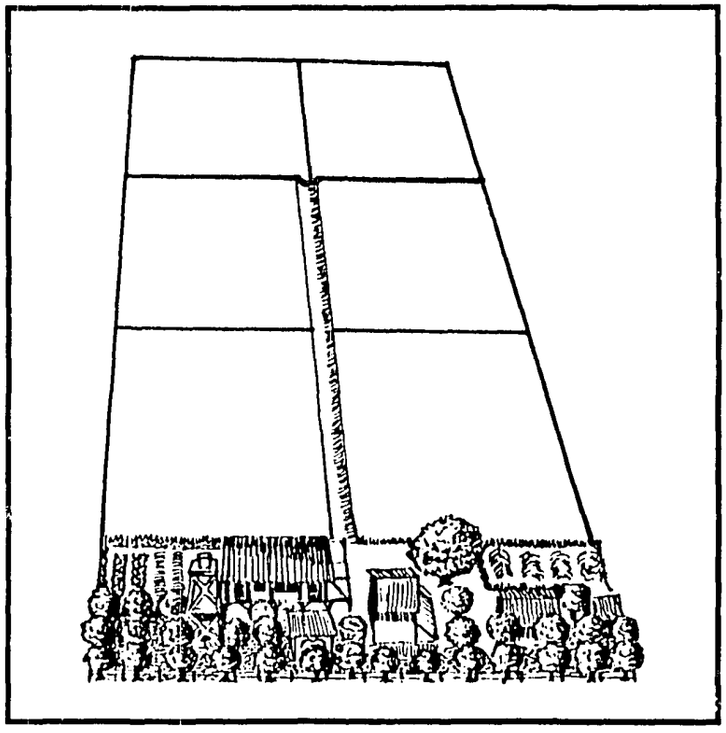
Project Goals

The primary goals of CET's food self-sufficiency project are to:

- Help peasants achieve year-round food self-sufficiency.
- Reduce farmers' reliance on scarce and expensive agricultural chemical inputs.
- Develop production systems that rebuild the productive capacities of the peasants' small holdings.

The principal clientele of the training compo-

The model small organic farm is built on one-half hectare. The house, vegetable garden, fruit trees, grape arbor, and livestock facilities are located together, leaving 4,400sq m for the six fields. The components are combined in ways to take full advantage of the limited space.



nent of the project are farmers, urban poor, and grass-roots extension agents.

Biological Structuring

The CET farm is a diversified combination of crops, trees, and animals. In an attempt to maximize production efficiencies, the components are structured to minimize losses to the system and promote positive interactions. Thus, crops, animals, and other farm resources are managed to optimize production efficiency, nutrient and organic matter recycling, and crop protection. The principal components are:

- Vegetables: spinach, cabbage, tomatoes, lettuce, etc.
- Intercropped maize/beans/potatoes and peas/fava beans.
- Cereals: wheat, oats, barley.
- Forage crops: clover, alfalfa, ryegrass.
- Fruit trees: grapes, oranges, peaches, apples, etc.
- Non-fruit trees: black locust, honey locust, willows, etc.
- Domestic animals: chickens, pigs, ducks, goats, bees, and one dairy cow.

The design is based on cropping patterns, crops, and management techniques practiced by local campesinos. In these systems, campesinos typically produce a great variety of crops and animals. It is not unusual to find as many as 5 or 10 tree crops, 10-15 annual crops, and 3-5 animal species on a single farm.

The physical layout of these farms varies, depending on the specific farmer's circumstances. It often includes an arbor of grapes

("parron") to provide shade, fruits, herbs, medicinal plants, and flowers, in addition to the tree and annual food crops. The typical farm animals include chickens, ducks, rabbits and, occasionally, a few pigs feeding on kitchen waste or crop residues. "Chacras," or intensified annual cropping systems, involving the use of simple crop patterns where only one crop is grown usually during the summer, are important. However, more typically the chacra involves more complex crop sequencing with a second crop following the first crop. In both cropping patterns, the campesino may practice a form of intercropping by planting two or more crops together in the same field at the same time. Common summer intercrops include corn and beans, garlic and/or onions mixed with lettuce and cabbage, and corn and potatoes. In the winter, peas and fava beans are the principal crops grown.

The vegetables, fruits, and chacra production are directly consumed by the family, but an occasional surplus sometimes occurs and may be sold. Wheat and oats are used for breadmaking. Forage crops and some chacra crops serve as food for the animals. Forage crops are also plowed under as green manure, when the field is rotated into crops. Fava beans provide the high-protein component of poultry feed. All plant residues and manures are used for making compost. Manure can also be applied directly around the base of the fruit trees. Crop residues of cereal straw and maize stalks can be used to feed the animals, or they may be left as stubble mulch on the soil surface.

Farmers also plant a variety of trees around the homestead. Many of these are fruit trees, including apples, peaches, and citrus, that provide food for family consumption. Small surpluses are sold in local markets to generate needed cash. Non-fruit trees are used for fodder, wood, fuel, and construction materials. The tree species, black locust (*Robinia pseudocacia*), is a nitrogen fixer and also produces termite-resistant wood suitable for fence posts and other building needs around the farm. The foliage of honey locust (*Gleditsia triacanthus*) and *Salix spp.* is used as fodder. Russian wild olive (*Elaeagnus spp.*), also a nitrogen fixer, provides habitat for wildlife.

photo by Miguel Altieri

Backyard livestock kept in confinement are important for both food and manure production. Their feed comes from household scraps and crop residues.

Dense planting controls weeds and conserves moisture. The combination of different species exploits different resources, while providing a year-round supply of nutritious vegetables.

photo by Miguel Altieri

Intensive Vegetable Production

At CET's demonstration and research farms, primary vegetable production occurred in an intensive garden with heavily composted raised beds located near the homestead. Seedlings were started in a solar greenhouse that consisted of a hole in the soil, 3 x 3m wide and about 1 1/2-2m deep, covered by transparent plastic.

This vegetable production system is designed to be appropriate for a variety of audiences. The urban family with a small backyard would use it alone as a supplement to purchased foods. The small farmer would integrate it into the larger farming system to supplement the family's diet of field crops and purchased foods. On the small farm, vegetables were also produced in conjunction with cereals, legumes, and forage plants in a rotational system.

The primary nutrient source for these gardens was compost. Various compost technologies have been demonstrated by CET, including simple, layered above-ground piles. Various intercropping combinations and rotations in the garden have been explored to maintain soil fertility and minimize pest problems. The influence of vegetable species on other companion plantings has been documented in various CET manuals for use by extensionists and farmers.

Under the optimal conditions of the CET farm, the production of seven species (tomato, beet, spinach, lettuce, carrots, radishes, and swiss chard) in four raised beds, measuring 28sq m, was monitored over one growing season. The monthly vegetable harvest was 82kg. If a family of five ate 30kg per month, this would leave 52kg for sale. However, it is expected that yields on smallholder farms will be up to 50 percent lower. Nonetheless, this still would leave a small surplus of 4-12kg per month.

Field Crop Rotations

The remaining vegetables, crops, and forages were grown in adjoining small fields. Relatively constant production was achieved by dividing the land into as many small fields of fairly equal productive capacity as there were years in the rotation. The rotation was designed to produce

The intensive six-year rotation provides a constant soil cover and supply of field crops and forage. The plant diversity created by the rotation helps prevent serious pest outbreaks.

photo by Miguel Altieri

the maximum variety of basic crops in six plots, taking advantage of soil-restoring properties of the rotation. Each plot received the following treatments during the six-year period:

Year 1. *Summer* - corn, beans, and potato.
Winter - peas and fava beans.

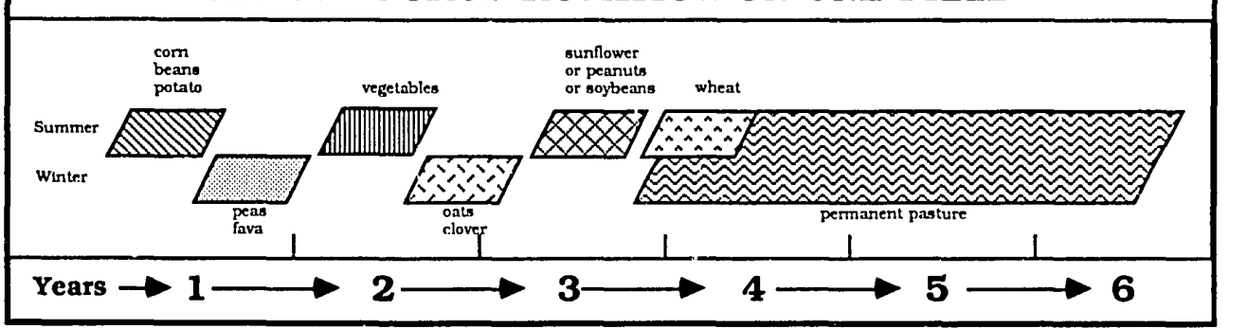
Year 2. *Summer* - tomato, onion, squash.
Winter - supplementary pasture (oats, clover, ryegrass).

Year 3. *Summer* - soybean, peanuts, or sunflower.
Winter - wheat companion-planted with pasture.

Yrs 4-6. *Permanent pasture* - clover, alfalfa, ryegrass.

In each plot, crops were grown in several temporal and spatial designs, such as strip-cropping, intercropping, mixed-cropping, cover crops, and living mulches, thus, optimizing the use of limited resources and enhancing the self-sustaining and resource-conserving attributes of the system. An important consideration in the rotational design was the stability of the cropping system in terms of soil fertility maintenance and pest regulation. It is well-accepted that a rotation of grains and leguminous forage

SIX-YEAR CROP ROTATION ON ONE FIELD



crops provides significant additional inputs of nitrogen and much higher yields of the subsequent crop of grain obtained with continuous grain monocropping. The output of grain depends on the efficiency of the legumes in supplying nitrogen. Studies in Chile, and elsewhere, have shown that legumes such as sweet clover, alfalfa, and hairy vetch can produce between 2.3-10 tons per ha of dry matter and fix between 76-367kg of nitrogen per ha. This is sufficient to meet most of the nitrogen requirement of agronomic and vegetable crops.

The rotational scheme provides nearly continuous plant cover that aids in the control of annual weeds. Incorporating legume cover crops in annual crops, such as corn, cabbage, and tomato, through overseeding and sod-based rotations, has reduced weeds significantly. In addition, these systems reduce erosion and conserve moisture and, therefore, offer great potential for hillside farmers.

Insect Control

Crop rotation also had a profound impact on insect pest populations. For example, the corn rootworm (*Diabrotica spp.*) consistently reached higher levels in a continuous corn monoculture than in corn fields following soybean, clover, alfalfa, or other crops. The presence of alfalfa in the rotational scheme enhanced the abundance and diversity of insect predators and parasites on the farm. Strip cutting of alfalfa forced movement of predators from alfalfa to other crops. Cutting and spreading alfalfa hay, containing high numbers of beneficial insects throughout the farm, also increased natural enemy populations. Cereal residues used as straw mulches in the succeeding crops significantly reduced white fly populations, the principal vector of several viruses, by affecting their attraction to host crops.

Numerous long-term rotations (3-6 years) were proposed to reduce populations of pathogens in the soil, although short-term sequences can also be effective. Peas, for example, reduced *Gaeumannomyces solancaerum* populations that built up during a preceding wheat crop. Incorporation of barley straw, hay, or mature legumes in the top soil as green manure also affected soil fungal populations and nematodes. Rape, pea, or mixed grass-legume green

photo by Miguel Altieri

Training at CET for farmers, community leaders, and grass-roots extensionists focuses on adapting, rather than adopting, technologies.

manures reduced populations of *G. graminis* in wheat by stimulating antagonists.

Multiplication

Groups of farmers (especially community leaders) coming from local and distant areas, lived at CET's farms for variable periods of time, learning through direct participation in planning, management, and evaluation activities involved in the organic production systems. After training, farmers were given a packet of the seeds they would need to set up a system similar to CET's. They then returned to their communities to teach their neighbors how to apply the model on their own farms.

Between 600-700 farmers, grass-roots extensionists, and community leaders pass through the CET farms annually. CET estimates that through these people they have reached more than 3,000 families per year.

In addition, about 40 technicians from other Chilean institutions have participated annually in special workshops and seminars conducted by CET. This has contributed to strong collaborative activities with other Chilean and Latin American organizations.

Follow-up evaluations of the program in rural communities revealed that a number of peasants adapted either a portion or all of the farm design. In many instances, peasants modified the technologies according to their own customs and resources. For example, in southern Chile, a group of peasants did not use compost but, instead, used litter from nearby Acacia forests, as traditionally done, to fertilize crop fields. Experience has shown that farmers do not derive a particular technological package or recipe from the training but, rather, a perspective, or a set of "criteria" for optimizing and managing their productive space. In this sense, CET's model farms present "pedagogical," rather than "technological," tools.

Conclusion

The CET model farms have led to various production alternatives for the small landholder and even for the urban poor. One example is the refinement of the intensive family garden concept in which large quantities of vegetables are grown in very small spaces. Another is the organic subsistence farm, which demonstrates the possibility of agricultural self-sufficiency on plots of little more than one-half hectare. The collaboration of CIAL has been crucial to scientifically quantify the "how" and "why" of CET's designs. To assure that this research will continue to improve the lot of the smallholder in Chile, CET continues to coordinate with other grass-roots, non-governmental agencies.

Program Analysis

Several factors that have contributed to the success of the CET food self-sufficiency program include:

- The technologies developed are based upon traditional agricultural practices.
- The program has focused on demonstrating the "adaptive process" versus individual technologies.
- Training activities have been geared to the grass-roots extensionists and farmers themselves.
- Existing private, non-governmental agencies have been actively involved as collaborative partners.

This case study is based on materials and information provided by Camilla Montecinos and on information gathered during a site visit by Miguel Altieri.

photo by Ken Tull

Machakos, Kenya

Joshua Mukusya, former government agriculture extension worker and present project director for World Neighbors, discovered that intercropping maize and finger millet not only produces acceptable yields of maize, but an extra crop of millet. He says dense planting conserves moisture because the soil is protected from the harsh sun. His wife, Rhoda, says it also cuts labor by two-thirds because the plant population prevents weed germination. This planting technique draws upon traditional cultivation methods.

CRITERIA FOR SUCCESS —OUR CONCLUSIONS

As we compared the case studies presented here, we concluded that successful programs share several common factors. Because we feel there is much we can learn from the studies, it may be useful to consider these factors as criteria for success in the design, management, modification, and evaluation of regenerative agriculture programs. Rather than simply providing a listing of conclusions, we have examined each factor as a separate topic, thereby, providing a more in-depth look at why it is, in our opinion, so important.

- **USE ADAPTABLE TECHNOLOGIES THAT BUILD ON TRADITIONAL PRACTICES**

Farmers have good reasons for the way they till their land. It is not just that they were taught how to do it that way by their fathers and mothers, but they know, barring inclement weather, or a massive pest infestation, what kind of yields to expect. This experience leads some people to think of farmers as being against change, or extremely conservative. This may be true, but farmers, especially subsistence level one, have good reason to be conservative. For them, adoption of an untested technology may mean the difference between survival or no survival for their family. In addition to the above reason for building upon farmers' existing experiences, this adaptive approach encourages farmers to become innovative themselves, because they have learned that their own technologies can be adapted, and in the process, they become more productive.

- **INVOLVE FARMERS IN THE DESIGN, IMPLEMENTATION, MANAGEMENT, AND EVALUATION OF THE PROGRAM**

If programs are going to continue on their own, the people for whom the program is intended must have a sense of ownership. Programs that do not directly involve farmers in the design, implementation, and evaluation, most often collapse with the departure of program staff.

This is a common problem with demonstration projects. Programs with farmers as partners, and not just as laborers, have a much better chance for success.

- **COORDINATE PROGRAM WITH EXISTING GOVERNMENTAL ACTIVITIES**

If a program is to reach its full potential for impact, it should be aware of those areas where its activities and those of other agencies and the government overlap. Too often, both non-governmental and governmental agencies are too territorial with their programs. There is often a greater desire to serve the interest of the agency rather than that of farm families. The most effective programs examine all available resources and seek cooperative working relationships to avoid duplicating activities in order to not waste limited resources. Secure agencies are able to do this without losing their own sense of identity.

- **ENSURE THAT PROGRAM HAS SUFFICIENTLY LONG-TERM TIME HORIZON.**

A challenge facing most programs is that they do not incorporate a long enough time horizon for technologies to be tested, adapted, and multiplied. The rush to be successful most often leads to failure. A common apology for this poor planning process is that the donor demands it. There is, unfortunately, some truth in that, but successful programs are those that have educated their donors on the importance of long-term commitment.

- **USE OF VISUALS AND DEMONSTRATIONS IN EXTENSION PROCESS**

Successful programs have discovered the truth in the Chinese proverb, "If I hear, I forget. If I see, I remember. But, if I do, I know."

Each of the "experiences in success" programs used a multimedia approach in extending its outreach. Filmstrips, slides, flipcharts, and pamphlets were used to introduce technologies and methodologies to farmers. The use of visuals was followed with practical, hands-on demonstrations by farmers.

- **EMPLOY PEOPLE FROM THE LOCAL AREA FOR PROGRAM STAFF**

Program leaders are often outsiders from other countries. However, traditional cultures consider outsiders as not only being from other countries, but also simply from outside the immediate local area. Experience has shown that the most dynamic programs are those that consider hiring of staff from the immediate local area a priority. A successful way of doing this is to implement a training program that upgrades demonstrator farmers' skills for staff positions. Such programs move more slowly in the initial stages, but grow more quickly in the long term and have a greater impact.

- **USE TECHNOLOGIES THAT CAN BE TAUGHT ONE FARMER TO ANOTHER**

If the technologies that are being promoted are too complex for one farmer to teach another, then they will be severely limited in their impact. Few countries can afford the cost of a large extension service, and in recent years, many countries have had to either limit their extension services or stop them altogether. If the technologies are appropriate, they are adaptive, and farmers can be instrumental in the multiplication process.

- **INSIST ON FOLLOW-UP VISITS**

Regardless of how appropriate the technology is, there are always farmers who need both technical and moral encouragement. During the early stages of program development, when technologies are being tested, program staff should record occasions when farmers doing the testing experience difficultues,and then use this record to plan follow-up visits with future farmers who are adapting the technology.

Contributing to Success with Regenerative Agriculture

Many agencies around the world recognize the importance of regenerative approaches to agriculture and have incorporated one or more aspects of regenerative farming or gardening techniques into some of their programs. The following list represents those agencies known to the authors:

Non-governmental Organizations

Academy for Educational Development, USA
Accion International, USA
Adventist Development and Relief Agency, USA
African Develoment Foundation, USA
Africare, USA
Agrecol Development Information, SWITZERLAND
Ashoka Society, USA
Asian Rural Institute, JAPAN
Associates in Rural Development, USA
Baptist Haiti Mission, USA
CARE International, USA
Center for Holistic Resource Management, USA
Center for Human Ecology, USA
Centro de Educación y Tecnologia, CHILE
Christian Care, ZIMBABWE
Cooperation in Development (CODEL), USA
Deccan Development Society, INDIA
Developing Countries Farm Radio Network, CANADA
Development Alternatives, Inc., USA
Development Through Self-Reliance, Inc., USA
Ecwa Rural Development, NIGERIA
Educational Concerns for Hunger Organization (ECHO, Inc.), USA
Energy and Environment Group, INDIA
Environnement & Développement du Tiers Monde, SENEGAL
Environment Liaison Centre, KENYA
Escuela Centroamericana de Ganaderia, COSTA RICA
Escuela Internacional de Agricultura, NICARAGUA
Experiment in International Living, USA
Farallones Institute, USA
Foster Parents Plan, USA
Fudumi Demonstration Farm, KENYA
Heifer Project International, Inc., USA
Henry Doubleday Research Association, ENGLAND
INADES Formation, IVORY COAST
India Organic Farmers Association
Institute for Alternative Agriculture, USA
International Alliance for Sustainable Agriculture, USA
International Centre for Low External Input Agriculture (ILEIA), THE NETHERLANDS
International Institute for Environment & Development, USA
International Institute for Rural Reconstruction, PHILIPPINES
International Union for the Conservation of Nature (IUCN), SWITZERLAND
Kerala Gandhi Samarak Nidhi, INDIA
Kerr Center for Sustainable Agriculture, USA
Land Rehabilitation Center, INDONESIA
Lutheran World Relief, USA
Mennonite Central Committee, USA
MINKA, PERU
Mutomo Soil & Water Conservation, KENYA
New Alchemy Institute, USA
Nitrogen Fixing Tree Association, USA

Overseas Development Council, USA
Oxfam, ENGLAND
Rodale International, USA
Sahabat Alam Malaysia, MALAYSIA
Save the Children, USA
The Green Belt Movement, KENYA
The Land Institute, USA
Tom Mboya Agroforestry Centre, KENYA
World Neighbors, USA
World Resources Institute, USA
Worldwatch Institute, USA

Government Agencies

AGRITEX, ZIMBABWE
Bureau of Forest Development, PHILIPPINES
Canadian International Development Agency
Canadian University Service Overseas
Chinese Academy of Agricultural Sciences
German Agency for Technical Cooperation (GTZ)
Instituto de Ciencia y Technologia y Agropecuaria, GUATEMALA
Office of Technology Assessment, USA
Swissaid
Tanzanian Agricultural Research Organization
United States Agency for Development (USAID)
United States Dept. of Agriculture, Soil Conservation Service
United States Peace Corps

Universities

Agricultural University of Wageningen, THE NETHERLANDS
Agrobiologia University Cochabamba, BOLIVIA
California Polytechnic State University, USA
Cornell University, USA
North Carolina State University, USA
Sokoine Agricultural University, TANZANIA
Swedish University of Agricultural Sciences, SWEDEN
University of California/Berkeley, USA
University of California/Davis, USA
University of California/Santa Cruz, USA
University of Florida/Gainesville, USA
University of Nebraska, USA
University of Wisconsin, USA
Virginia Polytechnic Institute, USA

Multilateral Research and Development Agencies

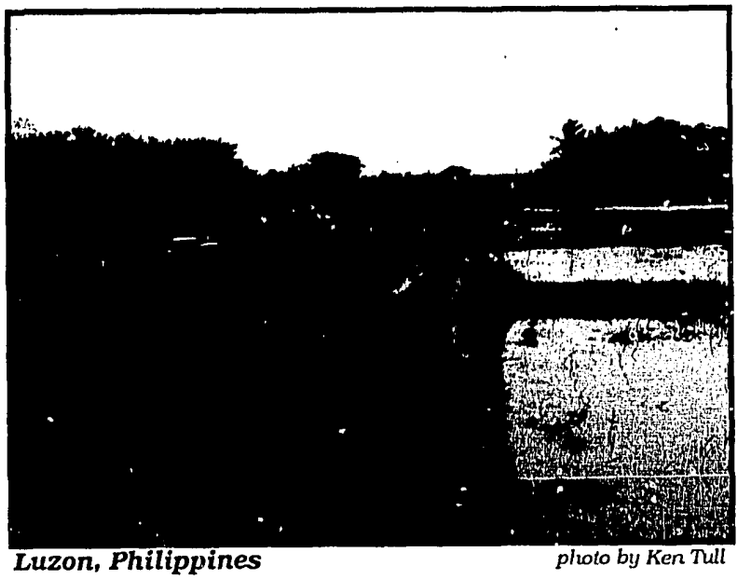
Asian Vegetable Research & Development Center, TAIWAN
Centro Agronómico Tropical de Investigación y Enseñanza, COSTA RICA
Centro Internacional de Mejoramiento de Maiz y Trigo, MEXICO
International Council for Research in Agroforestry, KENYA
International Crops Research Institute for the Semi-Arid Tropics, INDIA
International Livestock Center for Africa, ETHIOPIA
International Rice Research Institute, PHILIPPINES
International Service for National Agricultural Research, THE NETHERLANDS
International Development Research Centre (IRDC), CANADA
International Institute of Tropical Agriculture (IITA), NIGERIA
Winrock International, USA

SUCCESS CAPSULES

photo by Mike Sands

Progresso, Panama

Tropical kudzu is planted below plantain. This rapidly growing plant serves as a ground cover that suppresses weeds, and, because it is a leguminous plant, it is an important source of nitrogen. Farmers also use it as forage for pigs and other livestock.



Luzon, Philippines *photo by Ken Tull*

The IIRR is conducting tests on the use of azolla, an aquatic plant which encourages the growth of a nitrogen-fixing algae. This technique has been used as part of rice production in China for several centuries.

Mutare, Zimbabwe *photo by Ken Tull*

Naomi Tsangyika proudly shows the rock terraces that she and her husband, Aron, have constructed on a formerly eroded hillside. The Tsangyika's compost all plant residue and animal manure and add it to their soil.

Kerala, India *photo by Ken Tull*

Farm families working small farms want to produce more than enough grains and vegetables to feed their families---they want a little extra that can be sold for cash. Research on regenerative approaches to agriculture is helping that become a reality.