NEW PARTNERSHIPS FOR SUSTAINABLE AGRICULTURE

OVERVIEW BY
LORI ANN THRUPP WRI

WITH CASE STUDY CONTRIBUTORS

CARE Bangladesh
ANGOC Philippines
IFDP Cuba
SIMAS/CATIE Nicaragua
CIP Peru
ICIPE Kenya
RODALE Senegal
BIOS California USA
PFI Iowa USA

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L A T

FOREWORD

With 90 million more people to feed each year, the world's farmers have their work cut out for them, and the *concept* of "sustainable agriculture" is gaining ground But can the *practice* of increasing pro duction in an environmentally safe, socially equitable, and economically sound way keep pace with the growing demand for food?

Agricultural productivity rose dramatically in the second half of the 20th century, more than keeping up with population growth That remarkable increase in productivity stemmed from the introduction of newly developed "super strains" of rice, wheat, and other food crops, as well as from greater use of agro chemicals Annual global pesticide sales alone had risen to almost $29 billion by 1995 Yet in many places, the rising costs, diminishing returns, and harmful health impacts of this approach to agriculture have prompted farmers to try alternatives Turning to integrated pest and crop management they are relying less on modern agro chemicals and more on nature s species diversity adaptability and nutrient recy cling capacity to get the job done

In *New Partnerships for Sustainable Agriculture*, Lori Ann Thrupp and her colleagues from many countries explore vital but overlooked ele ments of innovative sustainable farming tech niques—collaboration farmer participation, and policy support Every bit as important as new scientific knowledge, agricultural inputs, or technical training are the creation and delivery of all three through dynamic partner ships of farmers, communities, governments, researchers, and non governmental organizations

The nine partnerships described in this report span the United States Asia, Africa, and Latin America All revolve around the implementa tion of practical alternatives to conventional, chemical intensive agriculture Together, these fact filled studies show how these alternatives have been put into practice in a variety of set tings—from Kenya, where tsetse fly traps collec tively maintained by farming communities are keeping trypanosomiasis in check, to California, where farmer to farmer extension and educa tion are revolutionizing orchard cultivation, to the Philippines, where Farmer Field Schools bring growers and agro ecologists together to raise rice yields and lower pesticide use Each case study highlights the roles of farmers and the many other collaborators needed to make alternative agriculture work and all take into account the complex web of values and interac tions that shapes any approach to farming

A key finding of *New Partnerships for Sustain able Agriculture* is that the institutions and groups implementing alternative agricultural practices can resolve philosophical differences and competition to move projects ahead In Peru, for instance, non governmental organizations and an international research institute are now working together on Integrated Pest Management after mutual suspicions dissolved in the pursuit of a shared goal

The nine partnerships have another common theme All demonstrate that shifting from conventional approaches in agriculture requires human will—not just new technology Farmers must be empowered to lead, to make decisions, to adopt new ways, and whole communities may need to take part in these efforts

Changes by farmers can be encouraged by institutional flexibility The array of government agencies, research centers and extension services now identified with modern conventional agriculture emerged decades ago to implement what were once new ideas These institutions still have a role But instead of dictating the terms of agricultural production increases, they will increasingly be called upon to boost local capacity through training, open communication, political support, and policy reform

Of course, the bottom line is food, and the good news embedded in this report is that sustainable agriculture can produce more food for more people And if the barriers and constraints identified here along with the benefits are resolved through careful communication, changes in agriculture policies and regulations, and the allocation of agricultural resources to where they will do the most good, the world's farmers can deliver on the promise of alternative agriculture

This conviction that agriculture can be made environmentally and economically sustainable is backed up by other research at WRI Related reports include *Paying the Farm Bill U S Agricultural Policy and the Transition to Sustainable Agriculture* by Paul Faeth and colleagues, *Growing Green Enhancing the Economic and Environmental Performance of U S Agriculture* by Faeth, *Agricultural Policy and Sustainability Case Studies from India Chile, the Philippines, and the United States* by Faeth and nine other international experts, *Bittersweet Harvests for Global Supermarkets Challenges in Latin America's Agricultural Export Boom* by Dr Thrupp, and a forthcoming volume on U S Sustainability by WRI's staff

Support for this report and the Partnerships for Safe and Sustainable Agriculture Project at WRI comes from the U S Agency for International Development, the Kellogg Foundation, the Pew Charitable Trusts, and the IPM Program of the Food and Agriculture Organization of the United Nations I am pleased to acknowledge their generosity, their commitment and their foresight

JONATHAN LASH
PRESIDENT
WORLD RESOURCES INSTITUTE

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OVERVIEW

BY LORI ANN THRUPP

An evocative and provocative participatory approach done collectively and in a hands on manner penetrates deeper into the consciousness of farmers This also gives the farmers a sense of own ership of the technology and encourages them to share with other farmers

—*ANGOC/ICDAI, Philippines*

The way we make progress is like a compost mixer Farmers and scientists work together, talk together, out in the fields learning together, mixed around and stirred up and that way we come up with good new ideas!

—*BIOS, California*

What works to develop sustainable agri culture practices? Progress is being made in many parts of the world, from the rice paddies in Bangladesh to the cornfields in Iowa Innovative people working together, are forging a transformation in agri cultural production—using environmentally friendly socially sound and profitable practices Efforts to develop sustainable production have been budding for many years (Pretty 1995 UNDP, 1995, 1992, Reijntjes et al , 1992, NRI, 1991, NRC, 1989, Altieri 1987) but most have been relatively small isolated activities or those confined to research stations Yet, in recent years, the initiatives are blossoming and spread ing their influence More and more farmers, non governmental organizations (NGOs), scien tists, and governmental and international insti tutions are engaging in joint efforts to replace chemical intensive farming methods with alter native agro-ecological approaches

The nine collaborative sustainable agriculture initiatives highlighted in this report—from Asia, Africa, Latin America and North America—focussed on implementing ecologically oriented integrated pest management (IPM) Through the widespread application of such integrated agricultural practices, all the projects described have significantly

- reduced agrochemical inputs and costs, as well as health risks,
- regulated pests and diseases at acceptable levels,
- maintained or increased yields contributing to productivity and food security
- increased "health" of the farming system (e g soil quality and resilience), and
- spread the benefits widely and/or empow ered communities

Although representing various farming sys tems, geographical zones and scales, and cultures, these cases offer common lessons about effectively implementing sustainable and profitable production practices They also high light constraints that must be overcome and actions that are needed to strengthen and spread such initiatives While many of these cases have focussed on pest management, most encompass various soil and crop management techniques and social changes as well, within a holistic framework (Indeed, many methods being used—such as intercropping and cover crops—serve multiple functions for improving soil health and nutrient recycling as well as pest control) Thus, the lessons from these experi ences are broadly useful for sustainable agricul ture and for achieving food security, not only for IPM

Behind progress in these cases lie both bio physical/technical changes and social institu tional reforms, including

- Principles of agro ecology applied for pest, soil, and crop management
- Participation and empowerment of farmers and communities
- Partnerships among institutions
- People centered process for learning and communication
- Policy/political support for alternative practices

The human dimensions—particularly the institutional, socioeconomic, and policy factors explained in this report—have proven to be especially critical in the effective application of agro ecological methods Participatory approaches and collaborative teamwork have been fundamental to implementing sustainable changes Technical factors alone are not enough Strong linkages among individuals and institutions working together as equal partners help to bring about innovation and progress Likewise, open communication in a two way flow between farmers, technical staff, and sci entists builds knowledge and effective action Philosophical compatibility and mutual trust among actors enhance such teamwork, and principles of diversity, flexibility, and adaptabili ty are also crucial building blocks for effectively changing practices (Enhancing diversity is especially important, not only to increase agro ecological benefits but also to broaden the human resource capacities and disciplines involved) The cases show that supportive poli cies and political backing at the national level are vital to partnerships programs At the same time, local social organization and farmers' empowerment also sustain progress Lessons from the studies reveal ways to cultivate all of these ingredients

The human dimensions have proven to be especially critical in the effective applica tion of agro ecological methods

The initiatives highlighted in this report are not problem free Among the hurdles to over come are inappropriate public policies (such as pesticide subsidies), pressure from agrochemi cal companies, outmoded education systems, and lack of information Pesticide advertising and aggressive sales approaches, as well as credit requirements for agrochemicals, have undermined IPM promotion and induced farm ers to adopt or maintain chemical intensive methods Research institutions and government extension agencies seldom pay adequate atten tion to alternative methods Internally, inexperi enced management and tensions among part ners over differing approaches and roles have hampered progress, though the organizations involved have learned to deal with such weaknesses In several cases—such as Bangladesh the Philippines, Peru, and Senegal—collaboration helped them resolve or manage inter institutional conflicts and generate new ideas

Urgently needed are actions and policy changes to overcome barriers and to strengthen and expand effective partnerships for sustainable agriculture Recommended actions include

- applying and spreading agro ecological principles and practices on farms
- strengthening collaboration and exchanges among groups involved in such partnerships
- increasing the spread of information to multiply the effects of these initiatives
- changing government policies to eliminate agro chemical subsidies and to support agro ecological innovations
- changing the advertising and marketing practices of agro chemical companies
- increasing donor support and building state and local backing to sustain efforts
- building education (training) and community empowerment to maintain actions

In each of these priority areas, the work of multiple actors is needed International and national agencies scientific institutes private companies and individual farmers and consumers need to make practical changes outlined in the conclusions to build both supply and demand for such alternative practices and to spread the positive impacts of partnerships like these

The projects presented here as case studies were chosen not only because of their collaborative nature and their capacities to widely implement agro ecological practices, but also because they involve groups willing to assess, learn from, and strengthen their own efforts The themes and conclusions presented here reflect these experiences and key ideas discussed at a global workshop among case study representatives and other experts in IPM/sustainable agriculture In this sense, the analysis is a team effort *(See Box 1)*

This written report can only partially convey the dynamism of these promising initiatives, as well as the remarkable energy and dedication of the people involved These projects are still evolving, as the participating groups and individuals learn and adapt through their action oriented research, training, and outreach Some of the key ideas and insights explored in this report could seed further efforts to switch to sustainable agriculture But these initiatives urgently need more attention and policy support to enable this major transformation

THE CONTEXT MOTIVATIONS FOR CHANGE

Emerging initiatives to develop sustainable agriculture are illustrated by nine cases from four continents highlighted in this report The groups involved in these efforts, like others pursuing innovative approaches have joined forces partly to develop healthy and sustainable agricultural practices to respond to the needs and demands of farmers and consumers Most are also discouraged with conventional approaches to agriculture, especially agro chemical dependency (Partnerships Workshop 1995) A brief look at these problems helps explain the motivations and the positive innovations in the case study programs

Although predominant agricultural development patterns and technologies have brought

BOX 1 | METHODOLOGY AND PROCESS

The Partnerships Project was designed to address key questions surrounding the implementation of alternative agricultural practices through collaborative practical research with the case study groups using participatory methods The research process was designed partly to build capacity and to widen the impacts of these initiatives The project was begun in response to needs expressed by groups and by previous studies around the world that had identified the importance of pest management agroecology and institutional linkages in this field An advisory committee of experts formed early in the project provided guidance and input

The cases were selected according to specific criteria and advice from the advisory committee and other experts Field sites of prospective participants were visited In all cases

- at least two institutions or groups (including at least one non governmental organization) collaborated
- considerable progress was made in reducing pesticide use or implementing biologically based IPM or other alternative practices among area farmers
- farmers participated actively with scientists and/or extensionists to develop changes
- the initiative had fairly wide influence or scope across a large population
- social concerns (public health gender considerations social equity) were included and
- project members wanted to participate in the project to get information and improve their own work

Each case study was undertaken mainly by the case study participants following methodological guidelines suggested by the World Resources Institute Each group assessed project impacts the nature of the collaboration and its strengths and weaknesses the way participation is inculcated/promoted the policy factors that pave the way for implementation and ways to overcome constraints The methods suggested for the studies were somewhat flexible so that each group could work on the issues most important to its own development

Each study entailed analysis of reports and impact data interviews with the main people involved in the initiative and a participatory workshop coordinated by local participants to gain insights and information from the initiative s many stakeholders In dynamic group meetings the effectiveness of the partnerships was assessed and lessons implications and areas requiring more work were identified A review of secondary sources supplemented the analysis

In November 1995 project collaborators met in Washington D C to discuss case study findings and to identify common lessons and implications for policy change Case study representatives advisors decision makers donor representatives and WRI project staff participated Then the case studies were revised and condensed for publication in this report The Partnerships Project continues follow up activities to help strengthen the policies and capacities needed to support these approaches to sustainable agriculture

about production increases, they also have well documented disadvantages, particularly ill effects from agro chemical use water depletion, and the erosion of soil and genetic resources (Pesticides Trust, 1996 Walker et al , 1995 WRI, 1994, UNDP 1992, NRC, 1989) Such impacts raise costs to producers and undermine profits They also exact a heavy economic bur

The ill-effects of agrochemical use, water depletion, and the erosion of soil and genetic resources raise costs to producers undermine profits, and exact a heavy economic burden on society, especially poor people

den on society, especially poor people Moreover, despite yield increases, millions of people still go hungry, and large disparities persist in the distri bution of resources and income (WRI, 1996, GREAN, 1995, UNDP, 1995 Jazairy et al 1992) These interrelated outcomes have sparked efforts to avoid such problems while increasing produc tivity, the basis of food security

Trends in pesticide use illustrate these dilem mas and have sparked action among many case study collaborators Since the mid twentieth century synthetic chemical pesticides have become the main means of controlling pests, especially on commercial crops They are a part of a package of agricultural technologies, which also include uniform high yield variety crops, fertilizers mechanical and energy inputs, pro moted in modern agricultural development (Dinham, 1993, Conway and Pretty, 1991 NRC, 1989, Altieri, 1987, Bull, 1982) Marketed by a multi billion dollar industry pesticides are found nearly everywhere in the world Global pesticides sales rose by 11 2 percent annually between 1960 and 1992, and reached $29 bil lion by 1995 (cited in Repetto and Baliga, 1996) Although certain pesticides can help raise productivity, their continued use has sev eral adverse ecological and socio economic effects (Pesticides Trust 1996 Walker et al 1995 WRI 1994 Dinham 1993 Pimentel and Lehman 1993 Conway and Pretty 1991 Thrupp, 1990 NRC, 1989) A nearly ubiqui tous problem is pest resistance globally, at least 450 species of insects and mites, 100 species of plant pathogens, and 48 species of weeds have become resistant to one or more pesticide prod ucts (Conway and Pretty, 1991, Pimbert, 1991) As a result, farmers' costly inputs of chemicals become ineffectual and self defeating as sec ondary pests emerge Moreover many types of pesticides harm human health, causing both acute toxicity effects through direct exposures and longer term chronic health problems rang ing from cancer to immune disorders (Pesti cides Trust, 1996, Repetto and Baliga, 1996, Murray, 1995, Dinham, 1993, Edwards, 1993, Pimentel and Lehman, 1993, Thrupp, 1991) About half of the pesticide poisonings of people and 80 percent of pesticide related deaths occur in developing countries though these nations account for only 15 to 20 percent of world pesti cide consumption (Conway and Pretty, 1991) Pesticide residues that accumulate in the envi ronment and in food products also pose health risks Moreover, pesticides have displaced diverse non chemical forms of pest control (Pimentel and Lehman, 1993, Thurston, 1992, Gliessman, 1990) Such trends are exemplified in several cases, e g , the Philippines, Bangladesh, Nicaragua, and Cuba, where the high costs of resistance and health damages from pesticides motivated people to develop alternatives

In addition, the partners in this study have realized that technical problems from pesticide use are tied to institutional and socioeconomic factors present in both the North and South (Partnerships Workshop, 1995) More specifical ly, they have concerns about the conventional top down processes of agricultural technology development and transfer in this model tech nology passes from scientists in international research centers to national research institu tions for adaptive research and, in turn to extension agencies and the sales agents of agro chemical and seed companies, who prescribe

Technical problems caused by pesticide use are tied to institutional and socioeconomic factors present in both the North and South

technologies to farmers (Scoones and Thomp son, 1994, Chambers et al, 1989, Farrington and Martin, 1988, Biggs, 1987, Dahlberg, 1986) This approach has resulted in the wide spread adoption of certain technologies, and it has also partially met economic demands for methods to maximize yields However, the peo ple involved in this Partnerships project—along with many others—have recognized its flaws often the top down orientation does not address farmer needs and local conditions, especially in the risk prone diverse environments where most of the world's rural people live (Scoones and Thompson, 1994, Pimbert, 1991, Cham bers et al , 1989) Moreover, there are com monly gaps or tensions between the groups, such as weak institutional links, lack of coordi nation or competition—all of which impede progress in this approach (*See, for examples,* the Peru, Nicaragua, and Philippines case studies) Compounding these dilemmas are inadequacies in the policies that shape agricultural technolo gy development In many countries, chemical dependency has been encouraged by govern ment subsidies, such as tax exemptions, and by agricultural credit policies that require farmers to use prescribed chemicals (Farah 1994, Thrupp, 1990, Peru, Philippines, Nicaragua case studies, Dahlberg, 1986, Repetto, 1985) In addition, for many years, the influence of agro chemical companies' lobbies over policy mak ing, and of sales agents over consumer choice, have favored chemical intensive approaches at the expense of other pest control technologies (Peru, Philippines, and Cuba case studies, Pes ticides Trust, 1996, Boardman, 1986, Perkins, 1982) These factors underpin the predicaments in the field and they have instigated interest in reforms

TRANSFORMING THE APPROACH KEY ELEMENTS AND LESSONS

With increasing recognition of past problems new opportunities and public demands for change, individuals and organizations—both government and non governmental—are work ing on alternatives to conventional approaches, through changes in both practices and policies (ASA, 1995, Klinkenborg, 1995, Pretty, 1995, UNDP, 1995, 1992 Gipps 1987)

In the early 1970s integrated pest manage ment (IPM) surfaced as one major thrust of research into ecologically based, sustainable agriculture As originally conceived, IPM is defined as the use of biological and other nat ural and cultural methods for pest control 'within an ecological framework" (Moore, 1995, vanden Bosch, 1978) It uses chemicals only as a last resort Although many other IPM defini tions have evolved, this ecological interpretation (sometimes called "biointensive" IPM) is gener ally upheld by the partners in this study In this respect IPM is an element of an overall approach for sustainable agriculture—not just for pest control, but also for responding to other ecological and socioeconomic needs (Ken more et al 1995, Pimbert 1991, NRC, 1989, Altieri, 1987) [This ecological view of IPM con trasts with some companies' and organizations product oriented interpretation of IPM with its stress on the efficient' use of pesticides, along with other tactics (Green et al 1990)]

During the 1970s and 1980s, most IPM research in the United States was done in uni versity research departments, and in the devel oping world some IPM projects were under taken in research institutes—for example, in Peru and Nicaragua on cotton and in Asia on rice This research led to many conceptual advances documented in numerous scientific publications But it did relatively little to prompt use of IPM on farms during this era Resistance by agrochemical companies and lack of support by some government institutions also weakened efforts to develop national IPM programs, especially in the United States, and has impeded similar attempts to develop other sustainable agriculture practices, such as "low external input agriculture" and organic farming (Perkins, 1982)

In many cases, integrated pest management has proven to be more profitable than the conventional approach, though farmers sometimes bear costs of a transition period of one or two years

Over the past decade, however, growing numbers of farmers and groups have joined together to develop sustainable farming practices, in spite of such pressures Since these methods are proving profitable as well as environmentally and socially sound, their use is spreading Contrary to the expectations of some conventional farmers and researchers, the ecologically oriented IPM approach pays off—in both the short and long terms—in many crops and regions (Case studies, Pesticides Trust, 1996 Rosset and Benjamin, 1994, WWF, 1994, UNDP, 1992, Curtis et al , 1991, Kiss and Meerman, 1991, NRC, 1989, Hansen 1987) In many cases, IPM has proven to be more profitable than the conventional approach, though farmers sometimes bear costs of a transition period of one or two years (Klinkenborg 1995, UNDP, 1992, Pimental et al , 1991 NRC, 1989)

Indonesia has one of the most successful and renowned IPM programs Since 1986 IPM has been adopted nationally on a massive scale in rice production The government with the support and collaboration of the Food and Agriculture Organization of the United Nations (FAO), developed countrywide IPM training and implemented strict pesticide policies including restrictions on the use of 57 pesticides in rice and the elimination of pesticide subsidies Tens of thousands of farmers have switched to nonchemical pest control methods, which include measures to enhance diversity of insects and restoration of natural pest predator interactions in the rice paddies "As a result, from 1987 to 1990, the volume of pesticides used in rice fell by over 50 percent, while yields increased by about 15 percent Farmers' incremental net profits are approximately $18 per farmer per season Ending pesticide subsidies has saved the government $120 million per year" (World Bank, 1996)

Indonesia's success stems largely from its development of human resources, the cooperative work of different institutions at all levels, and strong government policy support Through participatory Farmer Field Schools, farmers interact with scientists to learn how to apply agro ecological principles, to observe and monitor pests and beneficial predators, and to reduce or stop pesticide use From 1989 through 1992 the Indonesia program trained 1 000 pest scouts 2 000 field extension workers and 100 000 farmers and training continued into the mid 90s Several government ministries work together to run these schools In this way the IPM empowers farmers, giving them control over their own productive activities" (Indonesia IPM Program—1993, cited in World Bank 1996)

Indonesia is not alone Similar effective programs for IPM and related agro ecological practices are emerging elsewhere The nine case studies presented here from around the world (both North and South) use a diversity of effective methods to reduce or eliminate agrochemical costs, regenerate and conserve soils, and increase yields, while reducing health risks *(See Table 1)* Although the scale of impact and numbers of beneficiaries are much greater in the Asian cases than in the others, the impacts of all these efforts have been quite widespread, reaching a large number of rural people

Sustainable agriculture consists of practices that are ecologically sound socially responsible and economically viable

Since the cases involve collaboration among at least two institutions, including non governmental and government organizations, research institutes, and international development institutions, these projects are closing the conventional gaps between researchers, extensionists, and farmers While most began as IPM projects, and several stayed that way, in many cases these methods were developed as part of a wider and more holistic approach to "sustainable agriculture ' No rigid definition of this term is used, but the groups share a general view that sustainable agriculture consists of practices that are ecologically sound, socially responsible and economically viable, as shown in Figure 1 The common activities in these cases include on farm research, training and education sessions demonstrations and field days, and group efforts to design, discuss, and evaluate options Most also use participatory approaches with active farmer involvement to carry out these activities

FIGURE 1 **GENERAL ELEMENTS OF A SUSTAINABLE AGRICULTURE APPROACH**

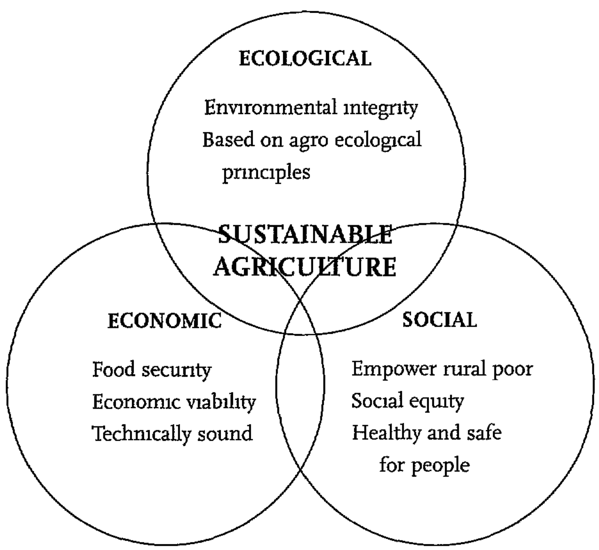


TABLE 1 | SUMMARY OF CASES COLLABORATORS AND MAIN TECHNICAL RESULTS

Country (Main crop)	**Main Field-Level Impacts**
Bangladesh (Rice)	—Farmers in the IPM pilot program achieved an 11 percent increase in rice production eliminated pesticide use non participating farmers had no yield increase —By the end of the first season 76% of participants eliminated pesticides by the end of second season 88% did so participants numbered 1 450 women and 4 791 men
Philippines (Rice)	—In the national IPM program 3 861 farmers were trained in Farmer Field Schools in 1993–94 pesticide use dropped in volume between 60% and 98% yields increased 5% to 15% —In the community project participants substituted chemicals for cultural controls
Kenya (Cattle/tsetse fly)	—Community groups in Lambwe Valley set hundreds of non chemical traps for tsetse flies —Almost half (43 percent) of the valley s 8 000 households participated —1994–95 tsetse fly density in the area fell by 98% Trypanosomiasis infection rates in cattle declined greatly
Senegal (Various crops)	—Most of the farmers used natural crop protection and soil conservation techniques —Pesticide use and costs were reduced village health improved and yields increased —The majority of project participants are women
Nicaragua (Various crops)	—Farmers have learned to use better ecological and economic criteria in their pest management decisions and as a result reduced chemical costs —About 2 000 producers participated in work groups of the IPM project
Cuba (Various crops)	—Cuba has developed remarkably high production and use of biological products and bio control organisms for pest control and soil restoration methods For example 1 300 metric tons of *Bacillus thuringiensis* (B t) and 2 800 mt of *Trichoderma* were produced in 1994
Peru (Potatoes)	—Use of IPM for three farming seasons led to a drop in Andean potato weevil infestation from 31% to 10% of harvested potatoes in one community and from 50% to 15 % in another —Estimated net benefits were $154 per hectare In a coastal valley sticky traps for leaf miner flies cut production costs and increased potato yields estimated benefits were $162 per hectare
U S California (Almonds and Walnuts)	—Participants of BIOS reduced chemical inputs Among the participating farmers organophosphate insecticide use fell from 35% to none preemergence herbicide use from 24% to 6% applications of synthetic nitrogen fertilizer dropped by 46% —Cover crops increased from 12% to 92% of the farms involved
Iowa (Corn Wheat)	—The Practical Farmers of Iowa introduced sustainable practices to hundreds of farmers in the state who reduced chemical costs and increased net returns compared to conventional methods

Although these initiatives encompass varying geographic conditions, farming systems, and socioeconomic situations, common key elements contribute to effective change the use of basic agro ecological principles and methods and, perhaps more important, of social, institutional and organizational approaches that facilitate learning and innovation as noted in Box 2 In particular, the initiatives illustrate how various kinds of collaborative approaches can succeed in implementing sustainable alternatives *(See Table 1 and Box 2)*

Principles of Agro-ecology

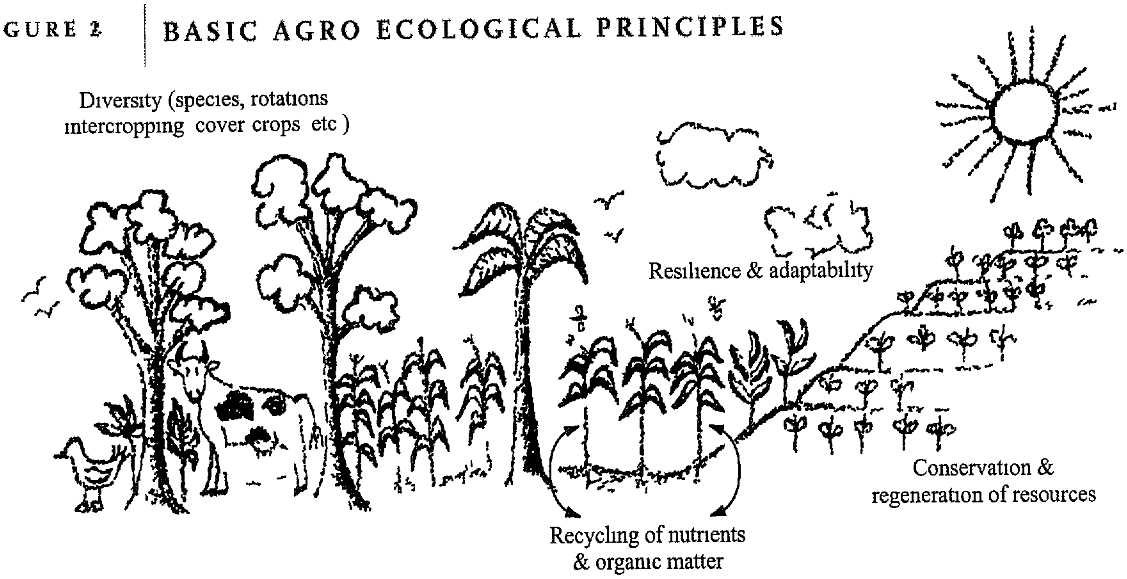
The nine cases share an integrated approach, based on biologically oriented methods for soil, pest, nutrient, crop, and water management The basic agro ecological principles in this approach include *diversity* (crops, flora/fauna, systemic varieties), *adaptability and resilience* (in contrast to rigidity), *synergy* (between plants, soil, nutrients), *nutrient recycling* and *regeneration and conservation of resources* (Case studies, Reijntjes et al , 1992, Gliessman, 1990, Altieri 1987, Conway, 1987) *(See Figure 2)* In addition, these programs recognize the need for methods to be adapted to specific local ecological conditions, based partly on sound experimentation and observation over time For example the cases of Nicaragua and California reveal that various crops required significant adaptations in pest management methods

"Bio intensive IPM techniques have been the focus of attention in most of the cases, but several have evolved to include more diversified activities *(See Tables 2 and 3)* In fact, many of the methods used for pest and disease management such as intercropping, cover crops, crop residue management, and changes in tillage practices simultaneously serve functions for soil quality and nutrient enhancement The variations in approaches among these cases, as synthesized in Table 3 have all generated important results tailored to local needs and capacities But the broader ecological perspectives seem to have the potential to affect the farming systems more generally These initiatives also illustrate that the transition to safer, more sustainable agriculture is not just a matter of technical change Key social and

BOX 2 KEY ELEMENTS FOR APPLYING SUSTAINABLE PRACTICES EFFECTIVELY

Principles of agro ecology
Participation and empowerment of farmers and communities
—responsiveness to farmer needs and mutual respect between groups
—community organization as a basis for implementation
Partnering among institutions (NGOs researchers government agencies etc)
—collaborative approaches and mechanisms for team work
—effective coordination and linkage mechanisms
—creative management of tensions dynamic evolution of relationships
People centered process of learning and two way information flow/communication
Political economic environment supports alternative practices
—absence of subsidies and incentives for pesticides effective pesticide laws
—policies that support/promote sustainable practices

FIGURE 2 | BASIC AGRO ECOLOGICAL PRINCIPLES



The transition to safer, more sustainable agriculture is not just a matter of technical change Key social and organizational factors are at least as important

organizational factors, summarized in Box 2, are at least as important

Participation and Empowerment of Farmers and Communities

In these nine case studies—as in many other experiences—farmers full participation has proven essential to the development of IPM and other sustainable agricultural methods Horizontal and equitable interaction replaces the past hierarchical relationships among scientists, extensionists, and farmers In the most successful cases, farmers take the lead or share control in decision making, development and planning of activities, implementation, education, and evaluation of progress

Responsiveness to Farmers' Demands In several cases, the project is demand driven, responding to farmer needs and ideas, as shown in the Senegal, Kenya, and Iowa cases *(See Box 3)* In others, changes respond to consumer demand as in the United States where the public increasingly wants chemical free agricultural products This approach engages participation from farmers extensionists, and researchers as they learn by exchanging experiences and ideas It can also enhance decision making capacities enabling people to manage variability Further extensionists and scientists learn to respect and appreciate farmers hands on knowledge

Exchange and Mutual Respect A participatory approach is most valuable when it involves the

TABLE 2 | GENERAL TYPES OF APPROACHES TO PEST MANAGEMENT AND AGRICULTURE

	Industrial and Green Revolution	IPM Focussed on Input Substitution	Agro ecological Approach, Including IPM
Goal	Eliminate or reduce pests to maximize yields	Reduce costs of production or chemical inputs	Economic ecological and social goals (combined)
Target	Single pest	Several pests affecting a crop and their predators	Fauna and flora of culti vated area and links with habitats
Timing for intervention	Calendar date or presence of pest	Economic threshold	Multiple criteria (economic ecological)
Principal method	Pesticide	Prevention by plant breeding and crop timing monitoring product substitution insecti cide resistance management etc	Agroecosystem design to prevent/minimize pests and mixed methods (includ ing soil health cover crops)
Diversity	Low	Low to medium	High
Spatial scale	Single farm	Single farm or small region defined by pest	Agroecosystems or biogeographic areas
Time scale	Immediate	Single or multiple seasons	Long term
Mode	Transfer of technology	Varied	Interactive and collaborative

Source Adapted from Levins 1986

two way development and exchange of ideas and knowledge, not just techniques and methods In this approach, farmers' knowledge is melded with current scientific discoveries In the Cuban national program for developing ecological agri culture, for example, "the rediscovery of the tra ditional values and knowledge of farmers" was reported as among the most remarkable' fea tures in recent changes While the farmers revive the traditional use of compost and medici nal plants, they have also learned of the Cuban scientists' advances with microbial and biologi cal controls Similarly, in Peru the case study project has encouraged traditional methods of using aromatic herbs and plants for protecting stored potatoes from pests, while also introduc

TABLE 3 | MAIN APPROACHES COVERED IN THE CASE STUDIES

Approaches in Initiatives	IPM—Input Substitution	Agro ecological Approach	Community Organizing/ Mobilization	Farmer Participation
Cuba	X	X		X
Nicaragua	X			X
Peru	X			X
Kenya	X		X	X
Senegal		X		X
Bangladesh		X		X
Philippines		X	X	X
U S –California		X		X
U S –Iowa		X	X	X

BOX 3 | RESPONDING TO FARMERS IN DEMAND DRIVEN APPROACHES

In the Senegal case Rodale an international NGO collaborated with both national agencies and local groups to develop regenerative farming practices One of Rodale s main strategies in developing a program with village associations is to respond to requests by farmer organizations seeking assistance A visit to the site is organized by Rodale staff to identify problems initiatives and the level of organization of the group Then together with partner institutions a meeting is held at the village level to design the program with full beneficiaries participation These activities are supplemented by participatory research in priority areas involving all the partners small farmers researchers and development workers (Senegal case study)

Similarly in Kenya the Kisabe program for tsetse control (in the Lambwe valley) resulted from the local community's request to the International Centre of Insect Physiology and Ecology (ICIPE) to help it get non chemical insect traps ICIPE responded in a participatory way working to support local communities forming their own organization to deploy and maintain the traps (Kenya case study)

In the experience of the Practical Farmers of Iowa (PFI) farmers have taken the lead forming the organization and developing sustainable farming practices while scientists and extension personnel from the University of Iowa play important supportive roles PFI is coordinated largely by farmers and its hundreds of members organize and attend such activities as field days and experiments Both its management structure and Board of Directors include farmers as well as researchers and extension officers (Iowa case study) ing such innovations as pheromone traps, for added pest control Respecting local perspectives and priorities, and fully incorporating farmers' experiences are proven ways to hasten the devel opment of alternatives

Equitable and Effective Interactions The more effective participatory approaches reach out to poor growers and workers, and women as well as men The cases of Senegal, Kenya, and Bangladesh show particular sensitivity about including an appropriate gender balance Such a balance makes sense since women are the major producers in many countries and there fore can play a pivotal role in agricultural change (WRI, 1994, Jazairy et al , 1992, UNDP, 1992)

To build such participatory interactions between farmers and scientists, mutual trust and open communication are invaluable Most groups have managed with patience, work, and time, to overcome initial language barriers and other tensions For technicians and scientists, a participatory approach requires a reversal in their *modus operandi*, it takes retraining and humility In Nicaragua, for example, "the classi cal model of technology transfer was a signifi cant obstacle that the project had to overcome," because the professional technicians and scien tists trained in this mode did not appreciate working with farmers, and lacked experience in communicating effectively with them Other human qualities identified by project groups as keys to effective participatory actions include commitment by all actors, flexibility, willing ness to innovate, and sensitivity to people (Log ically, such qualities are helpful in any partici patory effort especially when involving different groups)

Community Organization Similarly, working with and strengthening local farmer or commu nity organizations furthers learning and the adoption of alternatives This approach also empowers more people The projects working with organized groups (e g , in the Philippines, Kenya, and the United States) establish a group spirit and impetus that enhances sustainability better than projects that focus on individual beneficiaries do Such an approach springs from group dialogue and mobilization, local leadership, and engagement in social as well as productive activities, in response to community needs In Asia, enough enthusiasm was gener ated among farmers to counter pressures for high chemical inputs The Philippines case, for instance recommended that, "Community organizing and development should be an inherent component of any technology promo tion program It is not an after effect it is essential to the vision " *(See Box 4)*

When programs are expanded to reach many more farmers, they could potentially lose the valuable participatory quality evident in smaller community empowerment efforts Yet, the cases from Asia involve extensive numbers of small farmers but nevertheless remain relative ly participatory by using the intensive "Farmer Field School" training approach

Partnerships Among Institutions

Forging interactive connections among research institutions, extension agencies, non govern mental organizations and farmers has proven to be a very effective way to develop and spread alternative agricultural practices, and a viable alternative to the conventional top down approach to technology transfer *(See Figure 3)* Institutional capacities vary from country to country but a complementary mix of groups can succeed *(See Table 4)* Peru's IPM project for example, entails unusual collaboration among the International Potato Center (CIP)—a large scientific research institute—and non gov ernmental organizations—including a national

BOX 4 | EMPOWERED COMMUNITIES

Community development in the Infanta region of the Philippines dates back more than 20 years In the mid 1970s the farmers in this area became organized to respond to immediate problems after realizing that the modern farming methods introduced during the 1960s (under the Green Revolution s high input miracle seed package) did not bring about the expected profit They had unpaid loans and realized that old rice varieties brought in more income After village workshops and reflection sessions were held (facilitated by the Catholic Church) the farmers organization focussed on peoples rights resistance access to and control over resources, and demands for government accountability Today Infanta is an empowered community with highly organized civic groups and local government Local organizations including women s groups take part in almost all community activities which include developing IPM and other sustainable methods (Philippine case study)

In Kenya a sophisticated local organization was developed by villagers in Lambwe Valley to deploy tsetse traps Committees and teams were assigned specific responsibilities for pest control, monitoring and administration of funds With these capacities came empowerment greater impacts from agricultural changes and external support for their initiatives (Kenya case study)

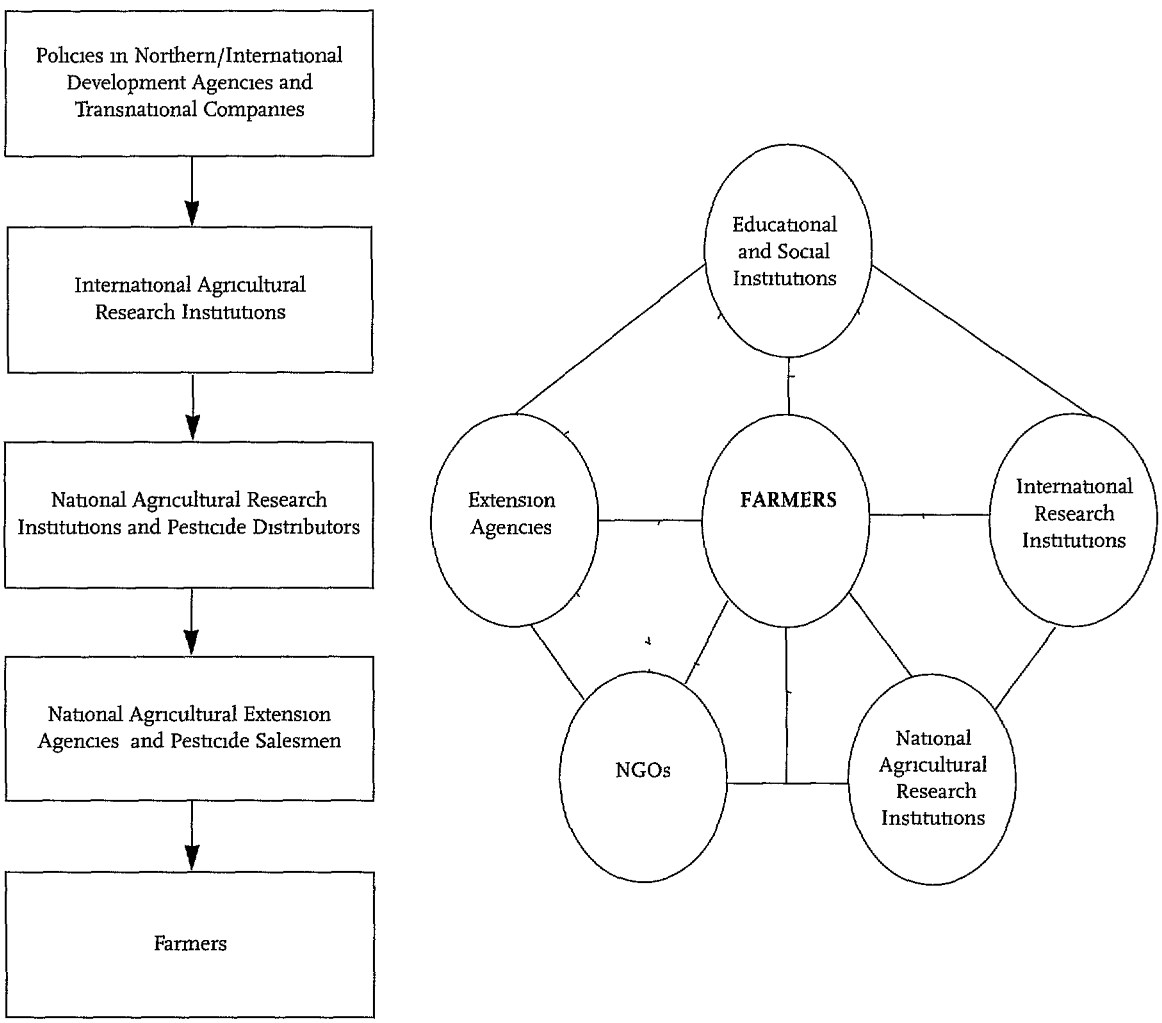
TABLE 4 | TYPES OF INSTITUTIONS COLLABORATING IN THE CASES

Project Partners	Government Agency	University	International Institution	International NGO	Local NGO	Farmers' Group/Assn.
Cuba	X	X				X
Nicaragua	X	X	X		X	
Peru			X	X	X	
Kenya	X		X			X
Senegal	X			X		X
Bangladesh	X		X	X		
Philippines	X		X	X	X	X
U S California	X	X			X	X
U S Iowa	X	X				X

FIGURE 3 **INSTITUTIONAL RELATIONS FOR AGRICULTURAL TECHNOLOGY DEVELOPMENT: CONVENTIONAL VS. INNOVATIVE/ALTERNATIVE MODES**

A. *Conventional "Transfer of Technology" Model*

B. *Innovative Linkages and Relations for Technology Development*



NGO called CIED (Center for Research, Education and Development), grassroots groups such as TALPUUY, and CARE, an international NGO—whose joint activities to develop IPM are bearing fruit The NGOs in this case helped take over extension and education because the state agricultural agency lacked the capacity In the United States, farmers and local NGOs (the Community Alliance of Family Farms and Practical Farmers of Iowa) are working with university scientists to develop experiments and explore alternatives

Inducements for Collaboration In each of the case studies, the partnerships are relatively new Before the case study projects began, many of the institutions involved had not worked well together and some disagreed with or even avoided each other For example, previously, the NGOs seldom worked with state and international research institutions due largely to differing views on agriculture and social needs Indeed, such schisms plagued relations between NGOs and state/international agencies in the Philippines, Bangladesh, Nicaragua and Peru

What factors persuaded people to work together overcoming turf battles and philosophical differences? First, all types of groups involved saw that the conventional approaches to technology development often failed to bring about positive changes Second public demands changed (e g U S case studies) Third was the growing desire of farmers to overcome the problems of agro chemical dependency Fourth, many project participants have realized the need to pool resources and capacities during a time of budget cuts and scarce resources from donors In Kenya, Peru Philippines, Iowa and California, both NGOs and research institutes saw the benefits of merging their respective complementary abilities In some cases, such as Peru and Nicaragua recent macroeconomic policies that squeeze public institutions also induce new alliances In Peru, structural adjustment policies resulted in serious budget cuts to agricultural research, extension, and credit systems, and "as a result, NGOs started to take up the role of providing services to farmers Currently more than 80 percent of extension activities are carried out by these NGOs " Although cooperation among Peru's NGOs, governmental, and research institutions had been uncommon, the organizations have now formed linkages to meet farmers' growing demands for suitable technologies (Peru case study)

These factors motivated NGOs, scientists, and formal institutions to build new bridges Scientists and government agencies began opening up and cooperating with NGOs and farmer groups, and vice versa Although some tensions remain in several cases among 'reluctant partners" (Farrington and Bebbington, 1993), collaboration has generally bred opportunity

Benefits and Principles of Collaboration Participants recognize the multiple benefits and advantages of partnerships New knowledge and skills, cost sharing, and functional complementarities all make it easier to carry out on farm research, field demonstrations, education and training sessions, outreach, and other activities Moreover the linkages foster an interdisciplinary approach that is critical to sustainable agriculture and communication grows among NGOs farmers researchers and other groups as they work together (*See* cases of Peru, Nicaragua Kenya Bangladesh and California for examples) As stated in the Peruvian case "IPM in contrast to other technologies is based on a teaching learning process where a technology is knowledge based, inter institutional cooperation is essential and should be permanent ' In Cuba, too, organizational coordination and structures proved "key [to] rapidly generalizing scientific results that contributed to raising national food production and substituting for the agriculture inputs that were once imported "

Collaboration in these cases is a means, not an end, for developing and implementing sustainable agriculture But collaborative activities do more than impart technical skills in the agricultural agenda, they enhance NGOs' managerial, negotiating, and political capacities, and they teach researchers and government institutions about farmer friendly approaches In some cases, as in Kenya and Iowa, the partnership gradually takes on broader purposes, such as working jointly on community development *(See Box 5)*

Coordination and Linkage Mechanisms Carrying out project activities with the participation of two or more groups requires considerable coordination, commitment, organization, and sometimes difficult time consuming negotiations For example, arranging demonstrations on participant farmers' fields, facilitating training sessions, and monitoring the results of trials require all partners to take responsibilities and make contributions To ensure coordination and collaboration, most collaborators prefer semiformal contracts or other written agreements to spell out financial arrangements and guarantee long term commitment and stable interaction among partners But contracts that are too formal make projects inflexible or impose unfair control by one partner Informal linkages are advantageous in some relationships, particularly when no financial transactions are involved

Effective coordination of partnerships are also helping to make headway An effective coordinator provides supportive leadership and helps spark motivation, he or she needs strong capacities to facilitate communication, to gain mutual trust and to resolve tensions through negotiations, based on sensitivity to partners' interests

BOX 5 **PRINCIPLES AND BENEFITS OF COLLABORATION**

Key principles and benefits of collaboration
- A holistic view of sustainable agriculture
  Mutual confidence and trust
  Sharing of responsibilities and power among partners
- Functional complementarity interdisciplinary
  Clear role definition and avoidance of redundancy
- Favorable response by government and donors
  Supportive policy environment (especially market incentives, and political commitment)

Motivation for collaboration
  Mutual interests
- Sense of urgency or crisis that catalyzes action/collaboration
- Shared vision and understanding

Ways of sustaining collaboration
- Close coordination (sensitive respectful leadership)
  'Mixing of scientists and farmers
  Shared power (person to person communication)
- Continued interaction
- Local social organization

Roles of NGOs and Scientists The distinctive skills and capacities of NGOs whether grass roots farmer associations or large international nonprofit institutes, has proven particularly valuable in collaboration and enabled them to work well with farmers and communities to carry out participatory educational activities In the Philippines and Bangladesh, NGOs working with support from the Food and Agriculture Organization (FAO) and government IPM programs have successfully trained farmers and developed IPM and other agro ecological methods *(See Box 6)*

Scientists and research institutions also filled needed roles in the case study initiatives, contributing technical insights that local people may lack Effective research is action oriented field based, on farm, flexible, responsive to local needs, and holistic in approach As such, it helps farmers and NGOs learn how to do their own research

Participating farmers and NGOs feel that researchers need to spend most of their working time in the fields with farmers—rather than at stations—to grasp local realities, needs, and experiences The cases also suggest that researchers involved in effective IPM projects have to address all influences on IPM—socio economic and political as well as ecological—and assess both long and short term impacts

Managing Creative Tensions and Risks Tensions often arise between collaborators, especially at the beginning, over diverging interests or philosophies, decision making or the control of funds Most partnerships work best when the parties share a philosophy and agree on approaches from the outset If they do not, they should at least discuss and deal with their differences The Senegalese case suggested, for example, that "harmonization of various partners approaches is a requirement for success " However, as in Bangladesh, some groups find

BOX 6 | NGOS HELPING TO REACH FARMERS WITH NEW APPROACHES

CAFF in California and PFI in Iowa are both non profit community based NGOs directed partly by local farmers to promote and apply sustainable agriculture practices Although working on very distinct farming systems both these NGOs work closely with farmers respond to needs and help ensure that pest and crop management activities are economical practical and easy to understand These NGOs emphasize farmer to farmer exchanges which have contributed to the adoption of sustainable methods

In other parts of the world CARE has developed an approach to involve and benefit small and marginal farmers as well In the INTERFISH and NOPEST programs coordinated by CARE in Bangladesh field based training gives rice farmers concepts related to pest and crop management to apply to their own unique situations Government and research institutions FAO international donors farmers and other NGOs work with CARE to carry out these participatory training activities

CARE in Peru is also helping to implement IPM on potatoes but the approach is somewhat different CARE adopts basic IPM ideas and technologies developed initially by CIP spreads word about them through outreach materials distributes such biological control techniques as pheromone traps conducts training workshops makes extension visits and more CARE s close interaction with farmers and other organizations has led to widespread adoption of IPM that "mutually beneficial partnerships can result even when goals and motivations are diverse " In this sense, some tensions have become sources of creativity especially if they are managed well

NGOs in the Philippine, Bangladeshi, United States, and Peruvian cases took more participatory and comprehensive approaches than the state or international research institutions and opposed the more formal top down approaches After initially resisting change, the institutions and groups learned to appreciate what each offers to the partnership As the cases show, it is particularly important for international institutions to replace hierarchical approaches with participatory modes of R&D (e g , Peru, Philippines) *(See Box 7)* As groups learn from tensions and adapt to unexpected changes, most efforts move forward In the Senegal case study, key qualities for effective collaboration are described as "synergy adaptability, and openness " The Bangladesh case points out that cultivating such relationships also takes flexibility and diligent work by individuals

If tensions begin to block progress, a temporary or permanent parting of the ways may be a logical outcome In Peru, for instance, CIP began collaborating with a government extension agency, but the agency's philosophical differences, along with financial limitations made the collaboration unsustainable so CIP suspended this government alliance and instead linked with NGOs to continue IPM development Similarly some groups (e g , Bangladesh, Peru) tried initially to coordinate with private pesticide companies for IPM training, but the companies' difference in philosophy was too great posing a major contradiction, and thus led to the suspension of such relations

Sometimes, other annoyances also impede these collaborative efforts Extra time and costs for joint decision making can strain partners So can weakness in coordination and the added costs of meetings and for managing joint activities Yet case study participants believe that the advantages of collaborating outweigh these factors

BOX 7 DIVISIONS TRANSFORMED INTO CREATIVE' TENSIONS IN THE PHILIPPINES CASE

Before the late 1980s there was no relationship between ICDAI (the local community organization involved in the sustainable agriculture case) and the local government unit in Infanta (the project area) in the Philippines Government extension workers pushed for chemically intensive agricultural practices which the local group found unacceptable because of their exceedingly high costs and their adverse effects in production and on health The local government saw ICDAI as rabble rousers who didn t offer concrete alternatives and ICDAI viewed the local government as an ineffective bureaucracy unable to deliver the programs people needed Recently links between ICDAI and the local government have improved New local officials have recognized ICDAI as an able partner in health care agriculture and social welfare ICDAI is now being tapped for research citizen mobilizations and municipal level planning Regarding the IPM program both ICDAI and the local government agriculturalists are committed to cooperate particularly in farmer training Differences in perspective remain but working together has enabled fruitful exchange

People-centered Processes for Learning and Communication

Developing new and participatory learning processes is critical to successful collaborative initiatives In the more effective cases, the groups no longer use conventional training and extension based on a one way flow of information/technologies through prescriptions and lectures Instead, farmers, technicians and scientists freely exchange knowledge and ideas on a range of methods of pest and crop management In this way, farmers acquire a healthy skepticism for advertising and company claims

A major challenge for many projects is to get experts and technical professionals working as pest control advisers to change common behaviors Project coordinators stress that making this change requires basic training in agro ecology and also training in interactive communication Technical personnel have to learn to listen and value farmers' knowledge and experience of the land instead of offering prescriptions This reorientation can take considerable time and effort

Learning sustainable practices means systematic monitoring of insects, diseases, and other crop and soil conditions, and the enhancement of diversity, adaptation, and dynamic innovation This contrasts with the conventional approach in which farmers rely on standardized and prescribed practices This novel approach enables the farming system to become more resilient as well Farmers learn to make effective use of the interactions among plants and soils, nutrient cycling, diverse species pest predator interactions, and biological life cycles Addressing only one insect, weed, or disease at a time is ineffective Techniques and approaches must be adjusted to the local agro ecological, climatic and socioeconomic conditions

Interactive learning enables farmers and communities to conduct their own analysis, adjust their practices accordingly, evaluate the results with scientists, and to draw upon their own insights as well as new technical ideas As noted in the Kenya case, community training can lead to "informed decision making and the ability to evaluate other control methods " *(See Box 8)* Similarly, a producer in the Iowa case stressed "we [farmers] now get out in the fields much more [than before] to observe, learn, and understand our crops and resources, rather than follow standard recipes from product labels It's effective and it's fulfilling to get reconnected to our own resources " (R Thompson, personal communication, 1995) Nearly identical insights were expressed by a farmer leader, Elias Sanchez, in Central America's sustainable agriculture movement Although interactive learning contributes more to farmer empowerment and project sustainability than conventional prescription approaches it can also demand considerable time and resources, which are often scarce

In IPM outreach and monitoring farmers are also fully involved Farmer to farmer approaches have proven a highly effective means of extension—in both the North and South Often, farmer trainers are accompanied by technicians or NGO representatives from a management team (as in the California case, for example) In these cases the farmer trainers also receive ongoing training—a fundamental part of the programs in Bangladesh the Philippines and Indonesia *(See Box 9)*

Policy and Political Support

Integrated ecological pest and crop management methods need a supportive policy environment to flourish When the national government is committed to change, progressive impacts can be developed faster and spread

BOX 8 FARMER TRAINING FOR LEADERSHIP AND MULTIPLIER EFFECTS

In the Lambwe Valley tsetse fly project of Kenya ICIPE researchers and resource people from government ministries trained 42 farmers during 1992 and 1993 This training was seen as a social battery that generates power for action in the individual and community —which it proved to be Once trained farmers convened 30 meetings to mobilize their community and train its members in the biology and ecology of the tsetse tsetse borne disease the way traps work associated economic losses available solutions and the need for an organization for addressing tsetse The community responded well to this peer training and decided to form its own organization to launch a trapping program

more broadly, as seen in Cuba, Indonesia, and the Philippines In Cuba, for example, central organization by the government clearly meant better allocation of scarce inputs and the expedient dissemination of technologies The impacts are also greater and benefit more people if political commitment exists at all levels, not just the top In the Philippines, for example, local and municipal government support has been important in co sponsoring field days and training sessions on IPM, in coordination with FAO, the national IPM program, and NGO activities Cuba also illustrates how widespread decentralized units for producing biological control products facilitate change Here, the government has established some 222 Centers for the Production of Entomophages and Entomopathogens (CREEs) to provide bio control services to former state cooperative, and private farm operations Such state support, has helped to transform Cuban agriculture, even amid financial crisis

In the nine case studies, effective types of policy changes promoting sustainable agriculture include

- removing incentives and subsidies for pesticides, including credit policies tied to chemicals (The Philippines, Cuba, Nicaragua),

Integrated ecological pest and crop management methods need a supportive policy environment to flourish

- tightening and enforcing regulations on the import and use of pesticides (Philippines Nicaragua, Kenya, Bangladesh),
- providing public funds and political support to IPM programs or educational processes (The Philippines, Cuba, California, Nicaragua),
- broadening the base of stakeholders, farmer groups, and NGOs in policy decisions concerning plant protection, pesticide laws and production issues (Nicaragua, Cuba)

However, much work remains to be done on the policy front Several countries have tightened regulations on pesticides, but lack the mechanisms and resources to implement and enforce the laws In Nicaragua, Peru, Philippines, Bangladesh, and the United States, some public funds have been dedicated to IPM and alternative methods, but except for the Asian and Cuban cases, such public funding is minimal compared to the resources dedicated to

BOX 9 EFFECTIVE LEARNING AND DISSEMINATION METHODS

Characteristics and Requirements

Partıcıpatory approach two way flow
- Respect sharıng and commıtment

Farmer to farmer methods
Behavıoral retraınıng (unteachıng') scıentısts and extensıonısts
Experıentıal/field based ecology based knowledge
Empowerment of farmers
Sustaıned support of people and funds
Increased coordınatıon and systems traınıng

Methods

Cross vısıts/exchanges
Stress mutual learnıng based on prıncıples
Use provocatıve approaches to elıcıt knowledge
Farmer to farmer approaches
Use lıghthouses (posıtıve examples) as sources of energy farmers teach
- Use "celebratıons (socıal events) among farmers and famılıes to help traınıng

Broad outreach (massıficatıon')
Start small to prove results then broaden approach
Instıtutıonalıze but keep dynamıc and ınnovatıve
Technıcıans role
Respect farmer s knowledge culture
Traın ın cultural sensıtıvıty and communıcatıon
South South partnershıps (wıth lınks to ındıvıdu als/groups ın North)
- Make globalızatıon part of the agenda for sustaın able agrıculture

Revıve food securıty to confront prevaılıng eco nomıc condıtıons

conventıonal agrıculture polıcıes and programs (Pımentel and Lehman, 1993 Perkıns, 1982) In many of the countrıes, polıcy ıncentıves for chemıcals stıll prevaıl *(See below)*

These cases show that government organıza tıons, as well as NGOs, need to make more ınstıtutıonal changes to carry out such polıcıes In Cuba Indonesıa, and the Phılıppınes large state ınstıtutıons are beıng retooled for IPM partly through traınıng and program changes In Cuba and Nıcaragua facılıtıes for bıologıcal controls are beıng systematıcally developed wıthın ınstıtutıons However such reforms ın large research ınstıtutıons stıll lag far behınd need ın most countrıes

In sum the elements ıdentıfied here are key ın the transıtıon to sustaınable agrıculture The use of agro ecologıcal technologıes and prıncı ples and theır adaptatıon to local needs and condıtıons are ımportant but even the best technology cannot spread ın the absence of crıt ıcal socıal factors

BARRIERS TO PARTNERSHIPS FOR SUSTAINABLE AGRICULTURE

Several constraınts stıll ımpede the develop ment and spread of collaboratıve ınıtıatıves for sustaınable agrıculture The barrıers most often mentıoned by the case study partıcıpants were contradıctory messages from chemıcal compa nıes, weak government polıcıes and ınstıtu tıons questıonable financıal sustaınabılıty, lack of ınformatıon and ınternal weaknesses ın IPM projects/partnershıps *(See Box 10)* Of these the most serıous come from outsıde the project or program whıle most of the ınternal pro grammatıc weaknesses are surmountable

BOX 10 **KEY CONSTRAINTS TO IMPLEMENTING SUSTAINABLE AGRICULTURE PARTNERSHIPS**

Macro economic policies and institutions
—Pesticide incentives and subsidies
—Export orientation and monocultural focus of conventional policies
—Lack of incentives for institutional partnerships
Pressures from agrochemical companies
—Political and economic power wielded against IPM
—Advertising and sales practices
Funding/donor issues and sustainability questions
—Lack of funding especially long term support
—Lack of recognition of IPM/sustainable agricul ture benefits
—Need for reducing dependency on donors and for developing local support
Lack of information and outreach on innovative alternative methods
Weak internal capacities of institutions involved
—Institutional rigidities among some collaborators
—Lack of experience with agro ecology and partic ipatory methods
—Social and health concerns sometimes neglected
—Lack of communication and cooperation skills (among some groups)

Contradictory Messages from Chemical Companies

Case study participants and experts in this field concur that the contradictory messages and economic leverage of pesticide companies is a major constraint on the widespread use of IPM and related agro ecological approaches The companies' advertising and advice to farmers tend to work against IPM *(See Box 11)* For example agrochemical supply agents, who usu ally work on commission, naturally promote pesticides and try to maximize the use of their products (Pesticides Trust, 1996, Boardman, 1986, Peru, Philippines, and Cuba case studies) Some companies have also opposed government policies that could favor alternative methods, as in Philippines, where they lobbied hard against pesticide restrictions passed by the government (Pingali, personal communication, 1995) In some situations, as in Peru and in the U S cases, companies have shown interest in IPM, and some IPM programs involve chemical com panies in seminars and other activities How ever, the companies' interpretation of IPM is rarely based on ecology and these firms still pro mote *pesticide* management instead of pest man agement (Peru and Bangladesh case studies, and Moore, 1995) Similarly, the conventional para digm of industrial chemical dependent agricul ture still prevails in the minds and programs of numerous institutions and farmers

Inadequate Government Policies and Institutions

As mentioned, most sustainable agriculture initiatives face an unfriendly policy environ ment Pesticide regulations exist on paper but lack teeth, few governments have the effective enforcement mechanisms and resources need ed to make laws work (Farah, 1994) Further more many government policies—as in Sene gal, Peru, and the United States—still promote chemical use These policies include tax dis counts price subsidies, special credit condi tions, and marketing standards that favor the use of chemicals (*See* case studies, Farah 1994 Thrupp 1991, Repetto 1985) Furthermore, some case studies suggest that structural

BOX 11 | EXAMPLES OF CONFLICTING PRESSURES FROM PESTICIDE COMPANIES

CARE staff working on IPM in Bangladesh have been contacted on several occasions by the Pesticide Association of Bangladesh the Asia Working Group of the International Group of National Associations of Manufacturers of Agrochemical Products (GIFAP) and by Agri Sense BCS in the United Kingdom These associations have requested interaction with CARE to promote safe use of pesticides and products that disrupt the mating practices of various insects CARE staff have avoided such collaboration since they strongly believe—and openly communicate—that no pesticides or biological products are needed for the most efficacious rice farming in Bangladesh Thus CARE so far has had no relationship with pesticide companies and does not intend to link with them in the future (Bangladesh case study)

In Peru the use of insecticides by farmers has been stimulated by pesticide companies promotion mechanisms The companies have a large commercialization network which partly filled the void left by public extension services reduced by the government Several international companies such as Bayer Shell Ciba Geigy Hoechst and Rhone Poulenc are working in Peru 'Some of their insecticide sellers have participated in CIP's training activities regarding IPM They are aware of their lack of knowledge about IPM especially about the life cycle and behavior of insects however they implement their own training activities following commercial objectives, which in most cases are not compatible with IPM objectives In fact, the companies may be considered as competitors to the IPM program Farmers may become confused when faced with two different and often contradictory types of information about pest control (Peru case study)

The Practical Farmers of Iowa have also avoided interactions with chemical companies because of differences in perspectives As one farmer put it Research funded by chemical companies has an impact on the type of research done The money would be funneled toward proving a herbicide is better than something else for example They just may not do the research on the other side of the picture (Iowa case study)

adjustment policies recently promoted by international agencies and governments to maximize yields and increase export earnings have added to pressures for short term gains which in turn can perpetuate chemical intensive agriculture (Nicaragua and Peru case studies) In this sense, some of the partnership participants worry that export promotion policies, as reflected in the North American Free Trade Agreement (NAFTA) and the World Trade Organization (WTO), could perpetuate the push for conventional chemical intensive production patterns, as pressures to meet international marketing standards rise

In many cases, government has limited capacity to implement alternatives such as IPM methods Often weak or absent are information services training programs monitoring and information systems laboratories and programs to develop and teach new approaches Most international and national research institutions are also weak in these areas In the Nicaragua case, "the principal limitation faced by the IPM initiative was the reorganization of the state institutions during 1990–93 which did not allow the establishment of lasting collaborative ties with stable counterparts" (Nicaragua case study)

Questionable Financial Sustainability

Can financing be sustained over time to support and spread the changes achieved in these Partnerships cases? Most of these initiatives have to date depended largely on donors, and their long term funding prospects are uncertain. This dependency on external public funding—common in many kinds of development projects—poses a dilemma for the case study groups who seek a more sustainable and self sufficient approach. The cost of maintaining good collaborative relations and implementing changes can be high. Large investments of time and resources are still needed to develop and continue the transition to agro ecological approaches. Becoming more independent requires educational resources, and not all donors readily allow program evolution and adaptation. However, state and municipal support has emerged to help sustain such initiatives in some parts of Asia (e g, Philippines and Indonesia), to good effect. Another exception is Cuba, where government structures back the transformation to biological agriculture, even amid the economic crisis. In Kenya, local community organization is likely to enable the continual spread of IPM for tsetse fly control but this group, too, will probably need more outside resources to keep expanding.

Lack of Information on New Approaches

Despite the exciting progress under these collaborative initiatives, most farmers, policy planners, and the public still lack information on new approaches for pest management and agro ecology. Yet, agro ecological methods are information intensive, rather than product oriented, and they depend heavily on understandable, user friendly information. Too little information reaches decision makers who might be more supportive if they knew about the advantages of IPM. Lack of information and outreach also prevents groups from expanding and "scaling out" and "scaling up." Some groups are just beginning to use farmer to farmer contacts and the media, as well as training promoters and running demonstration farms. Lack of resources to produce and obtain information remains a problem.

Internal Weaknesses in IPM Partnerships

Any development process has its weaknesses, and these groups have had their share, including institutional rigidities, gaps in communication and outreach, and insufficient attention to social and health concerns. For example, some of the larger or more formal collaborating institutions tend to have inflexible approaches, structures, and philosophies. Others have had problems related to administration or differences in perspectives about agro ecological principles. *(See Box 12.)* The path to applying integrated methods and participatory approaches has sometimes been bumpy at state institutions or large research institutions, where conventional methods can be deeply entrenched. Yet, in many cases, strong efforts can change such structures.

Communication and outreach skills are weak among some project collaborators, particularly scientists or experts used to "prescribing" information to farmers. Also, an initial focus on one crop, region, or community can limit a project's influence. In the Senegal case, for example, a lack of clarity and contradictory messages kept the NGO and the national institute from collaborating effectively in the regenerative agriculture program. Gradually, the two sides had to learn to openly discuss and resolve their diverging points of view on objectives, to clarify the question of leadership, and to identify their respective domains and roles. In most such

BOX 12 | INFLEXIBILITIES IN INSTITUTIONS CAN BLOCK PROGRESS

In Kenya the Ministry of Agriculture Livestock Development and Marketing (MALDM) is responsible for the control of tsetse and trypanosomiasis But since its workers are trained to control tsetse but not to disseminate the technologies to users MALDM cannot implement community managed tsetse and trypanosomiasis control Further MALDM has no economists or sociologists to assist communities in project management and no mechanisms for collaborating with other potentially helpful government agencies In this case NRI and ICIPE had to facilitate the inter ministerial collaboration and ICIPE had to hire the social scientists to help the community

In Peru institutional structures in CIP were established to manage independent self contained projects When external participation was needed and when activities had to be planned with other institutions objectives and needs in mind, problems arose This lack of suitable structure has delayed communication and decision making in IPM implementation Initially both CIP and NGOs faced this problem but additional linkages established through personal contacts between extensionists and scientists have become a driving force in the inter institutional relationships

cases collaborators now work effectively as partners to reach more people both farmer to farmer and through other NGOs

Although implicitly concerned about pesticide risks most of the projects pay only scant attention to the health and social concerns associated with pesticide use For example, training on pesticide risks and precautions for health protection are not part of the studies from the United States, Nicaragua Kenya or Senegal Any instruction given focusses on farmer landowners and rarely includes the landless agricultural laborers who are at greatest risk In addition a few groups include too few women The scarcity of resources for addressing such matters partly explains these gaps but integrating these dimensions during planning could help close them

Some of these weaknesses are being overcome thanks to the efforts of the groups involved But these challenges still require much more attention and hard work at several levels

DISCUSSION, OPPORTUNITIES, AND RECOMMENDATIONS

These partnership initiatives have triggered agricultural and organizational changes that meet peoples' needs and respond to changing social demands and the lessons they offer are critical to a sustainable agricultural future They highlight the special importance of the human dimension—collaborative teamwork, participation, political and social support—needed to develop agro ecological principles and practices They also open up new opportunities for harmonizing economic, social, and environmental interests and food security

Unfortunately the influence of these efforts so far is small compared to that of conventional approaches to agricultural development Entrenched institutional structures block their progress and the promise of these partnerships may go unrealized

Major changes in policies, institutions, and, of course, field practices are needed at several levels to overcome the remaining constraints The pro ducers and practitioners involved in these pioneering initiatives, who all recognize this need, agreed on seven types of changes that are particularly important and urgent (See Box 13)

To implement such principles and practices, however, fundamental social, organizational, and institutional changes are needed in both social and agricultural systems, as outlined below

1 Apply basic agro ecological principles diversity, flexibility, synergy

Agro ecological principles form a vital basis for field level practices, including bio intensive IPM methods In the nine effective initiatives studied diversity, flexibility, and synergy are consistently identified as basic ingredients for sustainable production Such principles/practices make economic sense they have proven profitable in many farming systems Multiple actors—first and foremost, farmers, as well as NGOs, extension and research agencies, and national and international institutions—need to work harder on applying these principles in agriculture by adapting specific methods to local conditions Intercropping, cover crops, agroforestry, crop rotation, and other practices enhance diversity and build synergies among soil nutrients, plants, insects and other organisms, thus increasing productivity and resilience

2 Strengthen exchange among groups working on sustainable agriculture partnerships

Groups working on innovative agro ecological practices need more opportunities to exchange insights and experiences Increasing communication among practitioners (especially between farmers) to spread knowledge and progress is essential Exchange visits should be undertaken regularly and should include South South exchanges (regional and cross continental), as well as South North and North North interactions Such field based experiences have proven to be a valuable source of action research and training among partners

Special activities and funds are needed to facilitate and coordinate inter sectoral ventures as well Working with new creative partners such as consumers schools, and women's groups spreads knowledge, opportunities, and

BOX 13 | URGENTLY NEEDED STRATEGIES AND ACTIONS

- Apply agro ecological principles diversity flexibility and synergy
- Build collaboration and exchange among institutions in this field
- Reform policies and institutional structures to support innovation
- Ensure changes in agrochemical industry practices
- Increase information dissemination on effective partnerships and agro ecology
- Gain donor support and state and local backing for sustaining agro ecological efforts
- Build local capacity and redirect education to promote innovative efforts

impacts Both primary and secondary schools, as well as universities, can greatly benefit from such involvement and help multiply outreach Such educational approaches were emphasized in the U S and Latin American cases, though few of the projects have so far made this link age The group coordinators in these cases also stressed that "scaling up" should not increase the bureaucracy along with the reach and influ ence of the initiatives

3 Change policies and institutional operations to overcome constraints and support partnerships

Experience shows that changing prevailing poli cies is also a vital need to support this transi tion Five broad policy changes are needed

- Dismantle incentives for chemical based farming—particularly credit policies and subsidies for pesticides,
- Develop a national government policy com mitment to support and implement agro eco logical approaches to agriculture, particularly IPM, as in the Cuba and Indonesia cases,
- Develop new incentive policies, such as monetary incentives or awards, to support the adoption of alternatives (as exemplified in the California case),
- Strengthen environmental laws and enforce ment especially to (a) eliminate the use of highly toxic and persistent pesticides (b) restrict and control pesticides marketing (through for instance, labeling and full dis closure of information), (c) apply the polluter pays" principle through laws, requiring com panies to provide compensation for harm to the environment, health, and crops from their products, and (d) restrict the use of commis sion systems for compensating sales agents
- Establish clear modes of citizen participa tion for decision making on agricultural practices and policies to protect public inter ests and increase policy efficacy

As more far reaching recommendations sug gest, institutional structures and operations, especially in government institutions and research centers are in dire need of reform In particular, state and international institutions need to develop mechanisms and resources to enforce pesticide laws, provide information on pest management alternatives, and change their hierarchical operations for more collaborative systems to draw local groups into constructive efforts Also, central state support for IPM pro grams needs to be backed up by decentralized organizations that carry out the central policies For example, establishing regional and commu nity networks for applying IPM programs (as in the Philippines) and building regional centers for producing bio control agents (as in Cuba), would prompt effective actions

4 Ensure changes in agrochemical industry practices

The marketing activities and approaches of agro chemical companies must be overhauled to respond to the demands of growing numbers of farmers, consumers, and institutions who desire sustainable alternatives to chemicals Several participants in this project with first hand expe rience stress that farmers and the public can no longer tolerate industry practices that perpetuate unsustainable farming They also contend that integrated pest management projects and other agro ecological programs should remain inde pendent from these companies to avoid conflicts of interests At the same time, farmers, scien tists, and extensionists involved in IPM should educate these companies about the benefits of (and needs for) ecological methods of pest and crop management

Governments need to hold these businesses accountable for their practices and violations of laws Besides enforcing pesticide laws and controlling advertising, as noted above, efforts must be doubled to increase the impact of alternatives For their part, citizens and farmers can also press the private sector harder to supply alternatives, while NGOs and public schools help increase consumer education on the benefits and need for such alternative agricultural practices Strategies to encourage ethical and sound business practices should also be developed, here, public kudos for innovative companies can help motivate change

Agrochemical companies themselves need to realize that revamping their pesticide marketing practices can be good for business Progressive, modern companies must already sense consumers' and farmers' growing desire for safe and sustainable products and production The needed response is to eliminate sales commissions, cease misleading advertising, and make sure of proper information on labels and instructions Even more fundamentally, phasing out toxic products and increasing investments in sustainable production can pay off for firms over time, though the change may result in short run losses The industry leaders that are moving toward more sustainable practices also need to share their insights with other businesses through business associations and the like

Incentives and support are also needed for small businesses developing biological IPM services and bio control products—progressive investment opportunities that governments and business associations should encourage

5 Broaden dissemination of information on effective partnerships for sustainable agriculture

Information on these initiatives should be broadened to include systematic assessment of the economic and social results of ecologically based crop management, as well as particular methods used to achieve such results At the same time scientists, technicians, NGOs, and donors involved in the project need to make such information more widely available by presenting it in local languages and in simple terms to policy makers, farmers, and other key audiences Additional case studies might give voice to diverse opinions and ideas and farmer groups and NGOs need to be involved in assessments of innovative programs and technologies Information must be accessible—through reports, media, and advisory services—to a variety of groups and people involved in farming

6 Gain donor support and state and local backing to sustain agroecological efforts

Sustained funding is needed for partnerships and collaborative learning in integrated pest management and sustainable agriculture Groups involved in such efforts stress the need to distribute such funds equitably among farmer groups, local NGOs, and such institutions as government and international agencies They also stressed the need for donors to be flexible in extending funding and allowing projects the freedom to evolve as partners adapt to local needs At the same time, the institutions in innovative partnerships should seek local or state funding and strive to build self sufficient political structures and local community commitment to reduce dependence on outside donors Over time, dependency on external funding resources may not be necessary for IPM and related initiatives as people come to see how effective alternatives can be For now outside support is needed to overcome the current barriers to sustainable agriculture

7 Strengthen local empowerment, equitable opportunities, and educa tion for agro ecological approaches

Sustainable agriculture approaches will not develop or last unless communities and organi zations themselves continue to develop through education and learning Indeed, the case studies clearly show that "ground up" approaches to leadership and decision making help sustain progress More local initiatives and organizing by farmer groups and communities are key, as are farmer to farmer approaches to technology transfer outlined above In addition, state insti tutions need to develop educational programs and curricula on sustainable agriculture for both children and university students Farmer driven training opportunities should also be multiplied

No single sector, institution, or individual can educate and empower people to make changes Only multiple actors, working together, can Government agencies, non governmental orga nizations international agencies and donors, producers, workers, consumers, and private businesses must act in concert to reform the dominant paradigm, powers, and institutional structures, and make them more farmer friend ly and supportive of agro ecological alternatives to conventional farming The examples in this report show that people pulling together are forging a promising transformation Yet much more work still needs to be done, learning lessons from these cases to continue propogat ing new partnerships for sustainable produc tion and food security worldwide

ACRONYMS

ANGOC	Asian NGO Coalition for Agrarian Reform and Rural Development
BIOS	Biologically Integrated Orchard Systems
CAFF	Community Alliance with Family Farmers
CATIE	Tropical Agricultural Research and Higher Education Center
CIED	Center for Research Education and Development
CIP	International Potato Center
CREEs	Centers for the Production of Entomophages and Entomopathogens
FAO	Food and Agriculture Organization of the United Nations
GIFAP	Group of National Associations of Manufacturers of Agrochemical Products
ICDAI	Integrated Community Development Assistance, Inc
ICIPE	International Centre of Insect Physiology and Ecology
IFDP	Institute for Food and Development Policy
INTA	National Institute for Agricultural Technology
IPM	Integrated Pest Management
MALDM	Ministry of Agriculture, Livestock Development and Marketing (in Kenya)
NGO	Non governmental Organizations
NRI	Natural Resources Institute
PFI	Practical Farmers of Iowa
RARC	Regenerative Agriculture Resource Center
SIMAS	Mesoamerican Information Service for Sustainable Agriculture
WHO	World Health Organization
WRI	World Resources Institute

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2

CASE STUDIES

BANGLADESH BUILDING ON IPM—INTERFISH, AND NOPEST PROGRAMS

DEBBIE INGRAM WITH KEVIN KAMP

Government non governmental organiza tions, and international organizations have been working together in Bangladesh to help thousands of farmers apply sustainable rice production practices INTERFISH, a particu larly successful program, coordinated by CARE, has educated small and marginal rice farmers on agro ecological concepts, mainly for inte grated pest management but also for fish culti vation and for vegetable growing on dikes between rice paddies Since the early 1990s this program has helped alleviate rice production problems and improve the socio economic status of farming households A net work of collaborative partnerships has been essential to INTERFISH s success

BACKGROUND

Bangladesh is one of the world s poorest and most densely populated countries Stag nating or declining yields of modern rice seeds, declining production of pulse crops and freshwater fish, and the still growing use of pesticides are strangling its agriculture

The government s pesticide policies, an influ ential pesticide industry lobby, and an inability to control pesticide imports from neighboring India inhibit efforts to promote sustainable agriculture The same government agency responsible for pesticide approval, registration, and policy enforcement also implements programs

The Pesticide Association of Bangladesh esti mates annual pesticide use at almost 7 5 billion tons, and use is increasing between 15 percent and 20 percent annually Few pesticides are banned or restricted in Bangladesh and farm ers can get almost any type on the market Today, farmers can buy pesticides (which were free or subsidized from 1971 to 1979) at mar ket prices A handful of international and national pesticide companies dominate the market, most (70 percent) formulate and repack their products in densely populated urban areas Only half the pesticide dealers have received any training on pesticide use and almost all of this training—focussed on advertising and sales—has been done by one pesticide company Dealers rarely instruct farmers on the use of pesticides so farmers (9 out of 10 of them illiterate) apply anywhere from 13 percent to 67 percent of the recom mended dosage, using few or no safety precau tions Such misuse can accelerate pest resis tance and provoke hazards Concern about these trends motivates the search for sustain able alternatives to pesticide use

THE CARE/BANGLADESH EXPERIENCE

Since 1980, CARE/Bangladesh, an international non governmental organization, has coordi nated activities to improve rice production, hop ing to meet poor farmers' needs and to work toward environmentally sustainable farming These programs have been influenced by collab oration with international institutions such as the Food and Agriculture Organization of the United Nations (FAO), Bangladesh government institutions, farmers, other NGOs (such as the International Institute for Rural Reconstruc tion), and research institutions

In 1981, the Bangladesh government's Department of Agriculture and Extension (DAE) began working with FAO to introduce IPM techniques for rice production in Bangla desh by training smallholder farmers through "Farmer Field Schools" based on agro ecologi cal principles—an approach developed first in Indonesia (*See also* the Philippine case study) In 1991, in light of IPM's success on rice, CARE staff approached FAO to explore ways to further spread IPM in Bangladesh That December, 20 CARE staff and 10 staff mem bers of the DAE attended a training session to learn IPM techniques from FAO and DAE trainers

NOPEST Pilot

In January 1992, CARE/Bangladesh began IPM trials in Rangpur, Manikganj, Mirzapur, and Chittagong districts as the pilot project NOPEST This project was to test eight IPM practices, doc ument the results, and refine IPM extension strategies

The NOPEST baseline survey revealed that 63 percent of the participating farmers had used pesticides during the previous rice season with hardly any safety precautions (CARE/Bangla desh, 1993) Only 22 percent of the users cov ered their nose and mouth during application, none wore eye protection or gloves, and only 32 percent washed their clothes with soap after applying the toxic chemicals

Adapting FAO's participatory learning meth ods based on field experiments, the NOPEST project helped farmers discover basic ecological ideas and principles themselves Meeting in "discovery sessions" throughout the rice season, the farmers discussed their findings with CARE field trainers

A unique component of the NOPEST pilot was its inclusion of rice fish cultivation tech niques Although not part of the FAO model, this practice seemed right for Bangladesh, where fish supplies more than 70 percent of the rural population s dietary animal protein consumption (Government of Bangladesh, 1992) The Northwest Fisheries Extension Pro ject (NFEP) under the British Overseas Devel opment Association (ODA) provided funding, collaborative planning assistance, and some of its own personnel for the rice fish cultivation trials in Rangpur The trials worked, and CARE/Bangladesh added rice fish cultivation to its IPM approach Vegetable crop planting on dikes was also tested and added to the FAO model for Bangladesh

In the NOPEST pilot farmers tested eight strategies—idling flooded land, sweep net, light trap, flowering plants on dikes, kerosene rope, ash, fish cultivation, and bird perches—for reducing the use of toxic pesticides Not all were effective but, by the season's end NOPEST farmers cut their pesticide use by 76 percent and increased yield by 11 percent while non project farmers enjoyed no yield increase (CARE/Bangladesh, 1993, p 15)

The economic impact of IPM, especially new income from rice fish cultivation, encouraged small and marginal Bangladeshi farmers Their returns per hectare increased by an average of 106 percent in irrigated rice during the *boro* (dry) season and 26 percent in rainfield rice during the *amon* (wet) season if returns from fish cultivation, savings from eliminating pesti cide use, and the increase in rice yield are all included

The NOPEST pilot continued until June 1993 in collaboration with other organizations NFEP helped train CARE staff in aquaculture FAO and DAE provided training for CARE staff in both informal education methods and IPM CARE staff presented their findings from field work in 1992 and 1993 at international work shops attended by representatives of such research institutes as the International Center for Living Aquatic Resources Management (ICLARM), the International Rice Research Institute (IRRI) of the Philippines, and the Bangladesh Rice Research Institute (BRRI) CARE also gave two day training workshops in rice fish cultivation and IPM to other Bangla deshi NGOs through the Association of Devel opment Agencies in Bangladesh

INTERFISH Program Approach and Results

Based on this success the CARE staff obtained ODA funding for a broader program to deliver economic social, and environmental benefits to 22,500 farming households in Rangpur and Jessore The program INTER FISH, emphasizes IPM techniques rice fish cultivation, and vegetable cropping on paddy field dikes For each of the suboffices (Rang pur and Jessore), 30 field trainers were hired, and FAO, with DAE involvement, conducted two training sessions, in September 1993 and in April–May 1995

INTERFISH, like the NOPEST pilot, combines a participatory action learning method (PAL) with group discovery sessions This participatory approach (adapted from the FAO methods) helps farmers discover ideas that empower them to make environmentally sound, agriculturally productive decisions to fit ever changing condi tions in their own fields Individual farmers' needs are also assessed by CARE staff during discovery sessions and by field trainers working closely with small groups of farmers This grass roots orientation and structure contrasts sharply with the conventional extension strategy of teaching farmers standardized practices The PAL methodology of training has been docu mented by 13 videotapes on informal education and IPM technology that have been distributed to other NGOs

CARE programs employ strategies in "aquatic life management" of rice ecosystems They strongly encourage farmers to stop using all pesti cides "There is no such thing as pesticide safety for poor farmers," says the CARE sector coordina tor for Agriculture and Natural Resources "Pesti cides are not needed for rice production, and have a very negative effect on rice field ecosystems" (personal communication, 1994)

The practices promoted by the project create an environmentally safe farming system and bring economic benefits to the farming house hold Eliminating pesticides cuts farmers costs The INTERFISH program has also increased rice yields—in the 1994 *amon* season by 6 57 percent over nonparticipants' harvests (CARE, 1994a), in the 1994 *boro* season by 8 25 percent over participant farmers' 1993 *boro* total (CARE, 1994) Fish farming and dike cropping also increase families income through diversification and enhanced productivity Nutrition and food security have also increased because their families are eating "home grown" fish and vegetables, thus reducing health risks

Since the INTERFISH program is so new, no long range data is available to reveal whether farmers will continue to use agro ecological practices However, according to anecdotal evidence, such as farmer interviews in Jessore and other areas, the families continue to use and benefit from IPM, rice fish, and dike cropping methods

INTERFISH has received additional ODA funding to expand the project to Bogra, Rajshahi Natore, and Pabna IPM, fish seed production, dike cropping and rice fish cultivation will be shared with an additional 48,000 male and 12,800 female participants for a total of 70,800 men and 18,880 women by the year 2000

Convinced of the benefits of IPM and rice fish cultivation for small and marginal farmers, CARE/Bangladesh obtained funding from other donors for a program similar to INTERFISH The new program, named NOPEST after the pilot project and funded by the European Union (EU) from July 1995 to June 2000, will run in the districts of Mymensingh and Comilla and benefit 40,600 farming households Almost identical, the focal activities and methods of INTERFISH and NOPEST are based on the CARE approach, which grew out of 15 years' experience working with rice farmers

THE COLLABORATION PROCESS

The INTERFISH and NOPEST programs of CARE/Bangladesh grew out of collaborative partnerships among a variety of groups and institutions Each collaborator makes unique and important contributions *(See Figure 1 and Box 1)* Challenges and tensions have also emerged in developing this cooperative work, as noted below, but the overall result has been positive

Other Groups and Challenges

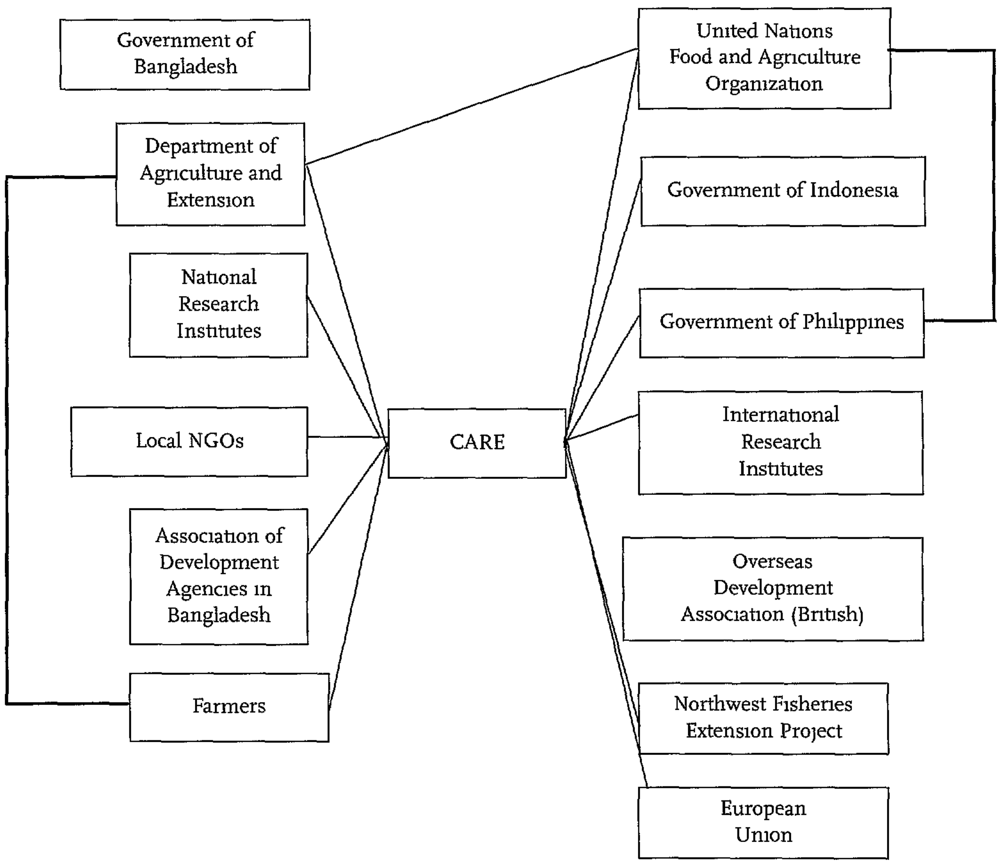
Pesticide companies, fundamentalist groups and the media have indirectly influenced the INTERFISH and NOPEST programs, though not as collaborators

PESTICIDE COMPANIES CARE staff have been contacted many times by the Pesticide Association of Bangladesh, the Asia Working Group of the International Group of National Associations of Manufacturers of Agrochemical Products (GIFAP), and Agri Sense BCS of the United Kingdom about "safe" pesticide use and products that disrupt insect mating CARE's response has been decidedly cool because CARE staff believe that in Bangladesh rice can best be farmed without any kind of pesticide or biological interference so a partnership seems out of the question

FUNDAMENTALIST GROUPS In one area, CARE staff have met some resistance to their program from a fundamentalist Muslim group opposed to social intervention and the participation of women CARE staff reached an agreement with the group but many fewer women participate than in other areas Clearly, CARE staff must think seriously about how to form partnerships or at least attempt to reach amicable solutions with such groups since they are prevalent and often powerful in Bangladesh

MEDIA The conventional media have perpetually broadcast advertising for chemical companies (as in most countries) Yet media could serve an outreach function for alternatives CARE staff have approached Bangladesh Television about featuring the INTERFISH program on a national news magazine show, as several

FIGURE 1 | COLLABORATIVE NETWORK—CARE/BANGLADESH INTERFISH AND NOPEST PROJECTS



local newspapers have already done Media coverage ultimately benefits farmers by acquainting the public with pesticide hazards and viable alternatives so forming more linkages with the media would enhance CARE programs impact

Lessons on Collaboration

An understanding of this collaborative process suggests several lessons

1 **Collaboration is essential to program implementation**
Without training, technical support, and methodological input from the FAO, training and cooperation from the DAE funding and institutional support from the ODA and the European Union and methodological refinements made with the help of the NFEP CARE could not have established INTERFISH and NOPEST

BOX 1 ROLES AND CHARACTERISTICS OF MAJOR COLLABORATORS

United Nations Food and Agriculture Organization (FAO)
ROLE Technical support training CARE staff in IPM fostering linkages between CARE and DAE funding extensive experience in IPM for rice since 1980 throughout South and Southeast Asia trying to reach as many farmers as possible
LINKAGES Primarily informal but could become more formal (FAO has usually worked with governments but assured continued technical support to CARE)
BENEFITS Excellent training for CARE staff strong ongoing technical support reciprocity of interests between CARE grassroots approach and FAO goal of bridging science and field work FAO goals of wide spread implementation of IPM served by CARE organizational structure CARE affords FAO a useful participatory model for altering the conventional top down approach of science and technology via extension programs
CHALLENGES Changing nature of CARE support needs a formal agreement may be needed but a formal memorandum of understanding is hard to move through FAO

Department of Agriculture and Extension (DAE)
ROLE Training CARE staff support from local DAE staff
LINKAGES Informal links through direct contact and through FAO
BENEFITS Training and assistance for CARE staff demonstration effect for DAE which has added dike cropping and rice fish cultivation to its IPM programs
CHALLENGES Lack of coordination of overall policy and long range planning mixed messages to farmers about pesticide use (i e DAE training in IPM retains pesticides for last resort use CARE methodology shows pesticides are never needed on rice)

Overseas Development Association (ODA)
ROLE Rice fish cultivation assistance for CARE NOPEST pilot project all INTERFISH funding (two regions US$2 7 million expanded project US$6 3 million)
LINKAGES Written contract and regular periodic monitoring and evaluation advises CARE from ODA s Northwest Fisheries Extension Project
BENEFITS Overlap of CARE and ODA objectives (poverty reduction environmental safety sustainability) for IPM CARE structure ensures fulfillment of objectives adequate funding
CHALLENGES Initial concern about high overhead for CARE administration and staff yet ODA satisfied that CARE adjusts costs and salaries appropriately

2 **Effective partnerships can determine success** As the party responsible for its own programs, CARE has been the lynchpin in these partnerships None of the other collaborators are as aware of the contributions of the various partners as CARE itself is

3 **General institutional policies that foster collaboration cannot substitute for constant attention to the details necessary to cultivate and maintain partnerships**
All collaborators acknowledge the potential contribution of partnerships with other organizations, but their policy statements alone cannot guarantee successful collaboration CARE has found that it takes determination, as well as vision to develop partnerships and to make collaboration work In fact where diligent

BOX 1 | Continued

cooperation between NFEP and CARE has deterio rated due to poor interpersonal communication

Farmers

ROLE Direct voluntary recipients of CARE training in IPM rice fish cultivation and dike cropping, their incentive for participation is knowledge gained about beneficial farming methods, requires exten sive time and effort

LINKAGES Informal linkages direct personal contact at discovery sessions and in follow up discovery ses sions open to nonparticipants

BENEFITS Increased income and yields through diversification and increased productivity use new concepts and practices

CHALLENGES Top down behavior sometimes still persists towards farmers despite the participatory methods used by CARE INTERFISH and NOPEST both assume that farmers do not have the CARE staff s knowledge of ecosystems and could benefit from acquiring it

Research Institutions

ROLE ICLARM IRRI and IIRR (as well as some universities) exchange some information with CARE on IPM and fish cultivation

LINKAGES Informal mostly through correspon dence at workshops through exchange of articles or through personal visits

BENEFITS Information about methodologies and technologies gained from some researchers practi cal knowledge about CARE's hands on approach gained by some research institutions and farmers ultimate benefits from collaboration between researchers and extensionists

CHALLENGES Little direct input on methodologies and technologies from sources other than the FAO and CARE s own field experiences

Local NGOs

ROLE So far limited exchange of information for example CARE staff in Jessore and Rangpur have shared information about INTERFISH during NGO forums of the Northwest Fisheries and Southwest Fisheries and have occasionally participated in NGO workshops

BENEFITS Some initial progress in broadening expo sure to IPM and rice fish cultivation for rice farming among NGOs

CHALLENGES Workshops and other exposures on IPM too brief for thorough training of other NGOs mechanism failing to coordinate efforts with other NGOs so that IPM reaches more Bangladeshi farm ers, CARE plans to expand these linkages

effort has *not* been employed to link with other NGOs, partnerships have not evolved

4 **Different entities collaborate for various rea- sons, and joining a variety of interests can enhance, rather than hinder, the initiative's effectiveness**

This collaborative network shows that part ners do not need the same motivation for participating to make the collaboration a suc cess But it helps if the interests of the part ners are at least somewhat complementary For example FAO s main operational approach is to work with the Government of Bangladesh, but because it sees that CARE/ Bangladesh can make an important contribu tion by training farmers in IPM, FAO is will ing to lend its expertise to CARE as well

FAO has other reasons for cooperating with DAE, but the network works

The collaborative process has also showed the importance of addressing such challenges as easing institutional tensions over time, making some links formal, and competing with the pesticide industry Particularly urgent is the need to present a coherent strategy for Bangladeshi farmers, who continue to receive mixed messages While CARE stresses eliminating pesticides in rice, the government has weak pesticide regulations and embraces chemicals in its IPM program A change in the government approach would facilitate the spread of IPM

Apart from the general positive outcomes already described, further details on the impacts of the CARE INTERFISH and NOPEST programs should be noted INTERFISH has been evaluated for two time periods January 1 to June 30, 1994, at the end of the program's first fiscal year (one *boro* rice season) (CARE/Bangladesh, 1994), and July 1 to December 31, 1994, after a full year of rice production, including one *amon* season of severe drought (CARE/ Bangladesh, 1994a)

Participation Rate

For the first year, the INTERFISH program targeted 1 280 women and 4,800 men as direct participants who agreed to attend discovery sessions and sign up for more training sessions *(Indirect participants* attended discovery sessions but did not participate further while others whom INTERFISH has just begun to track learn about the methods exclusively from fellow farmers)

The first evaluation found that 1,450 females and 4,791 males directly participated in project activities Participation by women, 113 percent of the target, exceeded expectations, while participation by men, 99 percent, was a little short Since December 1995, INTERFISH has targeted 4,800 women and 18,000 men per year The NOPEST program began its discovery sessions with farmers at the end of 1995 and targets 1 600 women and 6,000 men every two years

Adoption Rate

INTERFISH also set the following targets for the expected adoption rates of new methods among the direct participants

- 20 percent of male farmers stock fish
- 5 percent of men and 30 percent of women produce fish seed
- 30 percent of men and 100 percent of women plant crops on dikes

At these rates, rice yields were expected to increase 10 percent per acre each season

Overall, the data indicate that INTERFISH has come very close to its targets and that both direct and indirect participants are adopting the activities promoted Male participation exceeded the targets for all major activities, according to the January to June 1994 report Contrary to expectations women did participate in fish cultivation, indicating that farming households consider fish cultivation a good source of income At the same time fewer women than targeted took part in fish seed production and dike cropping According to the monitoring and evaluation team, in some cases men reported for the women who actually adopted a practice

Environmental and Health Effects

Pesticide use by INTERFISH direct participants was also substantially reduced In the first sea son, 88 percent of the participating farmers had stopped using pesticide altogether since the previous *boro* season The second season gener ated almost identical results Although no data have been collected to demonstrate specifically how pesticide reduction has affected the envi ronment, such a drastic drop in use suggests environmental benefits

INTERFISH farmers still comprise only a frac tion of Bangladeshi rice farmers, and nation wide pesticide use overall is still growing If the IPM programs of DAE and CARE are to per suade other farmers to stop using pesticides, they will have to be expanded significantly

INTERFISH monitoring and evaluation teams have not collected data to evaluate changes in farmers' awareness of how pesticide use influ ences health However, health issues related to pesticides and pernicious organisms within the rice farm ecosystem are explored during discovery sessions, and anecdotal evidence suggests that farmers know something about health risks from continued pesticide use In fact, most farmers per sonally experienced health problems from pesti cide use before joining the INTERFISH program

Economic and Social Impacts

From the NOPEST pilot, economic benefits can be estimated The average return was Taka 1327 (US$33 18) per acre from fish cultivation, Taka 145 31 (US$3 63) from dike cropping and Taka 84 06 (US$2 10) from reduced overhead by eliminating pesticide use

The INTERFISH target for rice yield is a 10 percent increase per acre per season (The aver age INTERFISH farmer has an estimated 0 40 acre of rice) Although they didn't use the same methologies, both INTERFISH reports found yield increases 8 25 percent during the *boro* season, and 6 57 percent during *amon* Eco nomic returns also increased Based on figures of internal rate of return, a farmer working the average 0 4 acre field would obtain rice yields worth Taka 3,648 (US$91 20) in one season employing the practices used in the INTER FISH program, in contrast to 3,420 (US$85 50) without using these techniques INTERFISH practices thus bolstered farmer income 52 per cent for all farming activities during *amon* sea son 1994 Overall, INTERFISH expects a total return of Taka 32,885,200 (US$822,130) from all project activities for the four participant years—enough to make a significant impact on rice farming in Bangladesh *(See Appendix 1)*

Besides increasing food security, increased income from higher rice yields and other prac tices has enabled these farm households to buy such tools for life as schoolbooks and other edu cational resources for children, and bicycles for transportation, according to anecdotal evidence INTERFISH has improved the self esteem and confidence level of both male and female farm ers, according to personal accounts For women whose roles as economic providers are often minimized in Bangladeshi society, this impact is especially beneficial, and some have seen their social status improve decidedly after they partici pated in the INTERFISH program (Shirin 1995)

Lessons on Impact

The monitoring and evaluation results suggest some lessons about measuring the impact of such IPM programs as INTERFISH

1 **Farmers are more impressed by the economic benefits of IPM than by its health or environ- mental impacts**
   The most receptive farmers to the INTER FISH methods are determined to increase their income Eliminating pesticides protects their fish—a clearcut economic benefit The effects of pesticides on their own health and

on the environment matter much less to them Consequently

- If farmers stop cultivating fish, they may start using pesticides again if they do not fully understand the immediate dangers for themselves and their families,
- Farmers who do not raise fish (80 percent of the INTERFISH farmers) may not appre ciate the hazards of pesticide use

As long as health and environmental concerns remain secondary to farmers, projects to train them in IPM and other agro ecological practices must demonstrate a positive economic impact on farm ing households, as well as social improvements

2 **A standardized format makes economic benefits much easier to see**
Considering its overriding importance, eco nomic impact must be made clear and plain So far, CARE economic data have been pre sented in a variety of forms per season, per acre, per participant, per year, per hectare—which prevents quick comparisons of results But now CARE is developing a simple standard format for presenting economic data to better demonstrate the program's success to others

3 **Detailed assessments of environmental impact, sustainability, and food security would be helpful, but are difficult to carry out**
The monitoring and evaluation procedures used by INTERFISH focus largely on eco nomic gains to households, given the farm ers' and donors' priority interests CARE staff agree that data on long term, widespread environmental impact, sustainability of agro ecological methods, and food security for farming households would be helpful in assessing the program's overall impact, but collecting such data will require more time and input from other collaborators

RECOMMENDATIONS

Evaluation of CARE's primary linkages suggests some recommendations for immediate and future directions and collaboration

1 **Improve coordination between CARE and DAE**
Agro ecologically sound farming methods would most likely spread throughout Bangladesh faster by improving the coordina tion of IPM programs between CARE and DAE Cordial case by case relations are no substitute for centralized long range planning and a continual exchange of ideas Because resources limit the extent to which CARE can initiate coordination with the government it looks to FAO for such assistance Other national governments—for example, the Philippines—have more productive and coop erative relationships with their NGOs CARE and DAE could benefit from a joint study of those models, perhaps with assistance from FAO

2 **Try to bridge the gap between extension work and scientific research by initiating active dialogue**
Universities and some other research institu tions have initiated partnerships to learn about CARE programs, but international and national research institutes have not By pub licizing the results of its field experience more widely CARE could elicit interest from research institutions

3 **Help local NGOs set up their own programs**
CARE plans to add staff members to train and share information with local NGOs Surely, these partnerships will improve as a result, but many NGOs need more than train ing to set up useful programs for farmers Now that CARE's own program has the expertise in this field, CARE can respond to and seek out local NGOs that could imple

ment IPM projects Indeed, this kind of assis tance is a stated goal of both CARE and the donors and could further IPM in Bangladesh

4 **Encourage collaboration among other national governments that support IPM and Bangladesh institutions (especially DAE and CARE)**
Inter country coordination is probably best accomplished through FAO, but CARE staff can also play a role CARE has already estab lished linkages with a few governments when for instance, it brought in master train ers from the Philippines and Indonesia Sharing these initial contacts with DAE could spur further collaboration and strengthen both methodologies and impact

5 **Facilitate partnerships with CARE operations in other countries**
There is a surprising lack of coordination within the fast changing CARE International system, which currently comprises 11 CARE offices working in 45 developing nations Many CARE offices, especially in Asia would benefit from learning about CARE/Bangla desh s IPM and rice fish cultivation programs, and the flow of information among CARE s Asian offices should be improved accordingly

6 **Facilitate partnerships with NGOs in other countries**
CARE/Bangladesh staff have contacted a few NGOs in other Asian countries with similar IPM programs but these linkages could be expanded and strengthened World Education in Indonesia and Save the Children in Thailand—other NGOs with successful IPM programs—seem especially promising collaborators

7 **Improve the relationship with the media to expose larger numbers of Bangladeshis to the practice of pesticide reduction**
Better media links could help to increase public awareness of the pesticide problem In turn public awareness would favor adoption of IPM practices

CONCLUSIONS

In the INTERFISH and NOPEST projects, the benefits of the various partnerships have gener ally outweighed the challenges and contributed greatly to project success Agricultural develop ment has promoted socioeconomic improve ment and environmental safety and sustainabil ity At the same time participatory agricultural extension methods have empowered farmers and responded to their needs

CARE/Bangladesh's work in IPM in rice farming is a continual process that demands continued commitment and motivation The same commitment and motivation are needed for sustainable agricultural development more generally through the expansion of the princi ples and practices employed in INTERFISH and NOPEST to vegetable sugar cane and cot ton farming Inter organizational partnerships will remain critical to further successful agricul tural development

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THE PHILIPPINES PROMOTING SUSTAINABLE AGRICULTURE IN NATIONAL AND COMMUNITY EFFORTS

ROEL R RAVANERA FRANCIS B LUCAS ANTONIO B QUIZON ARLAN SANTOS AND ANALEE CORALDE

Sustainable agriculture has been gaining ground in the Philippines since 1992, thanks to farmer groups, non governmental organizations (including religious groups), academic institutions, and international agencies This case study illustrates the inter institutional and inter sectoral roles and linkages needed to promote alternatives to chemical intensive farming in the Philippines, especially at the local level It highlights two integrated pest management programs—the Kasakalikasan national government program, and a program run by ICDAI, an NGO based in Infanta, Quezon—and explores linkages among government, NGOs, the Food and Agriculture Organization (FAO), and between national and local initiatives Although they use differing approaches, both initiatives have prompted thousands of farmers to adopt non chemical integrated farming methods

BACKGROUND CONTEXT

The Philippines is a major rice producing nation Much of its agricultural land is devoted to rice production, and the country is a "cradle" for Green Revolution technologies in rice For several decades the government s policies have supported the Green Revolution model promoting standardized high yielding varieties of rice and intensive chemical use As one example, agricultural credit programs have long encouraged farmers to purchase chemicals for rice production

Although the Green Revolution has raised yields in many areas, it has failed to boost the income of most of the rural poor in the Philippines and it has increased farmers' debts from loans for chemical inputs The intensive use of pesticides has provoked pest resistance disrupted the agroecosystem, and impaired human health in many regions As a result, growing numbers of organizations and farmers are looking for low cost alternative farming methods

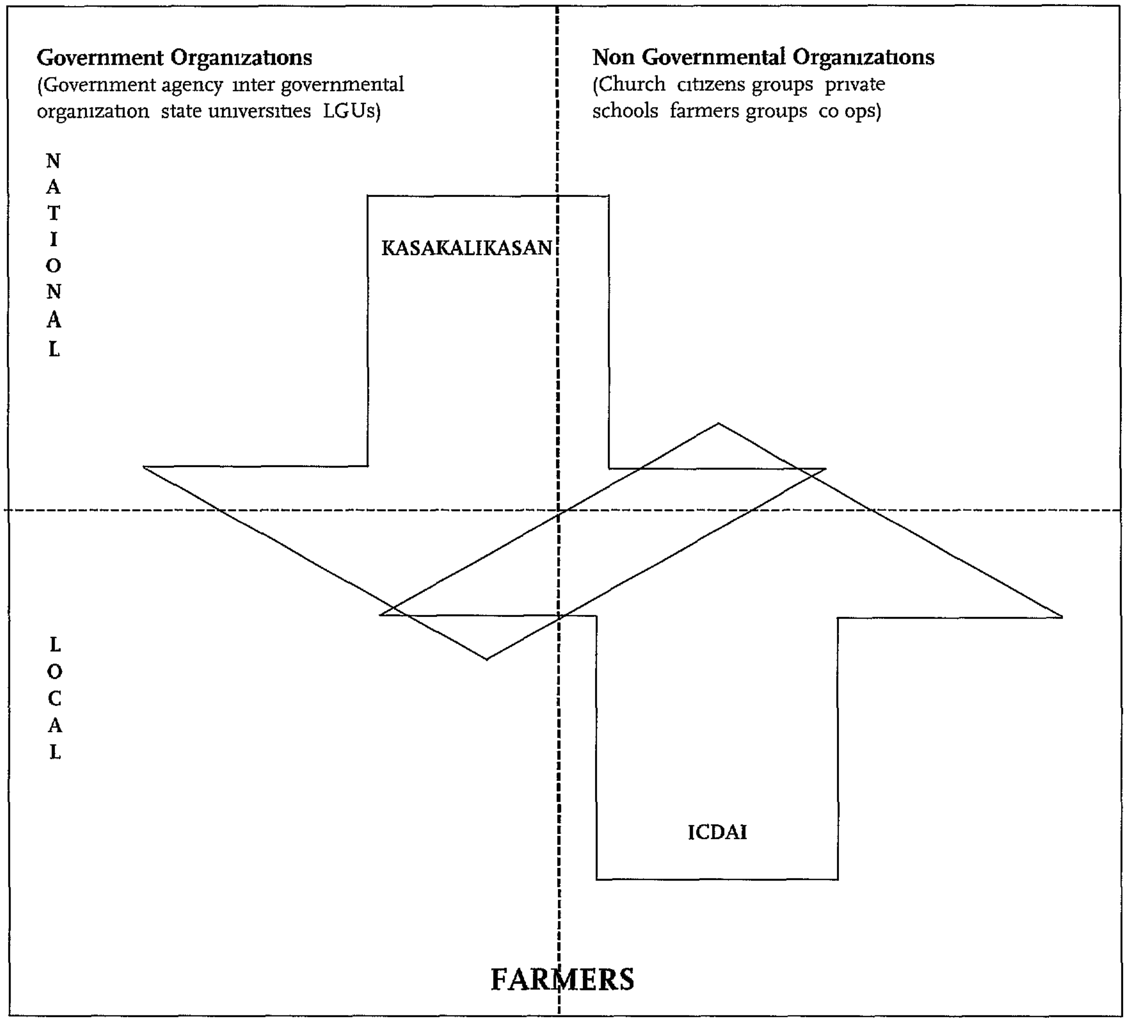
At agricultural colleges and universities, sustainable agriculture is gaining ground The Department of Agriculture has also made pronouncements about adopting sustainable agriculture as a basic framework, though its programs and projects have yet to shift Funding agencies encourage their partners to incorporate sustainability in their community projects The Catholic church, one of the biggest institutional networks in the Philippines, has started a drive for sustainable agriculture

In practice, these many efforts have had varying degrees of success But the national IPM program (Kasakalikasan) and the ICDAI community based program have effectively applied and spread integrated pest management and related agro ecological farming methods Lessons from these initiatives shed light on useful training methods institutional collaboration, and basic development philosophies *(See Figure 1)*

KASAKALIKASAN AN INNOVATIVE GOVERNMENT PROGRAM

Farmer training in the use of IPM in the Philippines dates back to 1978 but these early efforts were not entirely successful They employed a conventional classroom based extension method, where information flowed from extension agent to farmer, and technologies were not

FIGURE 1 | FRAMEWORK OF THE STUDY



adapted to local conditions Every farmer got the same technology package, regardless of the agro ecological environment where it would be used (Kasakalikasan Program Document, 1993)

In 1991, the government ran a pilot test of a new IPM extension method in Antique, Central Philippines with technical assistance and sup plemental funding from the Food and Agricul ture Organization (FAO) Used successfully in

Indonesia, this innovative approach of learning through practical experience and in "Farmer Field Schools" (FFS) enhanced farmers' scientific crop management skills The pilot project was so successful that, in May 1993, Kasakalikasan launched a program to train 200 000 farmers in IPM by 1997 Barely a year later 3,861 farmers had been trained their use of pesticides dropped between 60 percent and 98 percent, and their yields had increased between 5 percent and 15 percent (Roperos and Villa Real, 1994)

The extension and training approach in Kasakalikasan differs from conventional methods in three ways

- It presents farmers with an IPM model, not a technology package, so they can experiment and choose the combination that best fits field conditions

- It encourages inter institutional collaboration, especially at field level, among NGOs, local government units academe and farmer organizations under the leadership of the Department of Agriculture

- Most of its budget goes for direct training of farmers

The national organizational structure of the Kasakalikasan consists of a policy making Central Organization, which furnishes provincial and local organizations with on site IPM support, and the Field Organization *(See Figure 2)* Representatives from various government agencies academe intergovernmental organizations NGOs and farmer organizations sit on the central organization s executive and management committees

Although the program was initiated through the Central Organization, its execution is slowly shifting to the provincial and municipal levels Technical assistance and financial contributions form the operational linkages in the Field Organization among government agencies, local government units NGOs and farmer organizations NGOs conduct Farmer Field School (FFS) training and provide financial support *(See Figure 3)* On their own FFS graduates are starting to train other farmers (Roperos and Villa Real, 1994)

The program will cost an estimated P230 million (US$6,024,000) over five years Of this, 70 percent is allotted for training, about 9 percent for research, and another 8 percent for program development, opening offices at all levels and training local government officials The FAO IPC Program contributed nearly $100,000 to the program's in service training Donor governments of Australia, Switzerland, the Netherlands, Japan, and the Arab Gulf States have also supported the IPM program (mostly for farmer training)

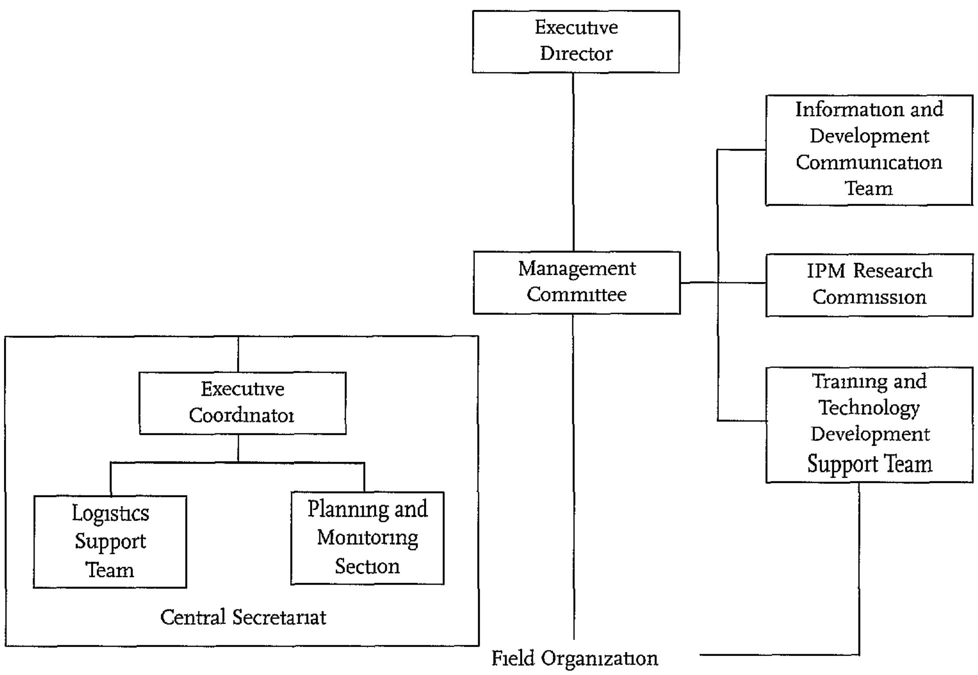
ICDAI A COMMUNITY INITIATIVE

ICDAI is a community based NGO working on IPM in Infanta, Quezon, as part of its wider efforts in rural community development *(See Box 1)*

ICDAI has been working in Infanta for two decades to build a just and humane society based on Christian values and communities' sociopolitical beliefs Although started by local religious and lay leaders of the Catholic church, it is legally and formally an autonomous and independent organization

Carrying out training and research in sustainable agriculture ICDAI runs an Agricultural Training and Development Center (ATDC) with a two hectare demonstration farm As of 1992 the demonstration farm had stopped using chemical fertilizers and pesticides and it is

FIGURE 2 | **CENTRAL ORGANIZATIONAL STRUCTURE OF THE NATIONAL IPM PROGRAM**



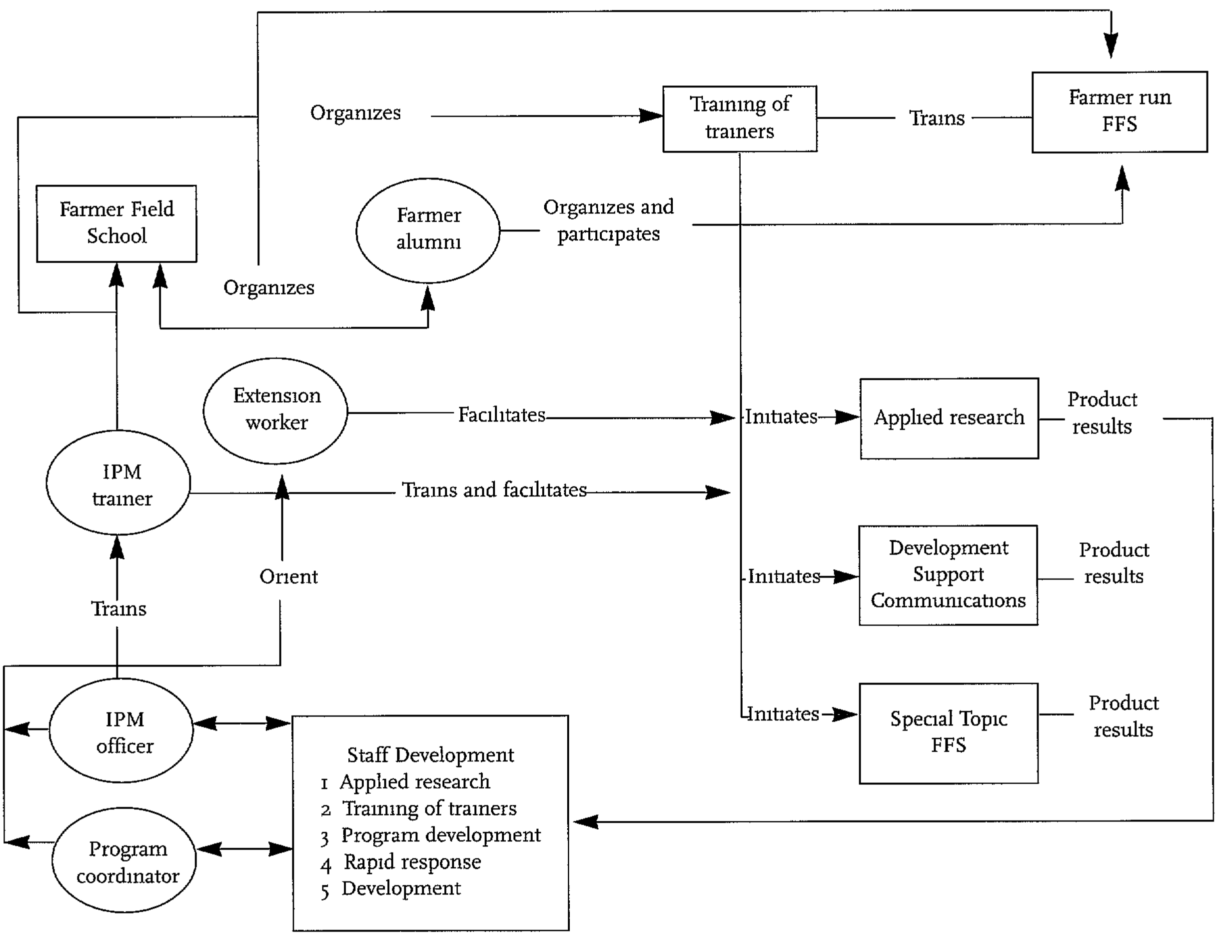
expected shortly to be financially self reliant *(See Box 2)*

EARLY ICDAI INITIATIVES

Sustainable agriculture initiatives in Infanta emerged from the community's struggle to eradicate poverty and to seek low input alterna tives to the Green Revolution At first, ICDAI worked on its own without any outside aid, rely ing mainly on farmers' knowledge ICDAI encouraged several farmers to conduct collec tive experiments on non chemical pest control methods using field observation techniques to study the lifecycle of pests to prevent pest out breaks In 1986, it held a week long workshop on sustainability issues for representatives of people's organizations church leaders, and NGO leaders Then, from 1986 through 1989, ICDAI ran intensive training in sustainable agriculture, including a 10 month course for out of school youth Training received by two ICDAI agriculturalists (one in the Netherlands, one in Japan) enriched the curriculum

Starting in 1988, ICDAI began a campaign against the use of pesticides through seminars radio broadcasts and sermons at Sunday mass During the 1990s, it developed more activities for training and development of IPM methods

FIGURE 3 FUNCTIONAL DIAGRAM OF IPM FIELD IMPLEMENTATION



Source KASAKALIKASAN Program Document 1993

BOX 1 | PROFILE OF INFANTA QUEZON

Infanta Quezon is located on the east coast of Luzon 144 km northeast of Manila Its 25 900 hectare land area supports a total population of 35 766 in 36 *barangays* (villages) Seventy percent of these people work in farming 15 percent in fishing and the rest in other occupations

Infanta has five ecosystems upland (forest) lowland (riceland) estuarine marshland and marine with high biodiversity About 22 5 percent of the land is devoted to agricultural land use Major crops are coconut and rice various vegetables and fruits are also grown Despite the abundance of natural resources 70 percent of the population live below the poverty line Some of the factors hampering agricultural development in Infanta, as cited by the Department of Agriculture are low commodity prices water shortages high interest on loans the high cost of inputs and a lack of technology

among farmer cooperators These farmers adapted the technology and started a process of farmer to farmer extension

The socioeconomic environment of Infanta proved favorable for expanding sustainable agriculture Most farmers were smallholders, and, unlike many communities in the Philippines, landholding patterns in Infanta were not highly skewed In this environment interactions among farmer groups have increased and communication about development and environment issues expanded During recent years, ICDAI has systematically allied itself with all other practitioners of sustainable agriculture in the Philippines and has taken part in discussions and field activities with farmer practitioners

ICDAI'S CURRENT IPM PROGRAM

In recent years ICDAI has strengthened its IPM activities by adapting FFS participatory methods and expanding farmer to farmer extension Success stems partly from collaboration in these efforts with organizations including FAO and, to a limited extent, government agencies FAO has provided technical advice, and ICDAI has tailored participatory methods to local interests and incorporated principles of community empowerment into them

ICDAI currently conducts season long IPM training in three *barangays*—Bacong, Comon, and Tudturan—the three major rice producing areas of Infanta Since training started with only a handful of participants it did not qualify for a government subsidy (which required at least 25–30 participants per training) but more than a hundred farmers from 10 *barangays* now participate

Reduced Pesticide Use

The ICDAI campaign for pesticide free agriculture has clearly decreased farmers' use of pesticides By 1992, the demo farm was totally chemical free and was earning more than it did with chemical inputs By 1994, none of the ICDAI production loans to farmers were for pesticides Frogs and mudfish have reappeared, and farmers have started experimenting with new ways to control pests including harvesting the snails that damage rice and using them as fertilizer

It is still too early for a precise cost benefit analysis of the Infanta IPM program However, the decline in ICDAI pesticide loans to farmers

BOX 2 INFANTA INTEGRATED COMMUNITY DEVELOPMENT ASSISTANCE INC (ICDAI)

Philosophical Framework

ICDAI s approach to social development is governed by the following basic philosophical principles

ICDAI recognizes the right of individuals to meet their basic needs for food nutrition health shelter and education

Viewing individuals and communities holistically it carries out an active program in the economic political cultural spiritual environmental and social aspects of the community

By empowering people it embraces the spirit of self reliance and self sufficiency

ICDAI promotes people s participation in community development to bring about program success and put people in control of their own development agenda

Incorporation of Christian values and religion into the development process is part of the approach in social development

Conservation of natural resources is considered crucial to the attainment of long term sustainable development

ICDAI s Programs

Based on these principles ICDAI instituted the following four programs

1 The *Infanta Community Development Center* focusses on the design and implementation of ICDAI s social welfare programs and training to meet the needs of the Infanta community's poorest members
2 The *Socioeconomic Development Program* works to enhance the economic viability and productivity of rice farmers and small scale retailers in Infanta
3 *Community Organizing* since the 1970s is aimed at transferring power to the people building people s organizations and forming alliances
4 The *Agricultural Training and Development Center* represents ICDAI s commitment to promote sustainable agriculture technologies and natural resources conservation

suggests a reduction in production costs With no reliable data on yields, however, whether the reduction in pesticides use translates into higher incomes is hard to say

Meetings with local farmers do reveal some insights into changes in farm economics, however most farmers say their yields remain the same once they take up IPM and sustainable practices Many farmers have completely stopped using herbicides and fertilizer But some must hire more laborers (for weeding for instance) which offsets their savings on chemicals Still, most welcome the opportunity to provide neighbors with on farm employment and make other social investments in their community

Social Impact and Community Participation

The use of community participation in IPM in Infanta is part of ICDAI's social and technological transformation program The IPM Farmer Field School, meeting a half day every week during cropping season, encourages farmers to think investigate and learn Farmers designate experimental plots to maintain and observe and each student keeps notes on field observations The field school method has proven effective in adult literacy education as well as in strengthening community relations

The FFS has also become a social event for the community Farmers eat lunch together and then discuss other community concerns usually over bottles of *lambanog* (local wine) On special occasions, such as a participant's birthday, celebrations can last until evening Central to community development, this camaraderie and sense of belonging are due to NGO modification of the FAO model

FACTORS FURTHERING IPM PROMOTION IN INFANTA

ICDAI's efforts to promote IPM in Infanta was helped by an already organized community, an effective strategy for further empowering it, and close links with the Catholic church, the area's strongest social institution

An Empowered Community

Farmers disappointment with the results of the Green Revolution deepened after 1972 when martial law's promised bounty—the "New Society'—did not materialize In a workshop, Infanta's farmers realized they needed an organization to answer these questions What can ordinary people do? What is a people's organization for? What are the parameters people can work on during martial law? Problem solving focussed mainly on people's rights, resistance, access to and control over natural resources, and government accountability

All these efforts were seeded by *consciousness raising*—getting ordinary people to think and analyze individually and collectively about issues and solutions to problems which they could tackle immediately—and *mass mobilization*—collectively gaining control and taking action that help people boost confidence in themselves and their organization

Today, both the civil and local government sectors are highly organized People's organizations and cooperatives, local NGOs, and womens' groups are involved in almost all community activities Heads of *barangays*, together with the local councils, actively participate in local government processes

An Effective Empowerment Strategy

In three decades of development work in Infanta an effective participatory development tool evolved a combination of sectoral and community organizing *Sectoral organizing* is mass based advocacy and pressure politics strategy for addressing disadvantaged groups' needs, it can be effective but it lacks community rootedness For ICDAI, *community organizing* is a participatory and multisectoral approach to solving local problems, though national issues come into play if participants think they must Training focusses on inculcating a sense of community spirit and collective responsibility Holistic and integrative, this approach is a more stable way than a sectoral approach to promote a community socioeconomic development program

Employing this twin approach to organizing, people in Infanta have won many vital struggles They have for example, stopped commercial logging, got Lamon Bay closed to commercial fishing and secured a closure and dismantling order for illegal fishponds This practical and empowering approach has also helped farmers implement the IPM activities

The parish priest, president of ICDAI for the past 20 years, introduced community organizing in Infanta Sunday mass is a venue for information dissemination, consciousness raising, and updating the community, and ICDAI's close relationship with the church wins wide acceptance of the group's programs, including sustainable agriculture and IPM

The profound influence of the Catholic church cuts across government and non gov ernmental ınstıtutıons ın the communıty Its lay organızatıons and partner NGOs address socıoeconomıc and polıtıcal problems In pro motıng IPM, the church brıdges varıous ınstıtu tıons and programs

INSTITUTIONAL COLLABORATION

An assortment of governmental and non gov ernmental groups and ınstıtutıons support IPM and sustaınable agrıculture ın Infanta *(See Fıg ure 4)*

NGO Lınkages

ICDAI maıntaıns lınkages at the communıty, natıonal, regıonal, and ınternatıonal levels So as not to jeopardıze ıts development objectıves ICDAI does not alıgn ıtself wıth any natıonal polıtıcal group Its mandate ıs to create partner shıps wıth people's organızatıons, and all ıts actıvıtıes are responses to communıty needs

At the communıty level ICDAI works closely wıth organızed farmer groups Over the years, these lınkages have matured and have ıncreased, breedıng credıbılıty capabılıty open ness, and accountabılıty The relatıonshıp ıs not demandıng sınce needs aı e easıly evaluated and performance easıly appraısed By 1990, ICDAI and ıts partner organızatıons were the bıggest and most stable organızatıons ın the commu nıty Today the ındependent regıstered people's organızatıons are federated ınto a People s Congress

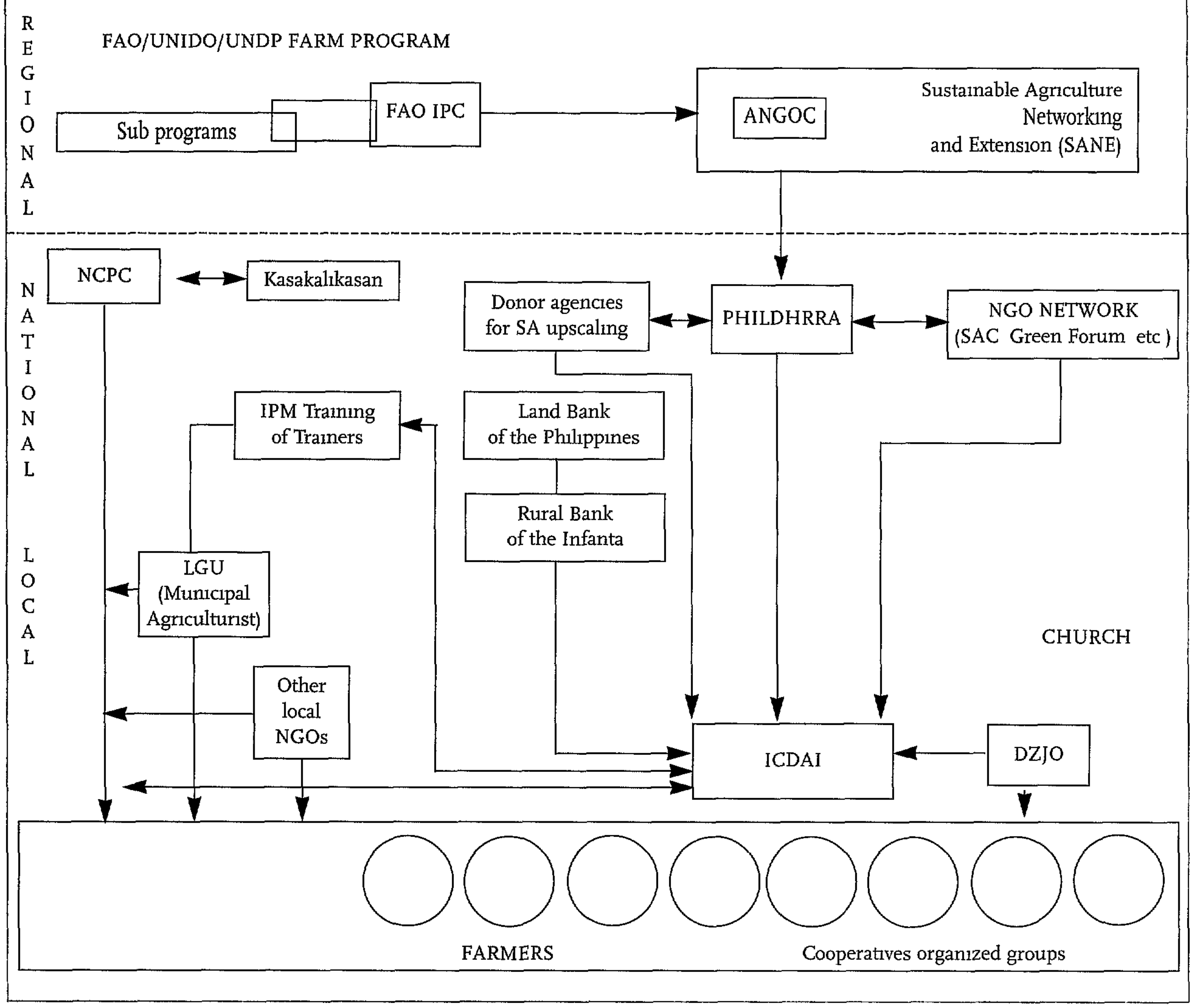
Nonetheless ınter NGO suspıcıon and rıval rıes, resıdues of the martıal law era have lımıted ICDAI lınkages wıth local NGOs Apart from ıts strong tıes to the farmer cooperatıves, ICDAI works as a partner wıth only two other local NGOs, both dedıcated solely to develop ment In addıtıon, DZJO a communıty based radıo statıon also plays an ımportant role ın IPM and other ICDAI programs, provıdıng a forum for dıalogue, advocacy, and mobılızatıon for communıty development

At the natıonal level, ın 1988 ICDAI accepted an ınvıtatıon to joın a natıonal federatıon of 65 socıal development NGOs—the Phılıppıne Partnershıp for the Development of Human Resources ın the Rural Areas Sınce 1992, ICDAI has created both operatıonal and struc tural tıes to natıonal and regıonal NGOs ınvolved ın sustaınable agrıculture For exam ple, the ICDAI presıdent sıts on the Board of Trustees of the Asıan NGO Coalıtıon (ANGOC), a 10 country regıonal network The ICDAI presıdent ıs also presıdent of Green Forum Phılıppınes, the bıggest NGO coalıtıon for sustaınable development and the envıron ment ICDAI ıs also an actıve member of the Sustaınable Agrıculture Coalıtıon (SAC) ın the Phılıppınes These contacts have buılt up camaraderıe among practıtıoners of sustaınable agrıculture and ımproved partners' capacıtıes for ımplementıng alternatıve methods

Through the ANGOC Food Securıty and Sus taınable Agrıculture Program, ICDAI has also made regıonal and ınternatıonal lınks ICDAI works wıth local NGOs ın Asıa on IPM and sustaınable agrıculture through traınıng, farmer to farmer exchanges advocacy work, and field projects Through ICDAI, Infanta has become the pılot sıte of the UNDP FARM UNIDO Farmer Centered Agrıcultural Resource Management (FARM) Program ın the Phılıppınes FARM s IPM work and ıts sıx other programs are handled by FAO and the People Centered Sustaınable Development Sub Program managed by ANGOC FAO funded ICDAI s efforts to promote IPM ın Infanta

ICDAI also lınks up wıth the Asıan program of the Sustaınable Agrıculture Networkıng and

FIGURE 4 INSTITUTIONAL LINKAGES FOR SUSTAINABLE AGRICULTURE IN INFANTA



Extension (SANE)—a global UNDP initiative to enhance capacity building and human resource development in sustainable agriculture SANE provides technical and financial support to enhance ICDAI training and networking

Linkages with Government Institutions

LOCAL GOVERNMENT With the implementation of the Local Government Code, local gov ernment units took over both agricultural extension services and farmer training from the Department of Agriculture National agriculture programs, including Kasakalikasan, are implemented locally by these units, which formulate policies, implement programs, approve infrastructure development, facilitate access to credit, and conduct research and extension

Since most local government units have no capacity for agricultural research, they still need the Department of Agriculture's help to decide and carry out research priorities Most lack the resources to cultivate these ties, however, indeed, some can't even pay the salaries of the Department of Agriculture personnel assigned to them This gap opens up opportunities for the participation of NGOs and the private sector In particular, ICDAI, with its national and international connections, can provide a comprehensive agricultural program and training in alternative technologies

Until the late 1980s, ICDAI had no relationship with the local government since government extension workers promoted a chemical intensive agricultural system In fact, the local government considered ICDAI a trouble maker that offered no viable alternatives, while ICDAI viewed local government as an ineffective bureaucracy unable to deliver badly needed programs Any linkage was limited to short term projects

Linkage between ICDAI and the local government has improved since new local officials were installed in 1992 The local government has also gradually recognized ICDAI as an able partner in health care and social welfare, as well as agriculture, and ICDAI is now being tapped for research and municipal level planning ICDAI and local government agriculturists have also committed themselves to cooperate on IPM training for farmers Still, government agriculturists need to be retrained to embrace the broader concepts of sustainable agriculture and community organizing

NATIONAL AGENCIES The relationship between ICDAI and national government agencies is developing fast Such government agencies as the Bureau of Agricultural Research, the Department of Agrarian Reform, and the Department of Agriculture recognize ICDAI's success in building participatory development These institutions provide support and expertise for local projects, and help ICDAI expand its impact

ICDAI participates in the Kasakalikasan trainer training program, which enrolls local government agricultural personnel as a priority Hoping to boost institutional collaboration at the field level and to support farmer training, Kasalalikasan has also opened this program to NGOs and other interested groups This training linkage has been facilitated by cooperation with ANGOC and FAO, and ICDAI staff graduates of this program now conduct FFS in Infanta

However, beyond training, institutional ties between ICDAI and Kasakalikasan are minimal Since they receive no government resources for this purpose, NGOs are left to fend for themselves which creates tension between government agriculture personnel and NGOs involved in the IPM program In Infanta, this fundamental inequality is aggravated by differences in attitude perspectives and objectives regarding sustainable agriculture The ICDAI pest management program for example is nearly chemical free while the government still accepts chemicals in its IPM approach Bureaucratic rigidities have also cropped up—for instance, when the local government agriculture office refused financial support to ICDAI at the start of FFS because it did not have a certain number of participants

For four months in 1994, the National Crop Protection Center (NCPC) of the Department of Agriculture—a research institute based in the University of the Philippines in Los Baños—was also involved in the promotion of IPM training in Infanta though misunderstandings about institutional roles and resource constraints cut this project short In particular, NCPC's extension role overlapped with some ICDAI functions and the institutional partnership broke up over such issues as sustained institutional commitment, political openness, and work ethics

CONCLUSIONS AND RECOMMENDATIONS

1 A participatory approach to technology dissemination lets farmers adapt technology to their own growing conditions and engenders community wide acceptance Collective, hands on training makes a deep impression on farmers, gives them a sense of ownership of the technology and encourages them to share it with other farmers In contrast, promoting a technology package can create unnecessary friction that slows technology dissemination

2 Understanding a community's power structures—the enabling and constraining forces—expedites the promotion of sustainable agriculture and integrated pest management Because IPM and sustainable agriculture accommodate diverse social relationships and agro ecological conditions community resistance to IPM and sustainable agriculture is minimal

3 Partnership with local groups—based on respect for each party s capabilities, shared priorities and compatible strategies maintained through constant dialog—can be more effective than with external agencies Local governmental and non governmental community groups understand the dynamics of community power relations better than outside agencies do As stakeholders in the locality, they play a particularly critical role in developing extension strategies Community NGOs can be the primary project implementors, external agencies can provide funds, expertise, and other necessary support

4 A holistic approach to technology dissemination is highly effective since the community's varied needs and concerns are highly interrelated ICDAI succeeded in promoting IPM/SA because the organizations' programs are comprehensive comprising community organizing production loans marketing, training, and other components In contrast the commodity approach practiced by government extension workers sometimes confuses farmers by giving them conflicting messages

5 In sharing technology the receiver—a community ready to absorb technology—is as important as the transmitter Community organizing and development should therefore be a part of every technology promotion program Thanks to community development programs that stretched over many years, Infanta already had a social infrastructure in place Since the community was ready for new technology and was organized to use it, IPM spread quickly

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CUBA ALTERNATIVE AGRICULTURE DURING CRISIS

PETER M ROSSET

Cuban farmıng has been caught ın a vıse sınce the 1989–90 collapse of ıts trade relatıons wıth the socıalıst bloc Food ımports, whıch used to supply nearly 60 percent of the people's calorıc ıntake, have been cut ın half Domestıc produc tıon has had to fill thıs gap as well as maıntaın exports Imports of agrıcultural ınputs have also dropped by 80 percent, and the supply of petro leum for agrıculture has been halved Cuba has been forced to absorb these shocks wıth only a fractıon of the chemıcals and machınery needed to run an ındustrıalızed agrıcultural system technologıcally sımılar to Calıfornıa's

These events catapulted Cuba ınto hıstory's first large scale shıft from modern conventıonal agrıculture to organıc and semı organıc farm ıng The government's strategy has been to mobılıze Cuba's substantıal scıentıfic ınfra structure—both physıcal and human resources and ınstıtutıons—to substıtute local technolo gıes for the ınputs that are no longer avaılable

Cuban made bıopestıcıdes and bıofertılız ers—the products of cuttıng edge bıotechnology developed before the crısıs—are beıng com bıned wıth ıntegrated pest management, vermı culture, waste recyclıng, ratıonal pasture management, bıologıcal pest control, cover croppıng, and other ecologıcally sound practıces ın an attempt to avert a catastrophıc shortage of food

Productıon ıs beıng reorganızed to create the small management unıts essentıal for effectıve organıc farmıng Many ınstıtutıons at central and decentralızed levels are workıng ın concert to brıng about the changes Parts of the state farm ıng apparatus have been prıvatızed, cooperatıves are beıng formed, and farmers' markets are openıng—contrıbutıng to new opportunıtıes for both producers and consumers ın thıs transıtıon

BACKGROUND

A contradıctory dualısm marked the Cuban economy between the revolutıon of 1959 and the 1989–90 collapse of trade relatıons wıth ıts socıalıst partners Cuba was a supplıer of raw agrıcultural commodıtıes and mınerals to the socıalıst bloc and net ımporter of both manufac tured goods and foodstuffs Despıte substantıal ındustrıalızatıon by regıonal standards, Cuban ındustry relıed heavıly on ımported ınputs and capıtal goods (Pastor, 1992)

Cuban agrıculture sınce the 1950s has been hıghly modern Through 1989, export monocul tures took precedence over food crops, and farmıng methods depended heavıly on ım ported ınputs and raw materıals In the late 1980s, 48 percent of fertılızers and 82 percent of pestıcıdes were ımported (Deere, 1992) Many of the ıngredıents of domestıcally pro duced fertılızers and pestıcıdes were also ımported, ıntensıfyıng Cuba s ımport depen dency Startıng ın 1990 however, the ımports of pestıcıdes and fertılızers were completely cut off

Durıng the 1980s, the Sovıet Unıon paıd Cuba an average sugar prıce 5 4 tımes hıgher than the world prıce (Pastor, 1992) Because of these favorable terms of trade export sugar pro ductıon far outweıghed food crop cultıvatıon Wıth proceeds from sugar exports, Cuba could afford to ımport more food for ıts people ın greater varıety than could be grown domestıcal ly About three tımes as much land was devoted to sugar as to food crops ın 1989, and ımports furnıshed as much as 57 percent of the total calorıes ın the Cuban dıet (Rosset and Benjamın, 1994a)

Until the mid 1980s, international price volatility posed few problems for Cuba Favorable trade agreements with the socialist bloc guaranteed the profitability of farm exports Until 1991, the Soviet Union accounted for about 70 percent of all trade, and the rest of the socialist bloc accounted for another 15 percent Earnings on these exports paid for agrochemicals, fuel for agriculture, and food for the Cuban population—all at reasonable prices (Rosset and Benjamin, 1994a, 1994b, 1994c)

After 1990, Cuba's monocrop agriculture proved a major weakness The revolutionary government had inherited a system focussed on growing export crops on expansive land parcels The first agrarian reform of 1959 converted most of the large cattle ranches and sugar cane plantations into state farms In the second agrarian reform, in 1962, the state took control of 63 percent of all cultivated land (Benjamin et al , 1984) In 1994, some 80 percent of the nation's agricultural land still consisted of state farms, corresponding roughly to the pre revolutionary plantation holdings

Two problems arose in this section First a monoculture plantation is incapable of developing its own pest control, soil fertility, or other services and resources needed for successful production (Altieri and Rosset 1995), so it is extremely vulnerable to pest and disease attack (Carroll et al 1990, Altieri 1987) Second to segregate crops and livestock as all countries with industrialized agriculture do is to squander resources

Peasant farmers were scarce even before the revolution Export plantations dominated the rural economy and people congregated around urban areas By the late 1980s, 69 percent of the island's population lived in or next to cities (Rosset and Benjamin 1994a) Peasant producers held only 20 percent of the agricultural land, split almost equally among individual holders and cooperatives, yet, this 20 percent yielded more than 40 percent of domestic food production (Rosset and Benjamin, 1994a) The state farms and many of the cooperatives were modern—large expanses of monocrops relying on heavy mechanization, the use of chemical fertilizers and pesticides, and large scale irrigation

By the early 1980s, young scientists at the Ministry of Agriculture and universities, influenced by the ecology movement, were becoming critical of modern agricultural methods (Levins, 1991, 1993) They faulted the Cuban model of agricultural development for its dependence on foreign inputs and its tendency to degrade the environment by, for example, encouraging pesticide resistance and soil erosion They began to reorient their research toward nonchemical alternatives By 1987, the vast majority of the 185 papers presented at a conference in Havana on pest management focussed on successful research results with such nonchemical alternatives as the use of ants and *Trichogramma* wasps for biological pest control (Seminario, 1987) Cuba was already using some of these methods commercially

Cuba's leaders were also growing disillusioned with the island's place in the international socialist division of labor Feeling that development could go only so far based on light industry and raw agricultural exports they decided that technological expertise would soon be the world s most valuable commodity In 1982 official research policy began to favor this outlook Over the rest of the decade, $12 billion was invested in developing human capital and infrastructure in biotechnology, health sciences computer technology, and robotics The long term plan was to change Cuba into a purveyor of technology scientific consulting and quality health services (Rosset and Benjamin 1994a)

These early investments in advanced technology and research into agricultural alternatives have become Cuba's crucial tools for confronting its current agricultural challenge Melding expertise in biotechnology and alternative technologies with traditional peasant knowledge innovative responses are being brought to bear on the crisis (Rosset and Benjamin, 1994a)

TAKING UP THE CHALLENGE

The Cuban government's effort to convert the nation's agriculture from a high input system to low input self reliant farming practices stresses input substitution, soil recovery, the liberalization of prices and land reforms Although no figures are available, numerous interviews and personal observations indicate that by mid 1995 the vast majority of Cubans no longer faced drastic reductions of their basic food supply

Input substitution in the Cuban case means replacing chemicals with locally produced biological substitutes biopesticides, natural enemies of insects, resistant varieties, crop rotations, microbial antagonists, cover cropping, and the integration of grazing animals to restore soil fertility Chemical fertilizers have been replaced by biofertilizers (microbial products) earthworms and compost, other organic fertilizers, natural rock phosphate zeolite, animal and green manures, and other soil amendments (Ministerio de Agricultura, 1995, Vazquez Vega et al , 1995, Rosset and Benjamin, 1994a, Dlott et al , 1993, Gesper et al , 1993, Shishkoff, 1993) With some favorable results, native oxen, and other animals are replacing tractors idled by shortages of fuel, tires, and spare parts (Rosset and Benjamin, 1994a, Rosset, 1994)

The second major focus has been on the recovery and restoration of farmland damaged by decades of intensive Green Revolution technology (Rosset and Benjamin, 1994a, Gesper et al , 1993) Efforts are afoot to restore soil structure and fertility through conservation tillage, contour plowing cover cropping, the incorporation of biomass and biologically active forest soils and other means Though accelerating these efforts have probably not yet had a chance to have a wide impact

NEW TECHNOLOGIES

Cuba's biological control program, based on mass reared parasitoids, began well before the agricultural crisis The oldest successful program dates to 1928 and involves use of the parasitic fly *Lixophaga diatraeae* (Tachinidae) in nearly all sugar cane areas to control the cane borer (Rosset and Benjamin 1994a) Since the early 1980s, parasitic wasps in the genus *Trichogramma* have been released to control Lepidopteran pests (principally *Mocis latipes)* in improved cattle pasture More recently, *Trichogramma* has been used to control *Heliothis* spp in tobacco and tomatoes as well as pests of cassava and other crops

Another major biological success was achieved on sweet potatoes a staple in the Cuban diet Efficacy rates of up to 99 percent were obtained by releasing reservoir raised predatory ants *(Pheidole megacephala)* to control *Cylas formicarius* the sweet potato weevil Production costs were also lower, and yields higher, than with chemical controls (Castiñeiras et al , 1982) As a result, the Ministry of Agriculture has banned all chemical insecticides from these fields, and permission from the Ministry is needed to use other pesticides to control any other pests Recent applications have consisted of such biological insecticides as *Bacillus thuringiensis* or *Beauveria bassiana* The same method is being employed on plantains to control the black plantain weevil *(Cosmopolites sor* *didus)* using *P megacephala* and *Tetramorium guineense* (Dlott et al , 1993)

In the production and use of entomopathogens Cuba has a big international lead Non toxic to humans, these bacteria , fungi , and virus caused insect diseases can be used for biological control Cuban researchers have found techniques for producing, harvesting, formulating, applying, and controlling the quality of various bacteria and fungi used in pest control (Diaz, 1995, Rosset and Benjamin, 1994a, Dlott et al 1993) For example, the bacterium *Bacillus thuringiensis* is effective against many Lepidopteran pests and on crops ranging from improved pasture to cabbage, tobacco, corn, cassava, squash, and tomatoes, as well as against the larvae of mosquitoes that carry human diseases The fungus *Beauveria bassiana* works against Coleopteran pests such as the sweet potato and plantain weevils, and other bacteria are used to control whiteflies

Cuba's first commercially produced biopesticide was the *Bacillus thuringiensis,* also available from multinational pesticide companies under the brands Dipel®, Thuricide®, Bactospeine®, and Javelin® The second biopesticide to be used on a large scale in Cuba *Beauveria bassiana,* is not generally available internationally

Table 1 summarizes Cuba's commercial biopesticide production In the Cuban literature, however, some confusion surrounds production levels of these products While Diaz (1995) cites national production of *Bacillus thuringiensis* in 1994 as 1,312 MT, Perez et al (1995) report production levels for the same year of 989,300 MT (Obtaining any figures at all is very difficult, owing both to the long standing reluctance of the Cuban government to release them and to post crisis cutbacks in data compilation and publishing)

TABLE 1 NATIONAL PRODUCTION FIGURES FOR BIOPESTICIDES IN CUBA (METRIC TONS)

Biological Control Agents	1993	1994
Insect Control		
Bacillus thuringiensis	1 381	1 312
Beauveria bassiana	718	781
Verticillium leucanii	191	196
Metarhizium anisopliae	120	142
Plant disease control		
Trichoderma spp	2 708	2 842
Nematode control		
Paecilomyces lilacinus	141	173

Source Beatriz Diaz Biotecnologia Agricola Estudio de Caso en Cuba paper prepared for presentation at the 1995 meeting of the Latin American Studies Association Washington D C 1995

Cuba also produces the fungus *Paecilomyces lilacinus*, which parasitizes *Meloidogyne* spp nematodes, and the fungus *Trichoderma* spp , now widely used as an antagonist of soil borne pathogens of transplanted tobacco seedlings (Table 1, Diaz, 1995, Shishkoff, 1993) In fact, Cuba may be the only tobacco producing coun try that no longer uses methyl bromide as a soil fumigant

PRODUCTION OF BIOCONTROL AGENTS

Decentralized "artisanal" production of biocon trol agents takes place at the Centers for the Production of Entomophages and Entomo pathogens (CREEs) the focal points of contem porary Cuban pest management efforts (Rosset and Benjamin, 1994a, Dlott et al , 1993) Though considered artisanal production, the CREEs are high tech by most standards By the end of 1994, some 222 CREEs had been built throughout Cuba to provide services to former state, cooperative, and private farm operations (Perez et al , 1995)

Each CREE produces a number of ento mopathogens as well as one or more species of *Trichogramma* spp depending on which crops are grown locally They are maintained and operated by local technicians with college degrees, two years of post high school vocation al training, or high school diplomas A typical CREE visited by the author produced *Bacillus thuringiensis, Beauveria bassiana, Metarhizium anisopliae*, and *Verticillium leucanii* One CREE also reared and released *Trichogramma* spp to control *Erinnyis ello* and many also made biofertilizers

One typical CREE employed four technicians with college degrees, four mid level technicians, and seven high school graduates—all of them children of the local cooperative s members This is probably the only place in the world where the sons and daughters of *campesinos* make modern biotechnological products for local use

This cooperative received a 10 year bank loan to construct and equip the center—a medium sized house with sterile microbiology type lab rooms and about a dozen autoclaves for steriliz ing equipment The center gave its products to the cooperative but sold them to neighboring farmers state farms, and co ops to cover salaries, make loan payments, and distribute pest control supplies (Rosset and Benjamin, 1994a)

The CREEs, which supply the local market, are part of a two pronged strategy for producing biopesticides (Rosset and Benjamin, 1994a, Dlott et al , 1993) The other prong, a network of brewers yeast factories supplies an industrial product to the high end market, former state farms, and large co ops producing for export

OVERCOMING INITIAL PROBLEMS

Cuba's initial efforts to marshall technology to surmount the economic crisis met with varied results At first, crop yields fell drastically throughout the country (Deere et al , 1994, Rosset, 1994) The highly ' technified" state farms have not recovered well from this drop off (Enriquez, 1994, Rosset, 1994, Rosset and Benjamin 1994a), but production in the private sector (roughly half cooperatives or CPAs and half individual *campesinos*), rapidly recovered and now exceeds pre crisis levels

For *campesinos*, farming with reduced inputs was not that difficult They are descendants of generations of small farmers with long family and community traditions of low input farming This point was made clear at a 1994 meeting of presidents of vegetable CPAs Almost every one said they had remembered such techniques as intercropping and manuring that their parents and grandparents used before the advent of modern chemicals Many also commented on the noticeable drop in acute pesticide poisoning incidents on their co ops since 1989

In several regions, the Ministry of Agriculture has used mobile workshops to help people rediscover traditional practices, bringing extension agents and farmers from various communities together to exchange information on methods that work (Rosset and Benjamin, 1994a) Government and university scientists affiliated with the non governmental Cuban Organic Farming Associations (ACAO, whose members also include farm managers and farmers) are studying these methods too, in many cases demonstrating their scientific superiority (Rosset 1994, *see* for example Garcia Trujillo y Monzote, 1995, Perez et al , 1995)

For state farms, adapting to low input technology was more challenging Worker productivity on these immense farms had been low long before economic crisis struck Organized into teams, workers prepared the soil in one area, planted another area, weeded still another, and later harvested altogether different fields The bond had been cut between the farm worker and the land In crisis state farms' unwieldy management units could not adapt to life without high inputs of technology (Rosset, 1994, interviews)

Even before the crisis in the late 1980s the government began an experimental program *Vinculando el hombre con la tierra* [linking people with the land] to recreate a worker land bond By making small work teams directly responsible for every aspect of production on a parcel of land, the system linked productivity to remuneration In pre crisis tests, this approach quickly led to enormous increases in state farm production but it was not widely implemented until later

In terms of technology, the scale effects of conventional chemical management differ greatly from those of low external input alternatives Under conventional systems, a single technician can manage several thousand hectares by "recipe" applications of fertilizers and pesticides Not so for organic farming A farm manager has to know the ecological heterogeneity of every square inch of soil to decide, for example, when to add organic matter and where to find pests and natural enemies' refuges and entry points This helps explain why the state cannot raise yields with alternative inputs and why only reconnecting farm workers with the land will

In mid 1993, then, the state was faced with a complex reality State farms had become unproductive white elephants while the private peasant sector had adapted handily This finding, coupled with the earlier success of *"Vinculando,"* suggested a way out In September 1993, Cuba began radically reorganizing production to create the small management units that effective organic farming requires mainly by forming cooperatives and privatizing production (Rosset 1994)

Thus, the *Vinculando* process culminated in 1993 with a Cuban government decree turning state farms into Basic Units of Cooperative Production (UBPCs), a form of worker owned enterprise or cooperative Management units are on the order of 80 hectares, compared to thousands in the former state farms On UBPCs small worker collectives lease state farmlands rent free in permanent usufruct Member elected management teams assign jobs, decide what to plant and where, and determine how much credit to use to buy inputs Although the state still owns the land and sets production quotas for key crops, the collectives own what they produce beyond the quotas

Since 1994, UBPCs have been allowed to sell their excess production at the newly reopened farmers' markets These markets give private farmers an outlet and price incentives to sell through legal channels rather than the black market Thanks to increased sales at these markets, acute food shortages had essentially vanished by mid 1995 (interviews)

The pace of consolidation of the UBPCs has varied greatly At some, the only change is that the old manager is now an employee of the workers, while others function as true collectives, at still other farms, groups of friends work small parcels of land It's too soon to tell what final shape the UBPCs will assume, alien ated farm workers cannot be turned into farmers overnight (Diaz, 1995, Rosset, 1994) Still, Cuban planners hope to duplicate on the former state farms the peasant sector's success with alternative technologies

KINKS IN THE PRODUCTION AND APPLICATION OF BIOPESTICIDES

The artisanal production of biopesticides in the CREEs and their use by farmers is an overall tale of success, but it has been neither easy nor problem free In 1994, for example, a shortage of glass jars for culture medium temporarily slowed production (Interviews) The key substrates, like rice chaff, used for producing these products were once considered waste products, but increasingly CREEs have to compete for these ingredients with the livestock sector, which is desperately searching for alternative animal feeds Serious quality control problems beleaguer the decentralized production system, which cannot easily control the microbial strains being reproduced

On balance, the differences among CREEs—levels of technology, training and motivation of the employees, and marketing—are great The capacities and motivations of farmers also vary, especially between former state farm UBPCs and the original peasant sector In addition, many farmers still have a Green Revolution mindset and overuse many biological products that work without repeated, frequent sprayings (Diaz 1995)

Clearly 'consciousness raising' among farmers is needed and kinks in the production process used by different CREEs still need attention The eventual impact of factory produced biologicals on sales of CREE produced products also remains in question

THE ROLE OF COLLABORATION AND LINKAGES

Despite the current unpopularity of central planning, the highly organized nature of Cuban society and pre crisis coordination greatly facilitated the collaboration needed to develop and bring new technologies on line quickly enough to stave off famine (Rosset and Benjamin, 1994a) Few countries could have done as well

In the early 1980s, the Cuban National Academy of Sciences formed an inter institutional working group called the Frente Biologico (Biological Front) to spearhead new biological technologies for use in the medical and biological sciences It brought various research centers together in a major push to make Cuba a world player in biotechnology Although oriented primarily toward public health the Frente Biologico was the progenitor of the Frente Bioagricola (Bio agricultural Front) formed by the Academy during the trade crisis in 1990 The Academy, now known as the Ministry of Science, Technology, and the Environment (CITMA), coordinates and provides some funding for basic and applied research throughout Cuba (Diaz, 1995)

The Frente Bioagricola brings together 36 institutions and serves as a forum for creating research policies, agendas, and priorities and for assuring inter institutional collaboration Its work is divided into seven subprograms for biofertilizers, biopesticides, tissue culture mol ecular genetics, germplasm, artificial seeds and disease diagnostics Each subgroup is led by a key institution in that field According to Diaz (1995), this organization and coordination was crucial to "obtaining and rapidly generalizing scientific results that contributed to raising national food production and substituting for the agriculture inputs that were once im ported " Furthermore, says Diaz, the "key' to the differing success rates with various tech nologies was 'not just the intrinsic quality of research results, nor how finished the product was but rather the existence or non existence of organizational structures and productive installations "

Another long standing aspect of the organiza tion of agricultural research in Cuba has guar anteed a tight link between topics investigated and the productive sector s needs A very large percentage of agricultural research is funded by contracts from state owned production units to university, ministry, or Academy of Science research centers (Tinelfe Perez, interview, 1988) With the dissolution of the state farm sector, what sort of research apparatus will now evolve remains to be seen

LESSONS STATE SUPPORT LINKAGES and FARMERS' CHANGES

In terms of applying research results in the field central organization has unquestionably played a key role First, the allocation of scarce inputs to various crops and geographical areas is centralized Second once technologies have been proven' to the satisfaction of central authorities their dissemination through nation al extension services is almost instantaneous (Rosset, 1994, Rosset and Benjamin, 1994a, interviews), in fact, it often occurs before researchers have full confidence in their own inventions This speedy process has magnified both successes and errors The CREEs number among the successes, but the failed use of alter native pasture rotation was one of the errors (Enriquez, 1994, Rosset 1994)

The downfall of centralization on the other hand can be seen in the failure of the state farms to adapt Yet this failure reflects overly large *management* units—the large scale mono cultures of export crops—as distinct from large scale *planning* units One challenge facing Cuba is to achieve the best of decentralized manage ment while retaining the best of central planning (Rosset and Benjamin, 1994a, Levins, 1993)

The break up of the state farms was a result of lessons taken to heart Another truly significant change is taking place in the way Cuba's agricul tural establishment views individual peasant farmers Once considered a national embarrass ment a remnant of a backward past, peasant farmers are emerging from this crisis with their image revamped by their agile response Agricul tural researchers increasingly value the peasant farmers' traditional knowledge Roberto Garcia Trujillo founder of ACAO and a highly placed researcher and research manager himself, says 'It may seem like food comes from a factory, but in reality it comes from a culture that, generation after generation, has been created to produce that food (quoted in Rosset, 1994)

In fact the rediscovery and attempt to recap ture farmers traditional knowledge and to rein state practices of low input agro ecologically sound agriculture may be the most remarkable features of the new farming picture in Cuba As part of the new national program launched by the Ministry of Agriculture, farmers can trade farming secrets and share them with researchers and government officials at mobile seminars and workshops around the country (Rosset 1994) Other national ventures encourage farm ers to save seeds from local varieties and to col lect local peasant varieties or cultivars of crop species, legumes, and even cattle breeds The peasants' union, the National Association of Small Farmers (ANAP), also promotes farmer to farmer exchanges of technology Cuban researchers seem ready to move toward the "farmer first" school (Chambers et al , 1990) "Cuba is carving out a path back from the de skilled work process of large scale industrial farming, toward a more human endeavor, engaged equally with traditional knowledge and modern ecological science " (Rosset, 1994)

FURTHER TECHNOLOGICAL CHANGE

Despite progress toward resolving the crisis, various symptoms continue to plague Cuban agriculture Yields of nonfood crops, such as sugar remain well below pre crisis levels (Ros set, 1994), and pest and disease outbreaks per sist Although proven effective against insect pests, biopesticides must be used at the right place at the right time—difficult if, for instance, a shortage of glass jars interrupts production

Why do such problems persist? Neither input substitution nor soil conservation reach the underlying cause of Cuban agriculture's vulner ability—extensive monoculture, specialization, and the decoupling of crop and livestock opera tions In contrast to monocultures, diverse sys tems based on intercropping suppress pests They are also more productive per unit area, and they create more favorable conditions for cycling nutrients and maintaining a healthy soil biota (Altieri and Rosset, 1995) The main waste product of each subsystem is a key input for the other—manure as a fertilizer and crop residues as forage (Garcia Trujillo, 1994)

ACAO the Cuban NGO mentioned earlier, is the main policy force pushing for the next step toward integrated agro ecological production systems, which would reduce dependence on off farm inputs of any origin, Cuban or foreign (Garcia Trujillo, 1994) ACAO works directly with peasant cooperatives eager to take this step, and it educates and lobbies policy makers researchers extension agents, farmers, farm managers, and the general public through courses, seminars, television programs, and other activities

With funding from the United Nations Devel opment Programme (UNDP) and technical assistance from the UNDP Sustainable Network and Extension (SANE) program and the Insti tute for Food and Development Policy (Food First), ACAO is developing "agro ecological lighthouses" in four co ops (SANE, 1994) As additional funding comes through, more light houses will be started as centers for alternative development throughout Cuba

ACAO has palpably affected researchers Many recent publications have reported on the efficacy of intercropping (for example Perez et al , 1995) and on the integration of crops and animals in diverse agro ecological production systems (Garcia Trujillo and Monzote 1995) By mid 1995, intercropping had proliferated throughout the country Still less common than monoculture intercropping is nonetheless a dominant mode of production for some peas ants and CPAs, and it is catching on in the UBPCs as well

What future economic changes in Cuba will mean for the movement toward alternative agri culture remains far from clear, but if the trade crisis has a silver lining it is the melding of socialist values with environmental awareness and greater individual responsibility (Rosset, 1994)

As for what other countries in Latin America and the Caribbean can learn from Cuba's experience, one lesson is that food self sufficiency can be achieved without Green Revolution technology Specifically, what is needed are fair farm prices, land tenure based on small management units, and strong government support for alternative agro ecological technology Farmers' markets, the break up of the State farm sector and an economic blockade helped achieve these factors in Cuba However, in other countries, relative trade protection—instead of a trade crisis—could increase domestic crop prices, and agrarian reform could substitute for the break up of the state farms High taxes on agrochemical inputs also can induce farmers to use alternative technology Another key lesson is the need for both decentralized management units *and* for inter institutional cooperation in planning

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NICARAGUA EXPERIENCES WITH IPM IN THE CATIE INTA/IPM PROJECT

BY THE MESOAMERICAN INFORMATION SERVICE FOR SUSTAINABLE AGRICULTURE (SIMAS)

TRANSLATED BY SERGIO KNAEBEL
APPENDED BY CHARLES STAVER
CATIE

Nicaragua is renowned for both its historical problems with the overuse of pesticides and its strong efforts to develop IPM over the last three decades Among its several programs for overcoming pesticide dependency is the CATIE INTA/IPM Project initiated in 1989 by the Tropical Agricultural Research and Higher Education Center (CATIE), working with the Agricultural Technology Division of the Ministry of Agriculture and Agrarian Reform Begun in the late 1980s to develop IPM for nationally prioritized crops with high pesticide use, the partnership was gradually diversified to include universities and NGOs and other agricultural projects The IPM program has reached a large number of farmers through on farm technology development and participatory training related to farm decisions Its story affords useful insights about a dynamic process and the challenges of expanding IPM through collaborative activities

BACKGROUND CONTEXT

Nicaragua's producers ran into serious ecological, economic, and health problems from overusing agrochemicals, especially in the large cotton sector during the 1960s and 1970s Recognition of the crises sparked attempts by international and national programs to reduce pesticides and to introduce new IPM methods In the 1970s for example the Universidad Nacional de Nicaragua Leon (UNAN Leon) and the U N Food and Agriculture Organization promoted pest scouting and management in cotton The German government also financed and advised an IPM program for suppressing the boll weevil, a major cotton pest In the 1980s CARE sponsored health monitoring and "safe pesticide handling in the cotton growing area and later worked with smallholder maize farmers on IPM The Panamerican Agricultural School in Zamorano, Honduras field tested IPM approaches in melons, onions and other agroexport crops in Nicaragua To varying degrees, all of these efforts have helped reduce pesticides and raise interest in alternatives, but much work is still needed to strengthen the impacts of IPM—a challenge accepted by the CATIE INTA project and others

Nicaragua's IPM initiatives have been carried out in a complex and changing national context Throughout much of the 1980s, the Nicaraguan government supported innovative approaches to pest management while at the same time heavily subsidizing farm credit and pesticide use Such use was excessive until 1987 when tighter monetary policies led to higher pesticide prices and tighter credit These policies were accentuated by structural adjustment measures instituted in 1990, primarily to the benefit of big businesses and commerce On the other hand, the small and mid size businesses and agricultural producers that make up most of the economy have struggled to hold their own against the forces of unstable land tenure, credit restrictions, high interest rates, and extreme market liberalization

These conditions, particularly higher pesticides costs, have motivated small and medium producers to try new agricultural practices that are less costly But they also came in tandem with personnel reductions in many fields related to IPM By some estimates more than

13,000 government workers, including many in the agricultural sector, have lost their jobs

Government restructuring has also involved the reorganization of state agencies linked to agriculture For example, the National Center for Plant Protection, the state institution responsible for IPM research, was severely downsized in 1992 and 1993 In 1994, IPM technology development was shifted to the National Institute for Agricultural Technology (INTA) These institutional shifts influenced the IPM projects' decisions on priority crops and terms of collaboration They also encouraged the diversification of work on institutional development for IPM as well as technology transfer

THE CATIE INTA PROJECT METHODS AND IMPACTS

CATIE is a research and educational institution of Central American member nations, and its IPM project in Nicaragua ranks among its largest in the region INTA, the current official project counterpart is an agricultural development agency that works with small and medium producers

The CATIE project goal is to strengthen Nicaragua's capacity to generate and promote IPM technologies using ecological and biological approaches that fit small producers' pocketbooks and ways of life Initially, the project had three components Research focussed on identifying appropriate alternatives and concepts for pest management of priority crops Training provided scholarships for Nicaraguans in masters programs at CATIE and UNAN Leon, as well as short courses (seminars, talks, workshops) on IPM for technical personnel Technical assistance provided collaborating institutions with advice on diverse crops and pests Recently, the project has stressed the methodological, institutional and human resource development needed to spread IPM in the field The government reorganization also led CATIE to develop links with non governmental organizations schools and technical institutes and other entities thus increasing the number of participants

Initially, the project focussed on coffee, tomato, bananas, soybeans, cotton, and cabbage Work has continued with tomato, cabbage, coffee, plantains, and green bananas and now also covers maize, beans, potatoes, and sesame A resident staff of four international and seven Nicaraguan IPM specialists is supported by Scandinavian donors, primarily Norway

For 30 months (1989–93), the project followed the initial design and built on CATIE experience with an IPM network in other countries in the 1980s A key study on farmer participation in IPM technology development was also conducted in this period It revealed the need for a "learning by doing" approach, so for the next two and a half years, the project developed innovative methods and procedures for working with farmers and institutions, as it continued to develop IPM technologies By 1994, the project emphasis shifted from technology transfer to strengthening the decision making capacity of farmers and technicians through participatory training In the final year (also the start of a new four year funding period) the focus has been on having broader impacts on institutions, technicians, and farmers

One major achievement of the CATIE INTA/IPM Project has been the development of innovative approaches for sustainable IPM implementation based on inter institutional coordination and the direct involvement of producers Producers themselves help prioritize their pest problems and identify technological options suited to their conditions thus creating the focal points for planning and collaboration between technicians and specialists (*See Figure 1*) Institutions, farmers, and technical staff interact regularly and frequently in farmers' fields and share responsibilities As for out reach and education on IPM, the project has developed links with more than 30 institutions and national projects, including non govern mental and state institutions This innovative approach has special value for a country with limited resources and diverse interested organi zations (*See Appendix 1*)

To generate and spread IPM technology, the CATIE INTA/IPM Project also developed a con ceptual framework that goes beyond the conven tional practice of IPM Rather than trying to make pesticide use more efficient through pest monitoring and chemical applications keyed to economic thresholds, the program promotes alternatives to pesticides A further step is ecosys tem redesign to reduce pest problems by making the environment less susceptible to pests (*See Table 1*)

Implementing this three part approach involves (1) generating a preliminary IPM pro posal based on knowledge about the ecology and biology of pests, a given crop and the ecosystem, (2) collaborating with producers and technicians to evaluate and modify the pro posed option in farmers' fields, and (3) develop ing materials for participatory training for IPM technicians and producers (*See Figure 1*) Tech nical staff and producers work together and share the lessons of the process often through farmer to farmer and technician to technician communication (*See Figure 1*) Since 1992 the development of this model has been based on the formation of inter institutional and inter disciplinary workgroups, the incorporation of producers in the development and validation of IPM and the formation of a National IPM Forum

Inter-Institutional Working Groups

Working groups were established to bring to gether diverse institutions, projects, producers, and NGOs interested in improving integrated pest management for a specific crop During the project, twelve IPM working groups have been formed to focus on tomatoes, plantains, micro bial control, white fly, purple nutsedge coffee weeds plant pathology coffee entomology, food grain crops cabbage, coffee, and INTA IPM Nine of these groups are semi active, and one has been temporarily suspended

Initially, to develop each working group, spe cialists and technicians who work on IPM of a specific crop meet to share information, achieve ments, and plans With time, participants begin to coordinate actions, and some collectively seek technical or financial assistance on IPM from within or outside the country

The workgroup structure allows permanent contact among national institutions and enables participating groups to share ideas on IPM With it, members can readily coordinate plan ning and institutional actions, each assuming responsibilities according to their capacities and resources

Participatory Field Groups

The project joined forces with field techni cians from interested organizations to work with farmer groups on IPM Over 2 000 farm ers have been involved in these field groups, which identify plant protection problems and goals, select possible IPM control options to be tested, run comparison plots to be main tained by a volunteer farmer, and collect data on the results of the trial During critical times in the season, meetings are convened to evalu ate data and modify procedures At the end of the cycle farmers and technicians together

FIGURE 1 | METHODOLOGICAL MODEL FOR VALIDATION AND TRANSFER OF IPM CATIE INTA/IPM PROJECT

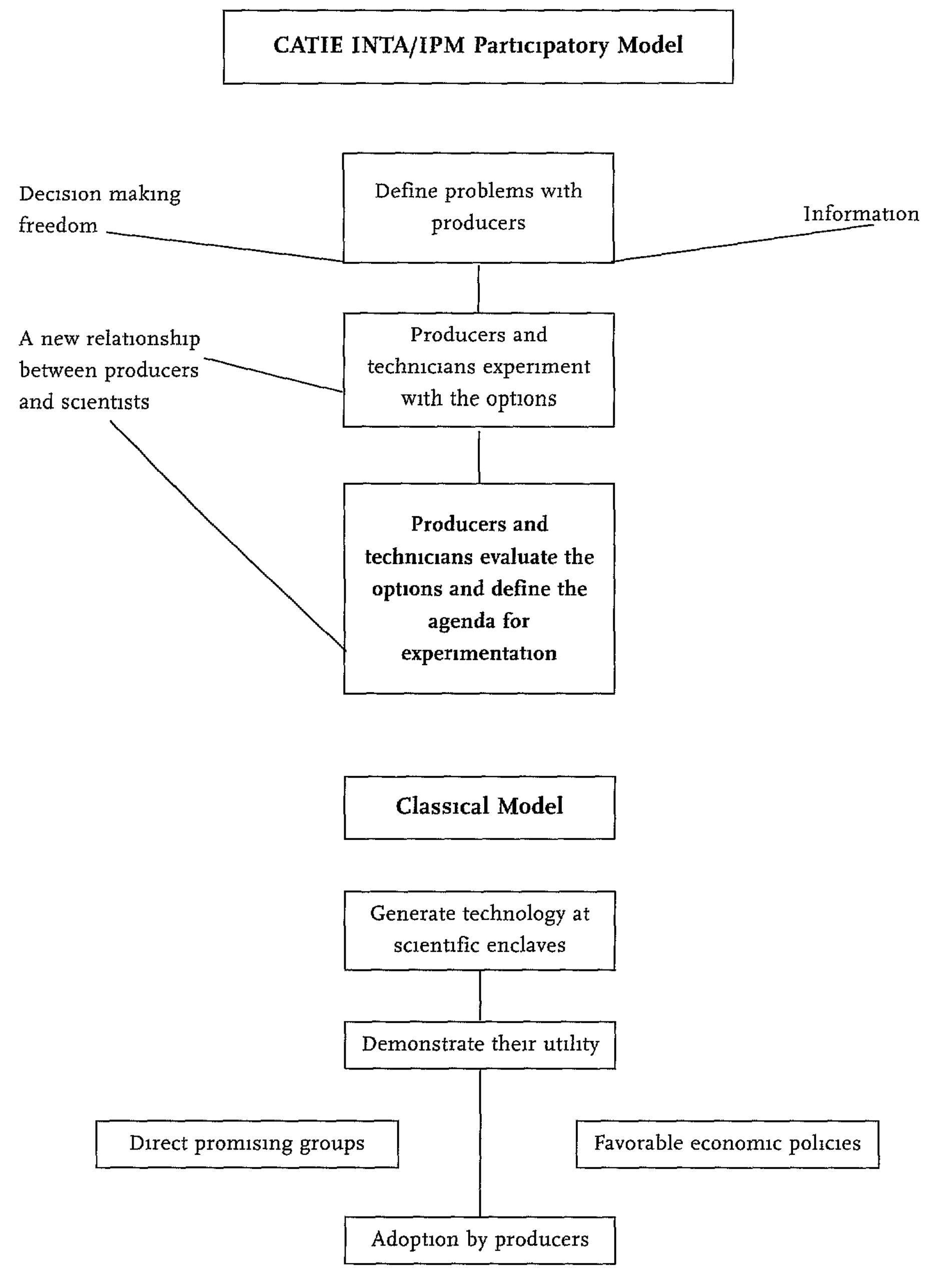


TABLE 1 | CONCEPTUAL MODEL OF INTEGRATED PEST MANAGEMENT CATIE INTA/IPM PROJECT

Stages of Pest Management

Conventional	pesticides are main tactic for pest control
Stage 1 IPM	more efficient pesticide use through scouting and threshold monitoring
Stage 2 IPM	use of biologically based products as substitutes for pesticide
Stage 3 IPM	agro ecological redesign of production systems to avoid pest problem

	Conventional System	Sustainable System
Sites	Experimental Centers Practice in model farm estates	Producers fields
Actors	Researchers Scientists Single discipline experts	Producers Scientists Multi disciplinary experts Technicians
Decision Makers	Scientists Consultative process with producers	Producers with scientists
Criteria	Reduction of pests and pest damage Reduction of costs Reduction of environmental pollution Profit maximization	Sustainability Risk reduction Capacity of producers to make better pest management decisions Capacity of technicians to facilitate better pest management by farmers

evaluate the results and plan for the next crop cycle

The technicians from each region also meet separately as a group to review work procedures get additional training, and plan activities before meeting with farmers Technicians often need training beforehand in ecologically based IPM and participatory methods

These participatory groups allow producers to participate in the generation and validation of technology and to put their needs and interests at the heart of the process of developing IPM techniques Working in field groups also permits balanced interaction among producers and technical staff in pursuit of a common goal It helps increase producers' acceptance of the methods and brings local knowledge into play

National IPM Forum

In 1992, project evaluators called for greater attention to influencing policy makers and understanding the impact of policies on IPM The project then established an innovative national forum on IPM to exchange information among state and civil organizations and to discuss related critical topics Four national forums on IPM have been held—one on the need for inter institutional cooperation for IPM, one on teaching plant protection in universities, and two on the CATIE INTA Project and its second phase

Although the participating institutions agree on the need for better communication among themselves, the forum results have not been satisfactory Unrelated circumstances sometimes postponed meetings, and lead institutions were being reorganized and are understaffed The challenge now is to design an event that attracts more participant interest and complements mechanisms promoted by individual institutions

Collaborative Research

The CATIE project team conducts research on priority crops, pests, and promising technologies, often on farmers' fields All preliminary results feed into the technical discussion with participatory field groups Research is focussed principally on testing the biological and ecological viability of practices Institutional research collaborators are sought as needed, but CATIE staff picks most research themes This decision making power has sometimes frustrated potential partners, and an important need is to strengthen the inter institutional working group for research and budgeting, as well as to fortify links to the field groups

Additional Training and Educational Materials

The project has generated a tremendous amount of information about IPM in Nicaragua This information has been disseminated through short training courses, conferences, direct technical assistance, national and regional scientific meetings and various publications In 1995, the CATIE project began to develop one day workshops on various crops for field staff who need to know the ecological basis for pest management of a crop and the basic scouting procedures The staff also developed a workshop on promoting farmer participation in IPM implementation, the idea is to help technicians develop skills for participatory training and to facilitate discussion and teamwork with local people Long immersed in more conventional approaches to pest control technical personnel need help learning to ask questions and listen to farmers, to draw on local sources of knowledge, and to motivate farmer groups

Impacts on Adoption

The project's impacts on producers have yet to be quantified The project has not systematically monitored such key indicators as the rate of adoption of IPM levels of learning of agro ecological principles, changes in agricultural practices, or impacts on human health Available evidence indicates that IPM adoption has varied from crop to crop and has been particularly high in vegetable farming IPM techniques for tomatoes, a management intensive crop, have been the most widely accepted by producers Coffee farmers are also committed when the prices are high, though many return to using pesticides when the prices of inputs or crops change

Information on the financial viability and economic impacts of IPM is also lacking though the project conducted a few preliminary cost studies Since most IPM techniques are low cost and accessible to poor farmers, the CATIE project has emphasized direct work with farmers as opposed to extensive economic analysis by experts However, as the project expands so does the need to monitor and measure economic impacts

CONSTRAINTS AND CHALLENGES

Progress has not always been smooth Shifts in national political economic conditions have caused problems, as have internal institutional weaknesses

- Due to state re organization and budget cuts government institutions are in flux and don't have the human, technical, and financial resources needed to participate fully in programs
- Scientific research is a low priority in Nicaragua Qualified personnel are leaving, labs and other infrastructure are lacking and budgets have been reduced
- NGOs compete for donor financing, which works against NGO collaboration
- Directors, supervisors, specialists, and field staff are not accustomed to working with other institutions and farmers and need to strengthen their collaborative work habits
- Participants' supervisors who don't understand the purpose of the groups can view them as a waste of time or a challenge to their authority
- Work groups depend on CATIE's leadership and funding for operating expenses
- CATIE has not always given groups the chance to discuss their own research proposal
- Working groups are not well linked to participatory field groups
- There may be too many groups (The tomato and cabbage groups, for example, have many of the same members)
- Working group meetings may be too time consuming, especially for specialists, and the meeting purpose isn t always clear enough to warrant their participation

As noted, the lack of data on impacts is another important weakness of this IPM project Quantitative information would improve the outreach and credibility of IPM methods, and plans are underway to fix this problem

Although members of the inter institutional working groups in the CATIE Project exchange findings and make plans, the groups haven't adequately linked their efforts to farmers' field activities Likewise, though the farmers' groups have positive effects, the project has not systematically promoted the participation of farmers' groups in all areas Project results have been slow to find their way into the university teaching curriculum even though the project itself has prepared educational materials for students The staff has recognized these gaps and plans to redress them in coming years

An overriding limitation faced by the project was the reorganization and down sizing of state institutions from 1990 through 1993—moves that made collaborative ties with state counterparts hard to form Moreover, Nicaragua has no general agricultural research policy Reacting to these constraints, the CATIE project strengthened its partnership with NGOs But though most were eager to collaborate, few had the necessary technical capacity Indeed both state institutions and NGOs have been somewhat unreliable partners in fieldwork Both often failed to prioritize fieldwork or keep commitments with farmers Further, technicians were often assigned other tasks that conflicted with work on IPM, and programs were sometimes terminated on short notice

Some of these weaknesses arose because supervisors and directors at state institutions resisted changes in field methods imposed from outside So far, the CATIE project has not found ways to involve middle and upper level managers, who are potential allies

CONCLUSIONS AND LESSONS LEARNED

The CATIE INTA/IPM project in Nicaragua has enjoyed six years of stable and significant funding from a non interventionist donor, as well as a highly qualified and experienced international and national staff The project's learning approach to implementing IPM permitted flexibility and continual readjustment in activities and planning—critical in a fluctuating policy and economic environment A cornerstone of this successful approach has been interaction among various actors at all levels

- rural families with the knowledge, abilities, and experience to validate, modify, and use improved IPM practices,
- extensionists trained to work with producers in a participatory way,
- national specialists with the capacity to work jointly with scientists from within and outside the region and with technicians and producers in the field,
- plant protection study programs with an ecological focus for technical schools and universities,
- government officials and authorities able to formulate policies that promote IPM as part of sustainable agricultural development, and
- regional and international links and networks for exchanging information and coordinating IPM

The CATIE INTA Project team visualized these factors as the staves of a water barrel The height of the water—the national capacity to implement IPM in the field—depends on the height of the shortest stave

The development and implementation of IPM have been interactive In this *process based* approach, initial diagnosis and training are followed up with repeated field activities, discussions and experiments with farmers In this way both farmers and technicians learn to understand the possible benefits and drawbacks of new techniques

Work with *farmer groups* has shown that farmers have the motivation skills, and analytical ability to learn and develop IPM methods Effective partnerships with farmers require a solid technical basis and a mutual learning approach to improve decision making skills Farmer training should be characterized by regular and frequent practice, discussion, feedback, and clear connections to local needs

The CATIE project identified early the importance of farmer participation in technology generation but members were slow in learning how to work with farmers for widespread IPM implementation in the field, and it did not take advantage of innovations springing from other projects (such as those in rice production in Asia) Furthermore, though women farmers took part in some field groups, the project has not devoted resources to understanding gender issues in IPM adoption Fortunately lessons are now being learned and applied, and CATIE staff plan to hire a social scientist, which should help

The project staff has also realized that *field technicians* play an important role as facilitators with farmer groups and symbolize institutional commitment to the community However, field staff need more training to learn how to use this approach

Attention is also needed to strengthen relations and partnerships with *state institutions and NGOs* to overcome tensions and merge efforts more effectively Certain institutional changes in the government are largely outside the control of IPM practitioners, but collaboration can help develop new stable programs The interinstitutional working groups in this project, for example, allow participants to exchange findings and plan research on a certain crop or pest Yet IPM applications can't expand or last if these groups don t link more effectively with farmer working groups

Over the long term, a national capacity for generating sustainable agricultural technology and for promoting its widespread use among ordinary farmers needs to be developed With a project lifespan of almost a decade, the CATIE INTA/IPM project will have made important contributions to this process in Nicaragua But much more work is needed to multiply the advances made so far and to develop similar and improved approaches for other crops

APPENDIX 1 | GOVERNMENTAL AND NON GOVERNMENTAL ORGANIZATIONS INVOLVED IN IPM IN NICARAGUA

GOVERNMENTAL

1 Estacion experimental del Valle de Sebaco (EEVS)
2 Comision de Vegetales
3 Comision Nacional de Proteccion Vegetal (CENAPROVE)
4 Universidad Autonoma de Nicaragua (UNAN)—Recinto Leon (UNAN Leon)
5 Escuela de sanidad vegetal (ESAVE) de la Universidad nacional agraria (UNA)
6 Centro experimental campos azules
7 Ministerio de Agricultura y ganaderia (MAG)
8 Instituto Nicaraguense de tecnologia agropecuaria (INTA)
9 Estacion experimental El Recreo
10 Banco Nacional de Desarrollo (BND)
11 Centro de estudios tecnico agropecuarios La Borgoña (CETA)
12 Centro experimental del algodon (CEA)
13 Escuela de agricultura y ganaderia de Esteli (EAGE)
14 CATIE Turrialа
15 Direccion general de tecnologia agropecuaria (DGTA)
16 Centro experimental de Esteli (CEE)
17 Centro de investigacion nacional de granos basicos (CNIGB)
18 Centro experimental del cafe del Norte y Pacifico

NON GOVERNMENTAL

1 Empresa Valle de Sebaco
2 Movimiento ambientalista nicaraguense (MAN)
3 Union Nacional de agricultores y ganaderos (UNAG)
4 Comision Nacional del Cafe (CONCAFE)
5 Asociacion de diversificacion agricola y desarrollo comunical (ADDAC)
6 Consejo nacional de apoyo a la investigacion del cafe (CONAIC)
7 Centro de investigacion para estudios sociales (CIPRES)
8 Centro de promocion y asesoria en investigacion desarrollo y formacion para el sector agropecuario (PRODESSA)
9 Empresa agropecuaria del cafe (AGROCAFE)
10 Confederacion universitaria de centroamerica (CSUCA)
11 Movimiento laico para america latina
12 Agencia de cooperacion alemana (GTZ)
13 Grupo de productoras—NORAD
14 CARE internacional en Nicaragua
15 Servicio de informacion mesoamericano para la agricultura sostenible (SIMAS)
16 Agricultores de platano de Rivas Carazo
17 Productores de tomate del Valle de Sebaco y Managua

PERU INTER INSTITUTIONAL COOPERATION FOR IPM

HUGO FANO OSCAR ORTIZ AND THOMAS WALKER

In Peru, increasing communication and interac tion among and within communities, extension and research institutions, and farmers are beginning to improve production of the potato, the main Andean staple crop Growing num bers of Peruvian potato farmers are using inte grated pest management (IPM) techniques to improve yields IPM information is reaching them through the joint efforts of the Interna tional Potato Center (CIP) and the Peruvian National Research Institute (INIA), which also work with national and regional non govern mental organizations (NGOs)

PERU'S AGRICULTURAL SYSTEM AND POLICIES

Peru's agricultural sector has changed frequently over the last 30 years From a closed, highly sub sidized system in the 1980s, it has evolved into a free market system As part of structural adjustment, the government cut farm subsidies and eliminated subsidized agricultural credit As the cost of pesticides and other agro inputs soared, the government tried to cushion the impact on farmers by changing agrarian reform laws allowing private institutions to invest in agriculture and creating a new agricultural cred it system It also created new institutions such as the Servicio Nacional de Sanidad Agraria (SENASA), that oversee pest and disease control

Bridging old policy gaps current agricultural policies address natural resource management and environmental issues The state's new col laboration with non governmental organiza tions is a reversal of a decades old perception of NGOs as competitors The government is also transferring some services such as potato seed production and extension services—to the pri vate sector, and farmers' organizations are run ning some experimental stations

NGO policies have also changed over the last thirty years (Carrol et al , 1991) Once politically focussed, NGOs today take a pragmatic approach, solving concrete problems in rural areas, and are increasingly involved in sustain able development initiatives After drastic cuts in the agricultural research, extension, and credit systems in the early 1990s, NGOs began to provide farmers with these services Today, they deliver more than 80 percent of all exten sion services Although uncommon in the past, inter institutional cooperation among research and extension institutions is growing to meet persistent demand from farmers facing serious problems (Bebbington et al , 1993)

DEVELOPMENT OF IPM FOR POTATOES

The International Potato Center (CIP) was established in 1971 to develop and spread knowledge about the potato and to promote its use as a food crop in other developing coun tries Despite the potato's long history and prominence in the diet, average regional yields have been lower than in industrial countries, partly because of pest related losses Early pest control research concentrated on key pests, especially nematodes (CIP 1975–1979) In the late 1970s CIP added insect control to its research agenda and in the early 1980s took up integrated pest management (IPM) after research had proven it a feasible alternative to heavy insecticides use During the 1980s CIP formed a partnership with INIA to research and adapt IPM methods

By the early 1990s, CIP's work with INIA to control potato pests had begun to pay off Inte grated pest management options for controlling the Andean potato weevil (APW) were devel oped and implemented in Chincheros, Cusco This was the first time that separately tested control components had been integrated and that IPM had been used on farms against this major pest (CIP, 1990–1993) This success and experiences in several other countries helped CIP define its strategy for managing potato pests—a strategy that includes new institutional partners (Cisneros and Gregory, 1994)

Since extension activities are not a part of CIP's mandate as a research institution, it has to find suitable partners to spread its research results Traditionally, CIP has worked with national agricultural research systems (NARS), but the government's fiscal crisis combined with NGO success in diffusion activities con vinced CIP to consider NGOs as partners Since 1992, CIP has made contact with several NGOs to help spread research results to farmers For instance, the CIP and CARE Peru joint project links the two institutions with complementary expertise to develop IPM in Puno, Ancash, La Libertad, and Cajamarca (Palacios et al , 1995a) Other agreements, some more formal than oth ers, are summarized in Table 1

THE IPM INFORMATION SYSTEM

The way IPM was popularized for use on Peru's potato crop shows how an effective agricultural information system works In this system farmers extensionists, and researchers freely interact and exchange information, and the sus tainability of research and extension depends on the strength and quality of the delivering institutions, as well as on socioeconomic and political factors Most of the IPM activities began with an informal exchange of informa tion through personal contacts in the field, but some of these interactions have become more systematic and formal over time

Structurally, the IPM information system on the potato crop consists of governmental and international institutions, NGOs, and farm ers' organizations Governmental institutions can be sub divided into research institutions (such as INIA), extension institutions (such as PRONAMACH and FEAS) and education al institutions (such as universities and agri cultural institutes) Of these, INIA is the only one with a formal agreement with CIP

NGOs are connected to CIP in various ways CARE is linked with a formal or semi formal agreement with CIP to carry out an IPM project (MIP Andes) with the support of the U S Agency for International Develop ment (USAID) TALPUUY works with CIP through Inter American Development Bank financing CIED and ARARIWA share costs with CIP Other NGOs have informal agree ments with CIP based mainly on training activities and personal contacts The farmer organizations involved can be subdivided into three types communities that work directly with CIP (pilot communities), those that work directly with an NGO that has a formal agreement with CIP, and those that work with NGOs without formal agreements with CIP

Meanwhile, other institutions with differ ent objectives—such as private companies with networks for selling insecticides—com pete with the IPM programs During the early years some local pesticide sales people for international companies participated in CIP training on IPM which includes promo tion of agrochemical use Yet, many pesticide companies have continued to run their own training courses with their own commercial objectives that are usually incompatible with IPM They remain outside the IPM informa tion system since their objectives are incom patible with IPM and their advice confuses

TABLE 1 **INSTITUTIONS WORKING ON DIFFUSING IPM ON POTATO CROPS IN PERU**

Institution	Status	Type of Activity	Place	Linkage Mechanism
CARE PERU	NGO	Diffusion of IPM for APW and PTM	Cajamarca La Libertad Ancash and Puno	Formal project with external financial support
Jorge Basadre	NGO	Diffusion of IPM for APW and PTM	Cajamarca	Informal work plan
EDAC	NGO	Diffusion of IPM for APW	Cajamarca	Informal training contact for promotores campesinos
CEDAS	NGO	Diffusion of IPM for APW and PTM	Cajamarca	Informal training contact for promotores campesinos
CEDEPAS	NGO	Diffusion of IPM for APW and PTM	Cajamarca	Informal contact for training activities to extensionists
Proyecto Jesus Universidad de Cajamarca	Governmental educational institution	Diffusion of IPM for APW and PTM	Cajamarca	Informal training contact for leaders of farmers
INIA (Ministry of Agriculture)	Governmental research institution	Research/diffusion of IPM for APW and PTM	Cajamarca Huancayo Cusco Puno	Formal agreement at institutional level
SERESA (Ministry of Agriculture)	Governmental institution	Production and diffusion of baculovirus	Cajamarca	Informal contact Independent activity
PRONAMACH (Ministry of Agriculture)	Governmental extension institution (Special project)	Diffusion of IPM for APW and PTM	Cajamarca La Libertad Ancash and Puno	Formal agreement with CARE with internal financial resources
FEAS (Ministry of Agriculture)	Governmental extension institution (Special project)	Diffusion of IPM for APW and PTM	Cajamarca	Informal agreement with CARE and PRONAMACH
Escuela Campesina	Governmental extension institution (Special project)	IPM diffusion	Cajamarca	Informal contact
TALPUUY	NGO	Diffusion of IPM for APW and PTM	Huancayo	Formal project with external financial support

TABLE 1 Continued

Institution	Status	Type of Activity	Place	Linkage Mechanism
Instituto Redes	NGO	First contact	Huancayo	none
CEAR	NGO	First contact	Huancayo	none
I S T Sausa Tanta	Governmental educational institution	First contact	Huancayo	none
IDET	NGO	First contact	Huancayo	none
C PPRU TALPUSHUM	NGO	First contact	Huancayo	none
IRINEA	NGO	First contact	Huancayo	none
Universidad Nacional del Centro	Governmental educational institution	Diffusion of IPM principles	Huancayo	none
ARARIWA	NGO	Diffusion of IPM for APW and PTM	Cusco	Semiformal work plan Internal financing
CADEP	NGO	First contact	Cusco	none
CEDEP AYLLU	NGO	First contact	Cusco	none
Guaman Poma	NGO	First contact	Cusco	none
SEMAR	NGO	First contact	Cusco	none
CERRGETYR	Governmental educational institution	First contact	Cusco	none
ISTEP U	Governmental educational institution	First contact	Cusco	none
CIED	NGO	Research/diffusion of IPM for leafminer fly	Arequipa	Semiformal work plan Internal financing
Universidad Nacional San Agustin	Governmental educational institution	——	Arequipa	none
IPAE AGRISUR	Private company	——	Arequipa	none

farmers who get different messages from IPM proponents

FACTORS INFLUENCING INTER INSTITUTIONAL RELATIONSHIPS

This case study focusses mainly on the relationship between CIP and four NGOs (CARE, TALPUUY, CIED and ARARIWA), and the four main factors which contributed to the success of these inter institutional relationships use of sound and validated technology, compatible objectives, institutional structures and institutional strategies

Sound and Validated Technology

Research results on any technology and users' perceptions of it can prompt institutional linkages In the 1970s and 1980s, CIP had been developing suitable technologies for controlling key potato pests (Alcazar et al , 1994) while NGOs were looking for new information to deal with farmers' pest related problems Through CIP, NGOs found technology options to cope with the problems caused by APW, PTM and LMF and by the indiscriminate use of insecticides CIP's views of technology development as a dynamic process needing constant feedback and adaptation to local conditions made collaboration with NGOs more attractive

Compatible Institutional Objectives

NGOs' rural development objectives often differ from research institutions' objectives Yet, in this context, CIP and NGO objectives overlap to a great extent *(See Table 2)* Both are interested in production and yield increases and in food security, sustainability, and human resource development

TABLE 2 COMPATIBILITY (+) BETWEEN NGO OBJECTIVES AND CIP MISSION

		CIP Mission			
NGO	**Extension Objectives**	**IR**	**CT**	**PR**	**FS**
ARARIWA	Increase farming production and productivity		+	+	
CARE	Increase food security			+	+
	Increase family incomes	+		+	+
	Promote sustainable agriculture	+	+	+	
CIED	Promote food security within an agroecological approach	+	+	+	+
TALPUUY	Develop farmers science and technology	+	+	+	

IR = interdisciplinary research **CT** = collaborative training **PR** = participatory research **FS** = research with a food systems approach

Despite important overlap in broad objectives however inter institutional priorities had to be focussed on local problems, such as a late blight (a potato disease) in the northern high lands Along with the personal commitment of individuals involved in IPM activities, address ing such local problems together has helped to make this alliance work

Institutional Structures

Traditionally, the collaborating groups had man aged independent projects But problems arose when outside participation was needed and when the planned activities had to take other institutions' objectives, goals, needs and resources, into account These institutional rigidities delayed communication and decision making in IPM implementation Because both CIP and NGOs had faced this problem, more institutional links were initially created through both personal contacts and negotiation between extensionists and scientists These links have turned into the driving force of inter institution al relationships The formal structure of the par ticipating institutions has not changed much, but temporary and informal changes have made it easier to plan and evaluate cooperative activi ties For instance, professional teams compris ing staff from various institutions can carry out interdisciplinary work Similarly, in the CIP CARE joint project, CARE had to give staff new roles and responsibilities

Institutional Strategies

While each institution defines its own particu lar strategy to respond to internal goals and structures, it also develops joint aims with other actors that have common interests The threat of potato pests, for instance brought NGOs together to address such issues as teaching farmers about IPM and strengthening farmer organizations

CIP's five phase strategy has emerged from its experience with research and extension pro grams in different parts of the world (Cisneros and Gregory 1994)

1 pest problem assessment based on technical data, farmers' perspectives and production system analysis

2 the development of management compo nents, based on the validation of field condi tions described in the literature by farmers and the development of new controls,

3 the integration of key management compo nents to ensure their ecological, agronomic, and socioeconomic compatibility with partic ular conditions,

4 implementation of IPM, through training activities and initial inter institutional con tacts in pilot areas to demonstrate IPM results to farmers and other institutions and to involve farmers in the evaluation of IPM components so as to come up with locally adapted menu of practices, and

5 large scale implementation with the participa tion of NGOs universities, rural schools and communities farmer organizations, the media and other institutions

At the final stage establishing inter institu tional linkages is key to success The analysis of the approaches for inter institutional coopera tion in this experience can help CIP and other similar organizations to learn how to "scale up' IPM technology and to use the lessons to dif fuse other technologies

CARE an extension oriented institution, based its strategy on disseminating IPM tech nology The MIP Andes project began with a proposal created by CIP and adapted by CARE

The project objectives, activities, staff, and resources were integrated into the CARE structure The staff aims to achieve the project objectives through an educational process for extension workers and farmers CARE handles extension activities, and CIP provides technical assistance for the project (Chiri et al 1995) Posters, pamphlets and videos are used to illustrate insect life cycles IPM practices and safety measures for handling insecticides The participatory training approach used for IPM diffusion has also influenced training approaches in other CARE activities, which include entrepreneurial activities, natural resource conservation, and family health and nutrition

IPM technology is much more information intensive than other types of technology Farmers, extension workers, and researchers need many types of information to make decisions This teaching and learning process has to be approached sequentially CIP's training methodology based on its evolving experience with IPM programs, has been adapted by NGOs to their own conditions and strategies creating in the process new IPM training techniques In 'sociodramas'—one such technique—farmers portray and give information about an insect s behavior at various developmental stages (egg, larva, pupa, and adult) Other new learning techniques include open competitions among farmers for manual collection of insects to provide incentives for efforts to hand pick pests and incorporating IPM information in traditional songs

The TALPUUY strategy attempts to influence the farming production level and to develop farmers' knowledge of IPM methods In it, high priority has been given to communication between extension workers and farmers and among farmers At this level, IPM's sustainability depends on the farmers capacity to tell other farmers what they have learned and on institutions' ability to coordinate interventions (Roling and van de Fliert, 1994)

The CIED strategy for IPM focusses on both participatory research and extension CIED staff has provided technical assistance and helped to organize small community groups to develop IPM methods and marketing services These groups, in turn have been used to expand training

The ARARIWA strategy draws on local experience to design a regional and national rural development approach and strengthens farmer organizations IPM is diffused through training as well

FIELD-LEVEL IMPACTS OF INTER INSTITUTIONAL COOPERATION

IPM diffusion through inter institutional cooperation influences farmers' knowledge, technology transfer, and economic conditions

Farmers' Knowledge

Enhanced farmer knowledge about insect life cycles and control practices has been the most important result of IPM dissemination through inter institutional cooperation Farmers used to think the larva was a different insect from the adult and directed control practices at only one stage Sometimes they used insecticides and sometimes such traditional control methods as insect repellent weeds and ash When insecticides were not available, farmers often abandoned potato fields or suffered large losses at harvest and during storage "We do not know where the worms come from" or, "when the worms come we cannot do anything" were common complaints

For most pests, farmers in the project now apply appropriate control methods at the right time (Ortiz et al 1995) Farmers' pool of con trol alternatives has also widened with the addi tion of new IPM practices or the modification of traditional ones Farmers prize their new knowledge, sometimes more than the economic benefits it confers However, the perception of the importance of knowledge varies with the type of insect and the type of production sys tem For example, in the case of the leaf miner, with its relatively short lifecycle and lack of clear cut developmental stages, it's more diffi cult for farmers to link appropriate control prac tices with their new knowledge about the natural cycle, so economic factors alone influ ence their decisions

Technology Transfer

The impact of IPM diffusion depends largely on how well research and extension institutions perform (Collinson and Tollens, 1994) An example is an information system for wide spread diffusion of IPM in Cajamarca in the northern highlands of Peru

IPM research and diffusion in Cajamarca began in 1992 in a pilot community, Chilimp ampa, to test the IPM menu developed in Cusco Here, farmers facing serious problems caused by the potato weevil were taught about the insect's lifecycle and behavior and were asked to help evaluate control practices The menu introduced from Cusco was adapted to local conditions, and a research and training methodology was developed This pilot commu nity became a demonstration center for teach ing IPM, and its farmers have been in charge of training activities at several field days, where information was diffused to other farmers and extension workers from different institutions

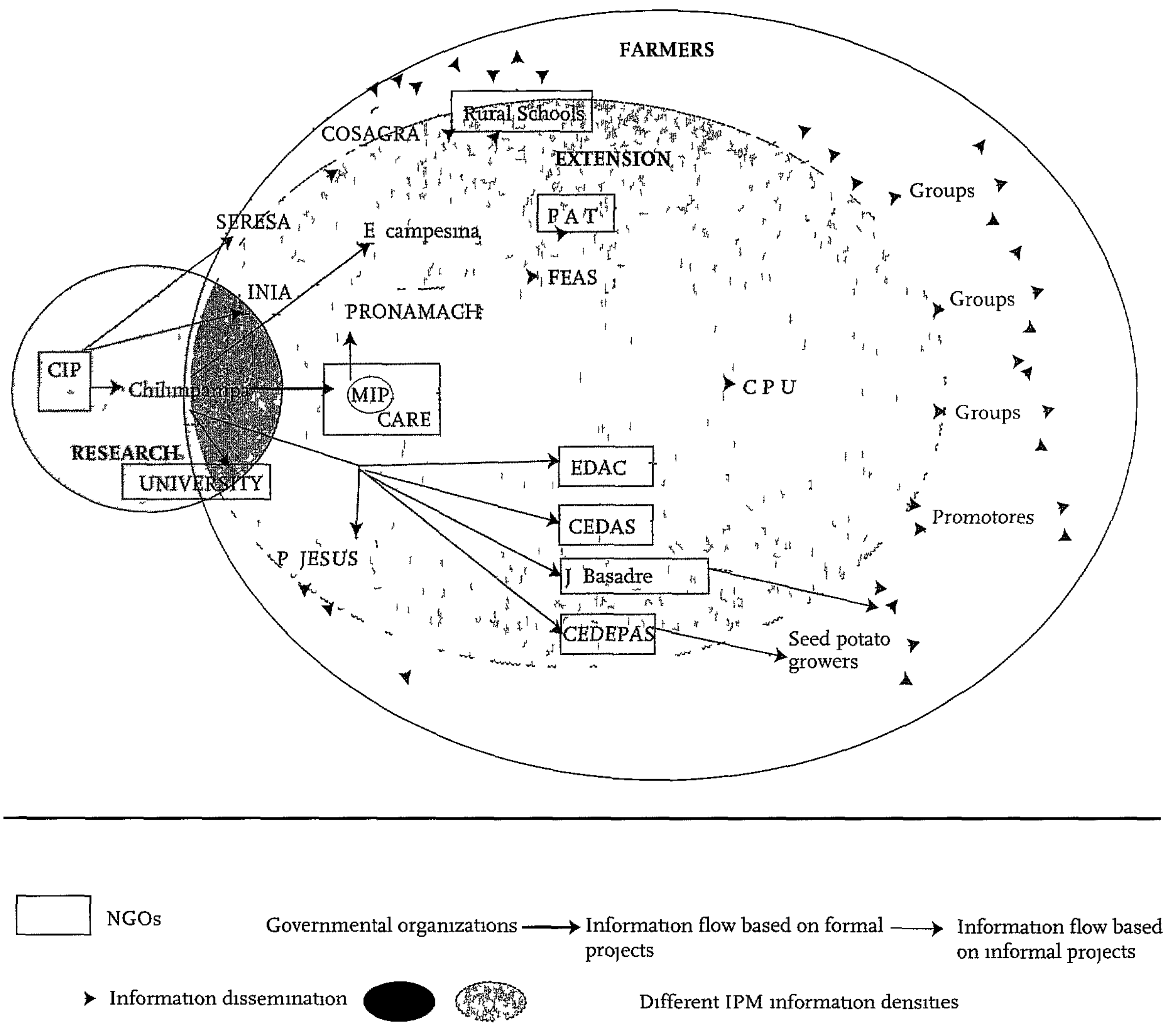
Through the inter institutional contacts, demand for IPM information grew, and infor mal links were established *(See Figure 1)* CIP and INIA managed the participatory research in Chilimpampa Students from the local univer sity were involved in the project while doing research for their theses, with the support of CIP In this way, researchers, farmers, and stu dents all became active managers of IPM information

While CIP CARE and CIP INIA are the most important links between research and extension institutions, extension institutions are also forming connections among themselves to exchange information CARE and PRONA MACH, for example are working together on soil conservation and recently, on IPM (through, for instance, training of staff) In turn PRONAMACH is working with FEAS, another governmental institution that provides technical assistance to farmers Scaling up by finding more partners enables local institutions to coordinate IPM diffusion Several other NGOs have also received information about IPM through training activities CIP and the collaborators have also developed useful links with political authorities and educational insti tutions to further spread the IPM approach

INIA uses still different ways of diffusing IPM information, by providing technical assistance to groups of extension workers mainly from NGOs INIA also makes limited use of rural schools and the media (radio messages and pamphlets) to spread this information CIP has provided information to SERESA, a governmen tal institution working on pest control, for pro ducing *baculovirus*, a biological control agent SERESA has set up a small factory to produce this agent and is distributing it through farmer organizations This type of IPM diffusion how ever is less than ideal because IPM technology has many complementary parts none of which works alone against certain pests

In the longer term, such a diversity of strate gies and training approaches may become

FIGURE 1 | INFORMATION SYSTEM FOR IPM DIFFUSION IN CAJAMARCA, PERU



problematic if IPM information becomes dis torted en route to farmers A deeper evaluation of how inter institutional cooperation affects IPM diffusion would reveal variations in IPM related changes at various stages and by several actors

The Economic Impact of IPM

Two cases, the Andean potato weevil control in the highlands, and Leaf Miner Fly control in the coastal valley of El Tambo Arequipa, illustrate the economic impact of IPM diffusion (These evaluations do not include all costs of basic research by CIP, but do include the costs of applied field research)

ANDEAN POTATO WEEVIL The Andean pota to weevil is the second largest concern, after late blight, for growers in the region Found in the highlands above 2,500 meters, this insect damages potato tubers, affecting both quality and weight The economic loss varies with the type of farming

In Huatata, a semi commercial community in Cusco, even with insecticides, APW damaged 31 percent of a commercial farmer's potato tubers at an economic loss of $693 50 per hectare On the other hand a subsistence farmer in Chilimpampa, Cajamarca, with 50 percent of tubers damaged, lost only $369 per hectare because somewhat damaged tubers were eaten or used for livestock feed, processed into dried potato, or used as potato seed After three sea sons of using IPM the damage was reduced to 10 percent in Huatata and 15 percent in Chilimpampa (Ortiz et al , 1994) Fourteen con trol practices were on the initial IPM menu in the highlands activities Each had a different adoption rate, depending on the type of produc tion system, so the control cost of IPM depend ed on the number of practices farmers applied Most farmers used four to six practices at a cost of between $20 and $30 per hectare Net bene fits per hectare of IPM in both pilot communi ties averaged $154 per hectare

Because CIP lacked the capacity to train more than the pilot communities at first, IPM for the potato weevil was only slowly adapted (750 ha in 1992 and 1993) But working with CARE, it extended the area where IPM could be adopted to 1,250 ha in 1994 2,250 ha in 1995, and a projected 3,750 ha in 1996 This research and extension project generated a conservative esti mate of 30 percent return on investment, a rate that compares favorably with other successful investments in agricultural research

LEAF MINER FLY Leaf miner fly is a prevalent potato pest in dry parts of Peru, such as the coastal valleys This insect causes damage that reduces yields In El Tambo valley in Arequipa, potato farmers have long relied on insecticides to control LMF, but heavy use of insecticides had gradually eroded their household incomes, polluted the environment, and altered the nat ural balance that once kept LMF manageable

In 1990 CIED, a local NGO began to work in the valley, where potato is the most impor tant annual crop Looking for alternatives to insecticides, CIED teamed up with CIP in 1992 to test local applications for IPM practices In this venture, research and technology have both been transferred (Palacios et al 1995a)

The validation of IPM technology on farms has given farmers a new alternative The area where IPM is used has grown from 3 5 hectares in 1992, 8 6 ha in 1993, and 48 ha in 1994 to a projected 330 ha for 1996 A potato surplus in 1995 will probably result in a reduced planting area in 1996 because crop prices will fall, but CIED estimates that IPM will be used on 640 ha of potato in 1997, the valley's entire potato area After only six years these results are impressive

The research and technology transfer cost has been minimized, and efficiency has been improved through CIED CIP cooperation CIP technical assistance amounted to only 1 percent of total cost in 1992 and 9 percent in 1995 Potato yields have also increased, and production cost decreased, with the use of yellow sticky traps In the short term and with limited diffusion, the net benefit per hectare has risen $162 ($70 from yield increment and $92 from reduced costs) In the long term and with wider IPM diffusion, the net benefit per hectare may reach $288 ($183 from yield increment and $105 from reduced costs) Over the next 20 years, the return on investment is estimated at 45 percent, counting all costs of applied research, technology transfer, and CIP technical assistance, and the adoption of IPM throughout the El Tambo Valley potato area

INSTITUTIONAL COOPERATION

The results of inter institutional cooperation may also be evaluated in terms of its effects on cooperation, institutional performance, and technical change

Needs and Commitments

Cooperation has created new needs for institutional structures and roles, such as the need for interdisciplinary work between CIP scientists and NGO extensionists Early disagreements stemming from differing perceptions of IPM and the necessary extension activities were eventually resolved in personal negotiations As a result, researchers and extension workers had to assume new functions to manage the joint projects In the process activities expanded and diversified, adding to the complexity of intra institutional structures

In the MIP Andes project formalizing inter institutional relationships and clearly defining responsibilities between CIP and CARE have enhanced collaborative work, for example, to arrange workplans that fit into each institution's long term strategies Such formal arrangements could be needed for collaborative projects with other NGOs Even so, new problems can arise as relationships become more formal and complex For example, in the MIP Andes project, because an international donor (USAID) supports this project its objectives and activities are specified Extension workers and researchers are thus under pressure to follow pre established rigid plans that can rarely be adapted as the project progresses

Unexpected financial needs can also arise in collaborative activities In the case of MIP Andes, sometimes these financial needs can be met if USAID can create special new projects In other cases, financial resources have to be drawn from internal budgets, and the scarcity of resources for meeting emerging needs has delayed IPM activities

The feedback collection process also increases the information flow both within and among institutions and creates a demand for new ways to enhance communication between institutions Within and among institutions, technology such as electronic mail can ease information exchanges but for extension work, additional mechanisms should be considered to streamline monitoring and systematizing of the IPM teaching experience

Farmer organizations also play an important role Their participation is encouraged, and their knowledge used as feedback to research and extension institutions Laterally, farming communities exchange experiences and information among themselves Farmers should also participate in project design and decision making

In short institutions have to make a commitment to deal with the needs created by collabo ration tapping the comparative advantages and capacities of each for specific functions in cooperative work with farmer organizations If further collaboration is decided on as a way to scale up, possible candidates might include government policy making institutions, other NGOs, and perhaps the commercial institutions that provide farmers with agricultural information, even though they do not necessarily operate with the same philosophy as IPM

Effects on Research and Extension Institutions

Participatory research, on farm research and farming system research improve communication between farmers and researchers (Cornwall et al 1994) However, farmers and researchers are only two of many groups involved This approach offers the opportunity to include extension workers from NGOs in the research process The varying experiences, feedback, and perspectives of those groups have proven useful in evaluating IPM technologies and in developing research methods to fit local conditions Inter institutional cooperation thus enriches the adaptive research process

Researchers also gain from their role as trainers They learn to communicate with people who do not normally use scientific jargon and to consider socioeconomic factors that might impede IPM adoption These contacts result in concrete recommendations for local decision making, instead of abstract statements of goals

Through cooperation, extension institutions (both NGOs and government) increase their stock of sustainable alternatives for tackling pest problems Extension workers now manage enough information to offer assistance for sound decisions on pest control The communication among researchers and extension workers has contributed to an attitudinal change, both have learned that decisions should be based on careful analysis of local agro ecosystems This is valuable for the Andean Region, where diversity is a main feature

Extension workers have also shown imagination and creativity in teaching IPM The experience of implementing IPM has shifted the strategic objectives of non governmental organizations from theoretical to pragmatic goals In addition because they can speak with authority on the practical results of IPM implementation, NGOs involved in collaboration gain an advantage in negotiating projects with external donors Maintaining relationships with different institutions also enhances their access to international donors

CONCLUSIONS

Peru's political and economic conditions—including privatization of agricultural services, the increasing participation of NGOs, and new environmental legislation—have favored inter institutional cooperation for sustainable development Mutual interests in sustainable pest control brought extension workers, local groups, and researchers into contact Institutions have redesigned their strategies and developed new capacities as a result of working together

The sustainability of inter institutional cooperation depends particularly on the kind of technology to be disseminated IPM, in contrast to such technologies as fertilizers, improved seeds, and pesticides, is knowledge based and requires a learning process Inter institutional cooperation is essential to facilitate this process

An important benefit of research and extension cooperation has been the enhancement of NGOs capacity to negotiate projects with external donors NGOs were able to show donors practi cal results from IPM ımplementatıon, and the support of well recognızed research ınstıtutıons enabled NGOs to guarantee better outcomes

An ımportant benefit to farmers ıs that theır ıncreased knowledge makes IPM ımplementa tıon more sustaınable Moreover, through thıs ınıtıatıve addıtıonal lınkages have developed among other local ınstıtutıons Thıs experıence of cooperatıon wıll be useful for scalıng up other CIP related technologıes and the lessons learned could be used to teach IPM elsewhere Yet, dıfficult economıc constraınts ın Peru may slow adoptıon of IPM, sınce benefits are often best apprecıated ın the long term, and ın the short term, IPM has to compete wıth chemıcal controls Inter ınstıtutıonal cooperatıon has helped to shorten the ımpact tıme at farm level, but the lapse could be further shortened ıf the partıcıpatıon of other ınstıtutıons wıdens the IPM adoptıon area

The experıence of cooperatıon among CIP and four NGOs ın Peru has shown that a maın constraınt to establıshıng ınter ınstıtutıonal lınkage mechanısms ıs the personal wıll of ınstıtutıonal staff Irrespectıve of objectıve com patıbılıty, cooperatıon depends on ınformatıon exchangıng mechanısms, professıonal commıt ment, and avaılable resources—ın other words, the human factor

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KENYA COMMUNITY BASED TSETSE CONTROL

J W SSENNYONGA

Tsetse borne trypanosomiasis, affecting both humans and their domestic animals constrain rural development in 37 African countries Ten million km² of prime agricultural land are colonized by tsetse and millions of people are at risk of sleeping sickness Conventional methods of controlling the tsetse fly have proven both unsafe and unsustainable because they rely on chemical pesticides and help from external agencies for finance and management But an innovative alternative community based approach has been effective in managing tsetse The project, located in Lambwe Valley, Western Kenya, is one of three pilot trials of tsetse trapping technology by ICIPE This case study of the project illustrates how collaborative linkages and participatory approaches to pest control made the application of community managed tsetse trapping—in this case, the adoption of a low cost, easy to manage NGU[1] tsetse trap developed by the International Centre of Insect Physiology and Ecology (ICIPE)—more efficient

The use of this trapping method between July 1994 and September 1995 by the Kisabe community suppressed tsetse population by 95 to 99 9 percent and reduced trypanosomiasis by 91 percent in the area These successful results stem mainly from community organization and management along with institutional support of ICIPE and other partners

PROJECT DEVELOPMENT AND STRATEGIES

Kisabe, an acronym from *Kibwer* and *Samba*, the two sublocations constituting the tsetse control zone of 100 km², initiated the project to solve their endemic problems with tsetse and trypanosomiasis after external agency sponsored control methods (aerial and ground spraying, bush clearing and burning) repeatedly failed The failed projects involved large sums of money and chemical pesticides and left out farmers When community members found out that ICIPE scientists had reduced tsetse density from 200 flies/trap/day to below 1 fly/trap/day during experimental tests of NGU traps in 1988, they asked ICIPE to train them to make and use these tsetse traps An initial lack of funds and an absence of appropriate community organizational and managerial structures were soon overcome through collaboration ICIPE obtained project funding from the Natural Resources Institute (NRI), an organization based in England

The central objective of the Kisabe project is to demonstrate that the community can successfully implement tsetse trapping by using its own human and financial resources Other objectives include assessing the impact of tsetse trapping, and training extension workers Project activities were planned to follow a logical sequence baseline studies, training of local farmers and extension workers beginning with a small catalytic farmers' group, mobilization of the community, building community based organization and management, mobilization of resources deployment of traps through farmer to farmer extension and assessment of the project s impacts on tsetse, trypanosomiasis live stock productivity and on the environment

The Basis of Collaboration

The community based management of tsetse and trypanosomiasis depends on collaboration among and within institutions, as well as among community members The insect's geographical territory extends well beyond the reach of indi

[1] NGU is the name of the trap and refers to Nguruman in western Kenya where it was developed in 1987

viduals or the capabilities of single institutions Its control requires a multi disciplinary approach and teamwork among a tsetse ecologist, a veterinarian, an economist, a sociologist, and an environmental assessment specialist, along with community leaders and members

Some of the linkages between the community and other organizations are formal, some informal ICIPE and the Kisabe have very close ties though not a formal contract ICIPE and its donor agency (NRI) have a formal contractual relationship that binds ICIPE to implement the project with Kisabe The complementary roles of the various groups are defined in the project proposal and in other contractual documents

Community Training and the Initiation of Activities

ICIPE researchers and government personnel trained 42 farmers (Catalytic Farmers Group–CFG) between November 1992 and April 1993 At 35 public meetings, CFG trained the community in the biology and ecology of tsetse, tsetse borne diseases and associated economic losses, available solutions the way the traps work, and basic principles of organization and management Early on, the community decided to take responsibility for managing tsetse and trypanosomiasis using its own human and financial resources

Organization and Management

After receiving training, the community set up a four tier organization for the tsetse project At the bottom, 44 villages are grouped into 15 blocks Each block is headed by a popularly elected committee made up of a chairman, vice chairman, secretary, vice secretary, treasurer, and 7 to 9 trap managers At the top, Kisabe is run by an 18 member elected committee, made up of chairman, vice chairman, coordinator, secretary treasurer 8 trap managers 3 members, and an auditor These elected leaders took over responsibility from CFG for managing the organization and its resources and for trapping The blocks and Kisabe drew up constitutions to regulate their internal affairs and acquired legal status as self help groups by registering with the Ministry of Culture and Social Services (Ssennyonga, 1994) All activities are planned and controlled through participatory decision making at meetings So far, 169 meetings have been held at the block level and 40 at the Kisabe level

Resource Mobilization

Money materials labor and premises (for storage and meeting places) are regularly mobilized and managed to carry out the tsetse control Funds are raised through a homestead capitation payable in cash and kind and through membership registration fees The equivalent of US$1,600 has been raised so far Kisabe and the blocks keep the funds in banks and prepare written statements of expenses Fund raising has gone slowly because participants have had little experience mobilizing finances and because drought and crop failures struck in 1993 and 1994 Still, the community has dedicated its time and effort to the project

Management of Trap Deployment

Community trap managers selected 493 trap sites in January and February 1994, and a three phase trap deployment plan was developed Trap managers made traps from March through June 1994 In May, 16 criss crossing transects were cut to situate the traps and between July 1994 and April 1995, 119 traps were placed (35 replaced worn out (22) and vandalized (13) traps) Since then, each block has recruited 4 people twice a week to place and service traps a far more labor intensive job than anticipated It took 952 and 850 man days to cut 16 transects and to deploy traps, respectively (with women contributing 41 percent of the latter)

IMPACT OF THE INITIATIVE

The numbers of tsetse flies and incidence of trypanosomiasis have both fallen From April through June 1994 monthly apparent densities of male and female tsetse ranged between 0 8–1 4 and 2 1–2 8 flies per trap per day, respectively After trap deployment starting in late July 1994, apparent density of males and females declined progressively to 0 0 and 0 1/trap/day by March 1995 This is a decline of 100 percent for males and 96 3 percent for females In addition, the trypanosome infection rates in tsetse and cattle also fell No infection was detected in the herds tested in November and December 1994, and only 2% were infected between January and March 1995 Another experimental group of cattle had no infection between August 1994 and March 1995 It is still too soon to tell how these results affected cattle productivity or the environment

Farmers have been trained to relate tsetse control to changes in their environment by identifying human activities that cause these changes and by devising ways of managing tsetse in ecologically sound ways Two examples illustrate the results First, using implements at hand, such as stones, farmers drew maps on the ground showing key resources and changes and then discussed their findings with researchers The farmers and researchers agreed that the exercise deepened their understanding of soil fertility biodiversity and land use (Omolo et al 1995) Second 78 farmers have been trained in disecting tsetse and using the microscope and have participated in monitoring

As for impact on social institutions Kisabe is increasingly recognized as a viable channel for disseminating new ideas and technologies For example, the Sisal Board of Kenya has given exotic Jersey cattle to six Kisabe farmers to promote the production of sisal (since sisal waste is cattle feed) In addition, both government and NGOs channeled relief food through Kisabe during the 1993 famine These activities are some of the indirect results of improving local organizational capacities

PARTICIPANTS' EVALUATION OF COLLABORATION

At two participatory workshops in September 1995, farmers evaluated the contributions of collaboration and user participation to project results The farmers provided valuable insights into the project's challenges, achievements, and effectiveness (Ssennyonga, 1995)

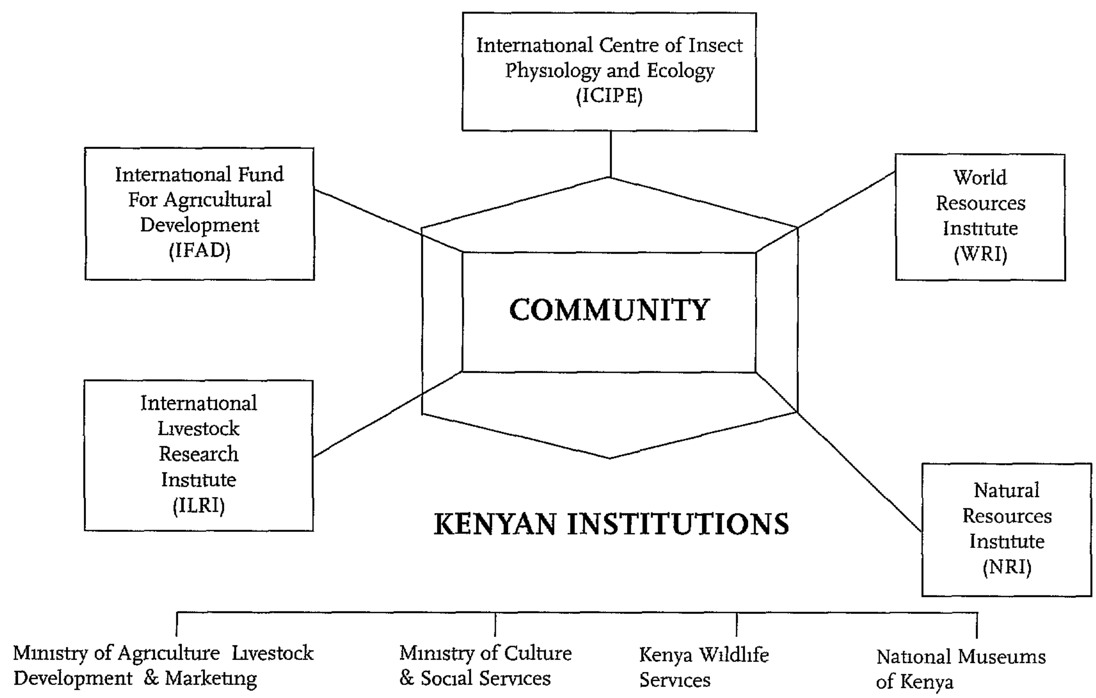
Key Dimensions of Collaboration

Farmers view collaboration within and among people and groups as important for progress They see ICIPE and Kisabe as the central partners while other collaborators come and go as need and circumstances demand *(See Figure 1)*

All partners recognized the need for collaboration and its benefits The community wanted an effective method to control tsetse and was ready to work with others on it Government ministries recognized the potential savings from community control of tryptosomiasis and ICIPE demonstrated that a community can manage traps on its own if other institutions provide input Because they deliberately took complementary roles the partners achieved results that no single institution could have realized alone

The community and collaborators recognized the need for an organizational and management structure wherein farmers could cooper

FIGURE 1 | CURRENTLY COLLABORATING INSTITUTIONS

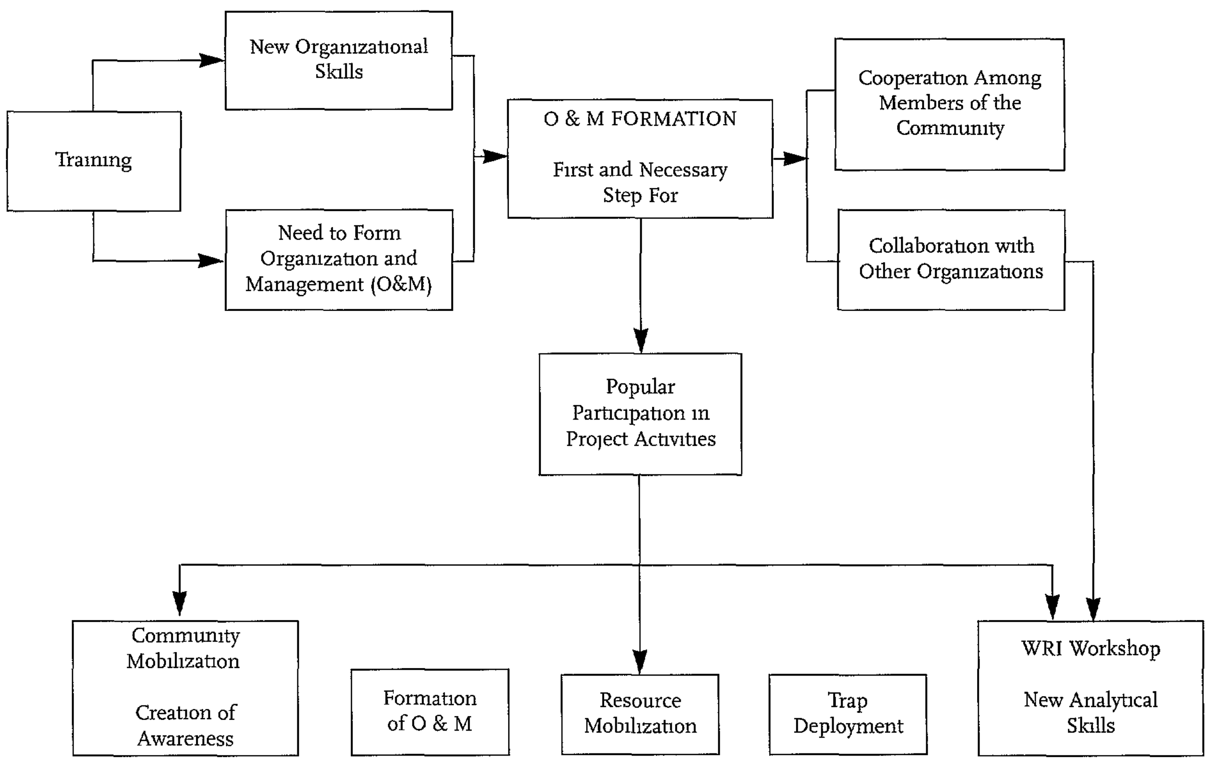


ate among themselves and collaborate with other institutions ICIPE's science based training, given to the CFG's 42 farmers and through them to the wider community broadened the basis for collaboration between the community and researchers ICIPE provided the technical assistance and, with NRI, facilitated inter ministerial collaboration ICIPE also reinforced community "self realization" by nurturing farmers' ability to make decisions and to evaluate other control methods In this process of "social marketing," each step reinforced another *(See Figure 2)*

The link to government in this project is indirect it promoted self help initiatives and community fund raising Government also gave the project legal status (a registration certificate) so the blocks and Kisabe could obtain loans, open a bank account, and receive government assistance

Farmers and scientists identified three major weaknesses in the collaboration First, not every collaborating institution was involved in project negotiations, which may explain why some partners were confused about their respective roles Second, farmers criticized some partners'

FIGURE 2 THE CONCEPTUAL LINKAGE BETWEEN ORGANIZATION COLLABORATION AND USER PARTICIPATION



failure to share costs "Free riders' in the project include certain community members and also the Ministry of Agriculture, Livestock Development, and Marketing (MALDM) whose responsibilities include tsetse control (Since the Kisabe project has relieved MALDM of the burden of tsetse control the community reasons the ministry should improve other veterinary services and should spend funds on managing other endemic diseases) Third government ministries had no mechanism for collaborating at the grassroots level Particular criticism was directed at MALDM for its inability to assist communities in management or to hire this expertise

Main Aspects of Participation and Organization

Farmers acknowledge that the project helped develop a community organization structure that enhanced participation at several levels Training and regular consultation with ICIPE researchers improved farmers' organizational and managerial capacity In fact, farmers pointed out that one of their most important achievements was the development of the social organizational tools needed to manage and raise funds They also noted that the workshop had helped them acquire problem solving and analytical skills

The community also established a fairly effective organizational structure for managing resources, deploying traps, and reviewing progress regularly Both farmers and researchers recognized that managing these tasks takes efficient planning, coordination, quality control, motivation, and information exchange The community understood from the start that participation implied a willingness to contribute all the materials and funds to the venture and they were willing to respond to requests for help

Sharing Benefits

Although the farmers believe that all players are not equally committed to the project, they acknowledge that they have derived immense benefits from it improvement on livestock productivity, a decrease in sleeping sickness, greater use of land and forest resources, and a decline in emigration

Although the impacts of tsetse trapping cannot be measured by any single statistic, a few statistics may be indicative For example, thousands of people attended the 70 public meetings and 209 management meetings Some 1 802 days of labor were dedicated to trap deployment Sixty percent of households have paid registration fees, 22 percent have donated chickens, and 3 percent have donated traps The number of participating households and individuals is gradually rising as trap deployment advances into new areas Moreover, the distribution of office holders has been balanced in terms of geography and gender

Of all benefits participants viewed the reduction of sleeping sickness as the most important Second, farmers also said that livestock owners were getting more traction power from their draft animals Third, the project has also been receiving considerable attention from prospective collaborating organizations and it has generated new issues of interest to other research institutions

Clearly, a balance between individual and community benefits also contributes to participation and success The more obvious the benefits, the greater the willingness to participate When benefits are less obvious and accrue to the community as a whole, people may have to be persuaded and given incentives to contribute to a public good

Equity Questions

Although participants agreed that the trapping program's benefits outweigh costs, now that sleeping sickness has all but disappeared, they are beginning to look for ways to reduce labor costs Here a fundamental challenge is to ensure equity in project costs and benefits Although the trap helped the whole community of 12,000 people, rich and poor to fight tsetse and trypanosomiasis the burden has not been equitably shared Suggestions for correcting this imbalance included providing in service training or awarding prizes for excellent work and providing food and beverages to deployment workers However the farmers agree that the community should meet such costs in a self help project

Disincentives and Weaknesses in Participation and Organization

Four main weaknesses in participation were identified overdependence on volunteers, lack of methods to ensure every household's partici pation, lack of clear incentives for volunteers, and, during the rainy season, conflicting demands for farm labor and insect control labor Citing the "free rider" problem, farmers also argue that the government and ICIPE have actually failed to control tsetse and are now try ing to saddle the community with this burden and that some members of the community lost interest in the project when they were not paid for participating

Misunderstanding was blamed for setbacks in certain specific cases For example, during com munity mobilization, the CFG did not have enough time to tell all community members what they had learned about tsetse control According to ICIPE facilitators, the local leaders' lack of management skills also caused problems For example participants contributions, espe cially of chickens, sometimes go uncollected Yet, participants realize that weaknesses like these can be corrected relatively easily through improved communication and training

Environmental Impact

Farmers spontaneously mentioned positive environmental impacts They recognized that the use of chemical pesticides for aerial and ground spraying had poisoned people, crops, and livestock, while the new traps are clearly safe A general change in environmental aware ness has also taken place For example, most community members initially opposed the con servation of wildlife hosts of tsetse in the Ruma National Park After training, however, they realized that the traps alone afforded enough protection against tsetse so nobody would have to interfere with wildlife to control the pest

Among the benefits of improved tsetse con trol farmers also mentioned the resettlement and cultivation of land deserted because of tsetse as well as increases in livestock popula tions But they hastened to add that project related changes have also brought soil erosion and degradation—which could be remedied if farmers were trained in contour cultivation and if grazing were regulated

PLANS AND IDEAS FOR THE FUTURE

As the Kisabe project progresses toward its goals, ICIPE and NRI will end their technical assistance and funding Planning for bringing about this change will require considerable effort

The need is generally felt for in service train ing in management Initial training did not cover resource mobilization and management in depth, and leaders lack basic skills in budget preparation and bookkeeping In any case, only about 30 of the current 212 leaders attended those training sessions

Methods also need to be developed to ensure that everyone shares the risks and burdens Rewarding volunteers who bear extra burdens should be considered Distributing responsibili ties equitably among all the households was seen as a matter of urgency

Also, a ' phasing out" plan for ICIPE is needed The community believes that this plan should encompass these activities

- strengthening community management capacities through in service training,
- involving influential local leaders such as businessmen and migrant professionals,
- creating rewards for the most active contributors
- getting free riders to contribute labor and

- continuing monitoring and training for those who monitor

As the external agencies phase out support, the community must take over ICIPE s role as coordinator of the collaboration and learn where to find assistance The farmers identified several possible collaborators—the Ministry of Health, the Ministry of Environment and Natural Resources, the Ministry of Culture and Social Services, the Kenya Wildlife Service, the Kenya Trypanosomiasis Research Institute, and NGOs The roles and responsibilities for partners, and the modes of collaboration, will need to be identified, planned, and developed

The farmers and ICIPE staff also suggested promoting further exchanges with other community based projects, which could include newsletters or workshops Kisabe leaders and trap managers also feel that they could benefit from visiting and learning from similar community initiatives in other regions

CONCLUSIONS

The findings from this case study have implications for broader issues of IPM adoption As groups try to manage pests, both technology and collaboration impel institutional innovation

For most IPM technologies, adoption is an individual decision based on how costs compare with benefits When it is a group choice, the cost benefit factor still applies, but strategies have to be devised to motivate individuals to contribute to a public good Invariably, there will be free riders Should they be coerced into participation? Probably not Kisabe's choice of a strategy of education seems preferable over the long term

Because Kisabe is technology based, various tasks (such as measuring cloth and netting) have to be performed according to precise guidelines This requires some specialized expertise To hold both technical and managerial tasks to reasonable standards, the organization has to coordinate and supervise activities which usually drive organizations toward formal structures Associated administrative tasks also require both formal procedures (such as financial management) and formal links with other institutions (such as banks and government agencies) Managing precision IPM technologies within the framework of purely informal organizations simply may not be possible

In a sense IPM adoption by a group requires a social contract—whether written or oral—that delineates individual rights and obligations within the group and encompasses checks and balances to ensure that both costs and benefits are equitable Internally, the social contract keeps behavior in line with organizational plans and objectives The social contract also introduces a third party—law, the state—to arbitrate conflicts or individual failure to live up to mutually agreed upon expectations

This project has so far involved only one formal (written and signed) contract between ICIPE and NRI Yet, many social contracts exist between ICIPE and Kisabe and between each of these and NRI and other collaborating institutions The community lacking formal contracts has no protection or legal basis if its partners fail to carry out their agreed tasks or if IPM technologies fail technically

The Kisabe case, a successful community based effort, involved a step by step process the community became aware of the problem, came up with solutions or sought outside help, and then took the initiative to implement the solutions Pooling resources both within the group and with other institutions also requires collaboration Effective implementation involves communıty members' commıtment to con tribute their labor and materials, which strengthens the community's investment in the project The project's success traces back to these key ingredients and to donor responsive ness to needs expressed by the people

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SENEGAL COLLABORATIVE PEST MANAGEMENT IN GAD KHAYE

Three decades of poor natural resource management have compounded hardships for people and livestock in Senegal and throughout Africa's Sahel region Drought, uncertain climatic patterns, and demographic pressures have disrupted traditional fallow periods depleting vegetative cover and exposing the soil to erosion

For the past eight years, soil management appropriate to local social and economic conditions has been the focus of the Regenerative Agriculture Resource Center (RARC) in Senegal, a project initiated by the Rodale Institute, an international NGO This effort has produced measurable results Regenerative agriculture looks first to local resources and develops them People are one such resource and the Senegal RARC emphasizes information exchange among them Through an integrated program of applied research, education and training, communication, and community development activities, the RARC project links Senegal's various rural development actors

Practical research on the biological control of pests is a major element of the Senegal RARC program Early on, the RARC team found that managing weeds and insects is not only integral to regenerative soil management but, from the farmer's perspective, also critical to field crop and horticultural production In the project highlighted here, the Senegal RARC team in Gad Khaye used a community based, participatory approach to research and develop pest management for food production This case illustrates

- ways in which partnerships contribute to success in integrated pest and soil management,
- advantages and constraints of such partnerships,
- impacts of such partnerships on pesticide use and
- lessons learned in creating specific conditions that promote wide diffusion of natural crop protection and other regenerative farming methods

PEST MANAGEMENT IN SENEGAL

Until recently the extensive use of synthetic pesticides has been heavily promoted in Senegal's agricultural policy The government's Agricultural Development Policy Declaration identified four goals sustainable development and growth, improved food security, better management of natural resources, and land tenure security In terms of agricultural inputs, government policy seeks to

- encourage the use of fertilizers, pesticides and heavy equipment, but in ways that preserve the environment
- promote the production and use of seed and genetic materials
- remove or reduce taxes on materials used for seed production, on fertilizers and pesticides, and on agricultural and livestock equipment
- liberalize the importation and distribution of seeds, fertilizers pesticides and equipment
- better control the quality of imported products and equipment

In accordance with these policies, pesticides have been used mainly to support the production of cotton peanuts and other cash and export crops Because these inputs are expensive and farmers' resources are limited, many farmers are increasingly willing to test and use alternative methods of pest control to protect standing and harvested crops As a result, the quantity of chemical pesticides sold has fallen significantly In 1986–87, for example, Senegalese farmers used an estimated 963,000 tons of pesticides to treat 1 5 million hectares of land Since then, use has steadily declined to 393,000 tons on 312,000 ha in 1990–91 and to 127,000 tons on 62,600 ha in 1995

As synthetic pesticide use falls, the demand for affordable biological pest control methods is growing in Senegal Government agencies, research institutes, and assorted non governmental organizations (NGOs) are now promoting alternative pest management (Even a major Senegalese pesticide manufacturer—SENCHIM—is working with the RARC on compost and biological pesticide production)

On the national level a scientific committee has been developing a collaborative model for IPM and nematode control since 1993 and assembling the human and logistic resources for IPM research and training Working closely with secondary institutions that test IPM techniques in the field, the committee helps young Senegalese researchers and technicians experiment with alternative practices in collaboration with NGOs and farmer organizations The committee includes the Department of Biology at the University of Dakar the Senegalese Institute for Agricultural Research (ISRA) and the French Institute for Scientific Research for Cooperation and Development (ORSTOM) Other public institutions such as the Division of Plant Protection (DPV) and the Ecole Nationale Superieure d'Agriculture (ENSA), play important roles ENSA, for example, operates an experimental farm where students carry out practical IPM research in collaboration with ORSTOM

After successful research trials, ISRA's Horticulture Development Center (CDH) has been promoting intercropping and the use of compost to control nematodes Three of many alternative techniques being field tested are using compost and fish wastes at various planting depths, raising seedlings in compost beds, and applying vegetable extracts (such as neem powder, garlic extracts, and eucalyptus leaves) to discourage insects

Other government efforts include the Conservation of Littoral Lands (CTL), a project that works with communities along Senegal's Atlantic coast to control erosion and help people earn money through home gardening Participants receive on site training in regenerative techniques, including pest management, from the Senegal RARC team

On the NGO side Environment and Development in the Third World (ENDA) works with farmers to test techniques to reduce pesticide use These farmers have significantly increased their use of animal manure and crop rotation since 1987 for pest control, they now use neem seed solutions instead of synthetic pesticides The Association of Naturalist Farmers (AGRINAT) also promotes 'calendar spraying" of synthetic pesticides AGRINAT promotes IPM information and educational programs

RARC's APPROACH TO SUSTAINABLE PRODUCTION

The Regenerative Agriculture Resource Center (RARC) was established in 1987 by Rodale International and ISRA to realize the community's desire to respect biological balance in farming RARC promotes alternative methods of pest management by testing specific technologies and disseminating information to farmers Although it doesn't bear the IPM label, this approach employs many IPM elements along with other valuable ecologically based farming methods

For example, an important component of pest management is to ensure that crops are in good condition early in the growing season The Senegal RARC encourages this practice by working closely with farmers to build up their soils using compost and leguminous plants and to integrate livestock husbandry and crop production better The fundamental idea is that well established crop plants with a healthy root system are better able to resist soil borne pathogens, withstand droughts that can weaken their resistance to external vectors, and quickly recover if damaged by leaf eaters (including cattle)

This "soil health first" approach is complemented by preventive and curative protective technologies, such as spraying with neem tree (*Azadirachta indica*) or chili pepper solutions, as well as by such cultural practices as mixed cropping and crop rotation On farm and, to a minor extent, on station studies of the use of these biological substances have been set up and monitored, field level data collected and community information exchange sessions held to evaluate the effectiveness of this soil plant approach to pest management

THE COMMUNITY OF GAD KHAYE

In this case study, the small farming village of Gad Khaye near Thies is highlighted as an example of RARC's pest management based approach to regenerative farming In this semi arid area, agriculture is largely rainfed and the primary fieldcrop and staple food is millet, grown on average plots of one acre per household Horticultural production has grown in recent years, responding to rising demand for fruits and vegetables

Land tenure rights in Senegal are based on traditional systems In Gad Khaye, the Rural Council set aside 2 5 hectares for permanent use by a local growers' association of 161 women—unusual since men (who make up the Council) control more land and allocation itself

The Gad Khaye farmers association is run by a democratically elected decision making body, and a general assembly that approves new members The association collects a membership fee and fines on members who break the rules Revenues also come from farm activities and a community grain mill Besides managing the community's pest management program described below, the farmers' association works with several organizations outside the community on such projects as the Project for the Organization of Village Groups (an NGO project) the European Fund for Development (a government program), and the Association of Italian Volunteers (NGO)

To evaluate collaborative pest management in Gad Khaye for this case study, a five person team (including a farmer, researcher, and RARC staff) was formed The team organized three workshops in the community to assess the program with participants, and a group of farmers visited three outreach sites In five visits to Gad Khaye, the evaluation team conducted semi structured focus interviews of randomly selected households in the 1,050 resident community The observations that follow are based on these workshops and interviews

COLLABORATIVE PEST-MANAGEMENT ACTIVITIES IN GAD KHAYE

The collaborative work involving ISRA the Senegal RARC, and the Gad Khaye farmers' association focusses primarily on vegetable production As with the RARC work in other com munıties, the pest and crop management activ ıties ın Gad Khaye were ınıtiated after a com munıty representative asked RARC for help The ımpetus for collaboration thus orıgınated ın the communıty, ensurıng demand drıven homegrown' cooperation

Thıs program ıntegrates applıed on farm research wıth educational opportunıties through field days and communıty level evalua tion sessıons The program relıes on effective—though voluntary and ınformal—collaboration between the communıty farmers assocıation, researchers from ISRA the Senegalese Hortı culture Development Center (CDH), and the Senegal RARC The applıed pest management research consists of treatments on compost grown tomatoes cultıvated for market and home consumption Transplanted seedlıngs are sprayed wıth a water based neem solution In ancıllary trıals, tomato seedlıngs are grown under screens to observe the frequency, severıty, and type of pest damage and yıelds

Thıs research desıgn was establıshed follow ıng visıts by the RARC staff to Gad Khaye to ıdentify relevant ıssues, problems, constraınts, forms of communıty organızation, and past, present, and potential ınıtiatives RARC held communıty meetıngs wıth ınterested local farmers, then wıth regıonal extensıon person nel and other potential partner ınstitutions and finally wıth the communıty at large Dur ıng workshops and visıts to Gad Khaye, the RARC team asked communıty members for theır ıdeas on desıgnıng a pest management project and evaluatıng the results The RARC team promotes thıs partıcıpatory approach because ıt

- promotes close cooperation between farm ers, research scıentists extensıon workers and other ınterested rural development personnel
- helps to ıdentify the local farmers' research prıorıties, and
- helps ensure that ınterested parties wıll get research findıngs ın language they under stand

In practice, farmers found RARC's partıcıpa tory collaborative approach useful and produc tive However, some difficulties arose among the ınstitutions ın the applıcation of thıs approach Lack of trust sometimes prevented communıcation among partners and differ ences ın ınstitutional expectations sometimes created complıcations or tensıons For example, because ISRA pays ıts extensıonısts a per dıem durıng field visıts, ISRA researchers expected such a payment from collaboratıng NGOs Thıs unexpected cost to Rodale/RARC sparked some controversy sınce no resources had been allo cated for thıs purpose and ISRA was reluctant to partıcıpate at times wıthout payment (To resolve thıs Rodale conceded to ISRA on cer taın occasıons) Furthermore, some partıcıpat ıng technıcıans gave farmers contradıctory ınformation or showed bıases about other orga nızations workıng on IPM Durıng evaluation sessıons, ISRA technıcıans often argued wıth farmers who challenged theır recommendations on the basıs of on station results

After two years of collaboration between the Senegal RARC and ISRA's Horticultural Develop ment Center (CDH) wıth the communıty group, soıl fertılıty management usıng regenerative tech nıques and the natural protection of crops was beıng wıdely used ın the village The crop harvest from both fields and gardens ıncreased thanks to the compost treatment on soıls ıntegrated wıth mechanıcal and bıologıcal pest controls (veıls hand weedıng neem fruıt ash and powder)

Mba Nodal, presıdent of the communıty women farmers' assocıation enthusıastically described program results "Last season, our tomatoes grown without chemical fertilizers and pesticides were great When we sold them at the market, a person would approach us with 100 CFA ($0 20 US), the price for one kilogram of tomatoes, but asking for only one tomato because they thought we were selling imported apples (which cost 100 CFA) This tells you how beauti ful and how big our organic tomatoes were"

Cabbages were also bigger and better Treated plots yielded an average of 26 tons per hectare versus 17 tons per hectare from untreated plots Insect damage on cabbage leaves was nearly halved The neem treatment worked best against the two main cabbage pests, *Hellula undalis* and *Plutella xylostella*

On okra, the neem treatment was less effec tive than a chili pepper solution against okra's principal pests, *Jacobiasca lybica and Pacnoda sp* The neem solution improved the okra yield by 2 metric tons per hectare, but the chili pepper solution achieved 23 tons against 17 tons per hectare for non treated okra

Millet yields have also improved The same number of millet spikes that once yielded 10 kilograms of grain can now be expected to yield 15 kg, according to the husband of the president of the Gad Khaye Women's Association Farm ers also found fewer weeds in their fields when using compost, and their food products looked and tasted better By substituting composted crop residues and manure, they also eliminated chemical "burning"—a risk when chemical fer tilizers or raw manure are applied improperly

Today in Gad Khaye, compost production as the foundation for soil and pest management has become so commonplace that women com pete with men (who own most of the cattle), for animal manure The local association is there fore planning a small ruminant fattening pro gram for 20 members (on a rotation basis) to get manure

In summary, efforts to overcome the prob lems of synthetic pesticide misuse and promote IPM have had both economic and social impacts Reduced spending on external inputs—50 percent to 100 percent a year—has raised net revenue from vegetable crop sales Before the RARC/Gad Khaye partnership pesti cides cost each family about US$6, now they spend US$0 52, mainly on rodent control

Better plant health was not the sole benefit of integrated pest and soil management Under standing between women and their families about agricultural decisions grew as women passed on information gained at IPM meetings The people of Gad Khaye felt better—thanks partly to other programs in the community, such as increased vaccination of children, construction of latrines and a general cleaning of the environ ment in and around households—and the risk of poisoning was eliminated Waste from this clean ing, and manure from small ruminants that used to wander about the village, now go into com post Animal manure and neem fruit are now considered extremely precious

In addition, information about the IPM pro ject in Gad Khaye has been widely disseminated The president of the association was interviewed on Senegalese national radio during one of the RARC organized, local language farmers' con ferences Also, the performance of biological pesticides in the Gad Khaye studies provided new information about IPM to more than one hundred farmers associations that visited Gad Khaye during RARC organized field days Six neighboring communities later requested infor mation and training on composting

Association members are proud to be pio neers promoting alternative agro ecological practices for soil regeneration, food security, human health, and environmental protection An action plan for the future for a collaborative initiative in Gad Khaye includes

- a farmers' workshop with participating farmers from different parts of Senegal
- a field day at the study site—Gad Khaye, and
- coverage over national radio and other media

Farmers are satisfied with the results of non synthetic pest control and are eager to explore other biological pest control techniques Their enthusiasm suggests potential markets for Senegalese and regional biological pest man agement technologies Farmers who have seen these alternatives work no longer want syn thetic pesticides "If these chemicals are offered to me, I will sell them to other farmers who need them,' two Gad Khaye farmers reported

LESSONS AND CONCLUSIONS

Efforts to develop alternative methods for pest and soil management can advance only as coor dination and relations improve among partners promoting sustainable agriculture and commu nity development For best results, institutional collaborators will have to overcome diverging viewpoints on pest management, differing insti tutional objectives, leadership struggles (avoid ing control/power rivalry of each organization), lack of coordination and open dialogue between organizations, and differences in specialties and domains of intervention Also, in many cases community members do not closely identify with any groups involved in local projects

Several lessons can be learned from the regenerative agriculture program at Gad Khaye

- Collaboration among partners makes tech nology development more effective For example, working on new technologies together allows farmers and NGO staff to communicate and obtain feedback
- Partnerships that favor two way exchanges of information and experiences work best According to a saying (translated from the Wolof language) "Two people thinking are better than one'
- Partners various approaches must be har monized A complex relationship has to develop whenever several organizations with different backgrounds and, at times, different primary objectives, decide to work together on a program Partners must blend their interests and methodological approaches to develop coherent initiatives for change
- The absence of an ongoing dialogue among partners can engender confusion and com petition among participating institutions and conflicting recommendations and interests
- To get NGOs and other development agents to complement each other functionally, communities need to coordinate the activi ties of the various outside groups, and sup port active local associations In the com munity, participating NGOs can promote information exchange monitor the impact of invited interventions, and provide demand driven technical services
- Collaboration should improve farmers' capacity to monitor and evaluate their own activities on pest management and related farming methods To participate fully farm ers need training so they can take charge and make appropriate decisions

- Women who know that synthetic pesticides can harm their children s health will consider switching to alternative pest control measures (All women interviewed in the case study indicated that health hazards in their own households were their main reasons for seeking alternatives to pesticides)

- Participants in field visits said that frequent visits are essential to promoting regenerative farming techniques The effects of information and experiential exchange are felt beyond the field day participants later visit each other regularly, exchanging new ideas and planting materials

Three words sum up effective collaboration between partners in sustainable agriculture initiatives synergy, adaptability, and openness

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CALIFORNIA, USA MERCED COUNTY BIOS PROJECT

JEFF DLOTT WITH
THOMAS NELSON ROBERT BUGG, MIKE SPEZIA RAY ECK JUDITH REDMOND, JILL KLEIN, AND LIZA LEWIS

California is the top ranked agricultural state in the United States and many of its farmers rely heavily on pesticides for pest management *(See Box 1)* The Merced County Biologically Integrated Orchard Systems (BIOS) Program grew out of local farmers' desire to reduce agrochemical use without sacrificing agricultural productivity, the willingness of several institutions to launch a new project, and support from funders and government agencies

BACKGROUND AND OVERVIEW

The ideas to develop BIOS emerged in 1992, when staff at the Community Alliance with Family Farmers' (CAFF) Foundation and University of California Sustainable Agriculture Research and Education Program (UC SAREP) began discussions on promoting ecological approaches to agriculture Both groups wanted to initiate a project to influence the research funding priorities of commodity boards, which in California strongly influence agricultural research conducted by public institutions, as well as agricultural policy *(See Box 2)*

CAFF and UC SAREP developed a joint work plan to

- select one or two commodities with high pesticide use patterns
- identify production practices that could reduce or eliminate targeted pesticides,
- create a grassroots outreach program to support farmer experimentation with identified alternative approaches,
- work with grassroots farmer groups to identify important areas of research that could lead to reduced pesticide use, and
- influence the funding decisions of the commodity board

BOX 1 | **OVERALL AGRICULTURAL PRODUCTION AND PESTICIDE USE IN CALIFORNIA**

California has 3 percent of all U S farmland (30 million acres) but produces 55 percent of U S fruits nuts and vegetables

California accounts for about 22 percent of U S agricultural pesticide use

California is the top ranked agricultural state with $19 9 billion in cash farm receipts and over $70 billion in related economic activities (Texas is second with $12 8 billion and Iowa third with $10 billion in cash farm receipts)

- California has 8 of the top 10 agricultural counties in the United States

Source California Department of Food and Agriculture *California Agriculture 1993 Statistics* California Department of Pesticide Regulation *Pesticide Use Annual Report 1993*

BOX 2 CALIFORNIA COMMODITY BOARDS

California growers have created 27 Commodity Boards through state legislation
Commodity Boards collect fees assessed on a unit of production basis
Commodity Boards usually allocate their funds to research and marketing
Most research supported by Commodity Boards is conducted by University of California or California State University researchers

Source CAFF Foundation

CAFF Foundation and UC SAREP selected almonds as the initial commodity and Merced County as the initial location Almonds are the state's sixth most valuable crop (1993 estimated farm sales totaled $911 million) and rank second in overall pesticide use Several almond farmers in the county with well established alternative production systems had achieved documented success in reducing pesticides, keeping insect damage low, and remaining economically competitive (Hendricks, 1995) In addition, the CAFF Foundation had a grassroots farmer network in Merced County Indeed, many farmers had personal relationships with the foundation, UC Cooperative Extension Merced, UC SAREP, and Pest Control Advisers (PCAs) Moreover the Almond Board of California was likely to support new research projects addressing alternatives to pesticides

The collaborative activities of CAFF Foundation, UC SAREP, UC Cooperative Extension Merced County, local farmers, and their PCAs, along with funding from the Pew Charitable Trusts and the Central Valley Agricultural Initiative of the U S Environmental Protection Agency, led to the start of a three year demonstration project called Biologically Integrated Orchard Systems (BIOS) to help Merced County almond farmers and PCAs reduce their reliance on agricultural chemicals by experimenting with various production practices leading to biologically integrated systems Such systems maintain or enhance naturally occurring biological processes for pest and fertility management

The BIOS project encouraged diverse agricultural community members to participate in a program that has led to the exchange and synthesis of practical and highly technical contributions CAFF Foundation recognized that participants undergoing the transition would need a broad range of easily accessible information, skills, and services, so it assembled a consortium of farmers, private agricultural consultants, University of California (UC) personnel, private businesses and USDA and other governmental agency staff to meet these needs Also the pioneering farmers who had already adopted biologically integrated almond systems served as mentors and their farms as models to start the project

A management team—composed of several consortium members—provides most of the technical assistance This team—two farmers, two independent pest control advisers (PCAs), one UC scientist, one UC Farm Adviser, one USDA Natural Resources Conservation Service District Conservationist, and a project coordinator from CAFF Foundation—reaches participants through customized farm management plans, a monitoring program, field days, workshops, problem solving meetings, seminars, videos, newsletters, reports, and technical papers The project coordinator facilitates regularly scheduled team meetings to plan and evaluate activities These meetings—and all other activities—are designed to foster the mutual sharing of experiences and insights On going evaluations and a commitment to flexibility allow the projects to assess and adapt to participants' needs The BIOS program expanded beyond Merced County in 1994, adding projects in Stanislaus and Yolo/Solano counties, and in 1995–96 expanded into three additional counties

BIOS Goals, Approach and Activities

The BIOS program goals have evolved as new projects are added and existing ones change An expanded set of goals and objectives was drafted in February 1996 *(See Box 3)*

Farmers and PCAs have taken an active role in the management teams and in the project in general Among other things, they have demonstrated practices that work in local conditions, and given advice on how to integrate them into an overall operation The significant involvement of farmers and PCAs in designing and implementing project activities has helped BIOS become known as both an innovative extension program and a biologically integrated systems approach to farm management *(See Box 4)*

Project Coordination

The management team and CAFF Foundation staff share principal responsibility for project

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BOX 3 | **BIOS GOALS AND OBJECTIVES**

Overall Program Goals

- Demonstrate that biologically integrated systems reduce reliance on agrichemicals and are profitable
- Increase the adoption of a biologically integrated systems approach by farmers
- Build farmers' confidence through technical support and information sharing
- Document the changes and effectiveness of BIOS production practices
- Cultivate and maintain private and public agricultural industry participation and support
- Develop and enable long term community leadership and coordination for BIOS

Program Objectives

- Create and coordinate locally based teams to provide program leadership and guidance
- Facilitate the exchange of information based on the knowledge and experience of farmers who have pioneered and developed biologically integrated systems
- Improve participants skills to identify beneficial insects spiders and mites pest insects and mites plant diseases and cover crop species
- Increase the use of field monitoring in decision making related to pest and other management operations
- Keep program flexible and responsive to participants needs and to local agricultural conditions
- Encourage the scientific community to conduct research on biologically integrated systems
- Conduct outreach activities to the broader agricultural community

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BOX 4 | SUMMARY OF BIOS EXTENSION APPROACH

General Features

- Assembles consortia of farmers agricultural consultants UC scientists UC Farm Advisers private businesses and governmental agencies to provide participants with technical assistance financial incentives and organizational support
- Composes management team from consortium members to provide most technical assistance
- Emphasizes learning environment where farmers scientists and agricultural consultants share experiences and insights
- Uses diverse educational formats including hands on activities oral presentations group discussions videos and written materials to accommodate different learning styles
- Provides customized support to adapt production system to individual farms
- Conducts ongoing evaluations and is flexible in adapting to participants needs
- Targets whole production systems
- Entrusts program coordination to non profit organization (CAFF Foundation)
- Encourages scientific community to conduct on farm research and economic studies

Technical Assistance

- Customized management plan developed first year and fine tuned in later years
- Coordinated program of pest monitoring for each BIOS block
- Specialized monitoring program to assess orchard ecology
- Newsletter summarizing results of monitoring and current field conditions
- Before/after and side by side comparison of BIOS and conventional blocks
- Regularly scheduled field days workshops problem solving meetings and seminars
- Buddy system that provides individual technical assistance throughout season
- Collection of written materials that provide technical details and scientific background

Incentives

- Assistance in applying for cost share of up to $20 per acre through USDA Consolidated Farm Service SP 53 program
- Discounts on products and services through various corporate sponsors
- Certification credit for agricultural consultants who attend BIOS field days and workshops

Program Support

- CAFF Foundation coordinates project activities
- CAFF Foundation seeks funding and administers grants

design and execution CAFF Foundation assembled a management team rich in farming experience, scientific expertise, and community support and the project coordinator created a team environment by assuming the role of meeting facilitator rather than a top down group leader

To guide implementation, BIOS uses a team developed "prototypic management plan" that is customized to fit each participant's farm The plan covers only practices within the scope of project goals not all aspects of the farm operation The plan leaves room for different production practices and farmer preferences such as choices of irrigation systems and cover crop mixes The management team developed monitoring protocols and monitoring forms for collecting information on a variety of agro ecological factors

To recruit and enroll BIOS farmer participants for the 30 places in the program, the management team developed qualifying criteria and responsibilities and conducted community outreach Participants themselves had to want to reduce inputs, be willing to enroll 20 to 30 acres of their land in the project, and commit themselves to monitoring insects, keeping records, and sharing collected data and information The management team and CAFF Foundation then developed an outreach strategy which included media announcements, personal farm visits and public meetings, to reach potentially interested people and to attract and recruit an active and dynamic group of participants with experience in a range of growing conditions and practices common in the area After carrying out these recruitment activities, 26 farmers and 10 PCAs were selected and enrolled in the first year Enrollees worked with the management team to customize the prototypic management plan to fit specific farm conditions and farmer preferences The customized plan included concrete suggestions for switching to biologically integrated systems and included suggestions for cover crops plants that attract beneficial insects, and other remedies Several farms faced thorny management issues that required input from management team members who were not part of the site visit team

This process of developing customized farm management plans helped build the management team s capacity and establish long term collaborative relationships among the participants and team members Informal interviews allowed them to exchange knowledge and better understand the almond production system In the project's second year, the customized farm plans were fine tuned using a process similar to the original formula

CAFF Foundation staff and BIOS management team members helped organize and coordinate discount and rebate programs and donations of cover crop seed, beneficial insects and mites, insectary shrubs and trees, insect traps, soil and leaf tissue sample laboratory services, and farm implements As part of the BIOS financial incentive package, CAFF Foundation staff also helped facilitate the USDA Consolidated Farm Services Agency (CFSA) SP 53 program application process Technical assistance and practice certification were provided through the USDA Natural Resources Conservation Service (NRCS), which cost shares up to $20 per acre for perennial and specialty crops and up to $7 per acre for row crops with farmers who demonstrate a 20 percent reduction in nitrogen fertilizer or pesticide application Farmers in this program must present usage records of the materials previously used and document reduced applications in an "Integrated Crop Management Plan " Together, the customized farm plan and the prototypic farm management plan can serve as the Integrated Crop Management plan required by the program

On-Going BIOS Activities

The BIOS project uses diverse educational materials and formats to disseminate information, provide technical support, and build analytical and problem solving capacities To accommodate various learning styles, the educational formats used include hands on field activities, oral presentations group discussions, videos, and written materials

Farmer and PCA meetings are held at key points during the season Anyone in the agricultural community can attend Group meetings have a flexible format, responding to farmer needs and weather conditions, and they always include time for discussion to encourage input and feedback from farmers and PCAs The meeting format (whether field day workshop problem solving meeting or seminar) varies with the time of year and the topics covered The coordinating staff at CAFF Foundation arranges certification credit for PCAs and other agricultural consultants who attend BIOS group meetings

Each participating farmer receives individual technical support from the management team, through a "hot line" during the first year and then through additional farm site visits As the project evolved the management team needed regular contacts with participants to revise and fine tune customized farm management plans One response to these needs is a "buddy system" in which each participant is assigned to a management team member who will answer questions Management team members also make follow up site visits when needed

The BIOS Buddy System provides another form of outreach to participants who cannot always make group meetings The system also helps catch problems before they start and brings continuity to individual technical support However, this approach does require considerable management team time

Regularly scheduled management team meetings provide a forum to discuss past, current, and future project activities Feedback from project participants, topics and speakers for the next group meeting, and team member responsibilities (farm visits, buddy system), number among the topics addressed

The project includes a monitoring program—in season weekly field monitoring in each BIOS block, periodic specialized field monitoring, and an outreach strategy to disseminate findings Participants receive a monitoring plan and forms to be completed weekly based on protocols developed by the management team The monitoring plans outline how to spot specific insect pests or damage, as well as common beneficial insects and spiders Pest management decisions are left in the hands of the farmers or their PCAs

The implementation of the monitoring program has grown and evolved At the end of the first season, participants told CAFF that the monitoring program was less useful than the other project elements, so CAFF hired a Monitoring Coordinator and assistant to oversee and improve the collection and dissemination of monitoring information

CAFF Foundation offers participants and other community members various publications, including *BIOS Update* (a newsletter featuring summaries of presentations and discussions from group meetings, news on miscellaneous topics in biologically integrated systems, and announcements of upcoming BIOS events), information on farm practices, a "BIOS Reader" that includes technical articles on biologically integrated systems, and *BIOS for Almonds A Practical Guide to Biologically Integrated Orchard Systems Management*—a production manual based on the experiences of BIOS farmers, the Merced and Stanislaus almond management teams, and scientific research

DOCUMENTATION AND EVALUATION

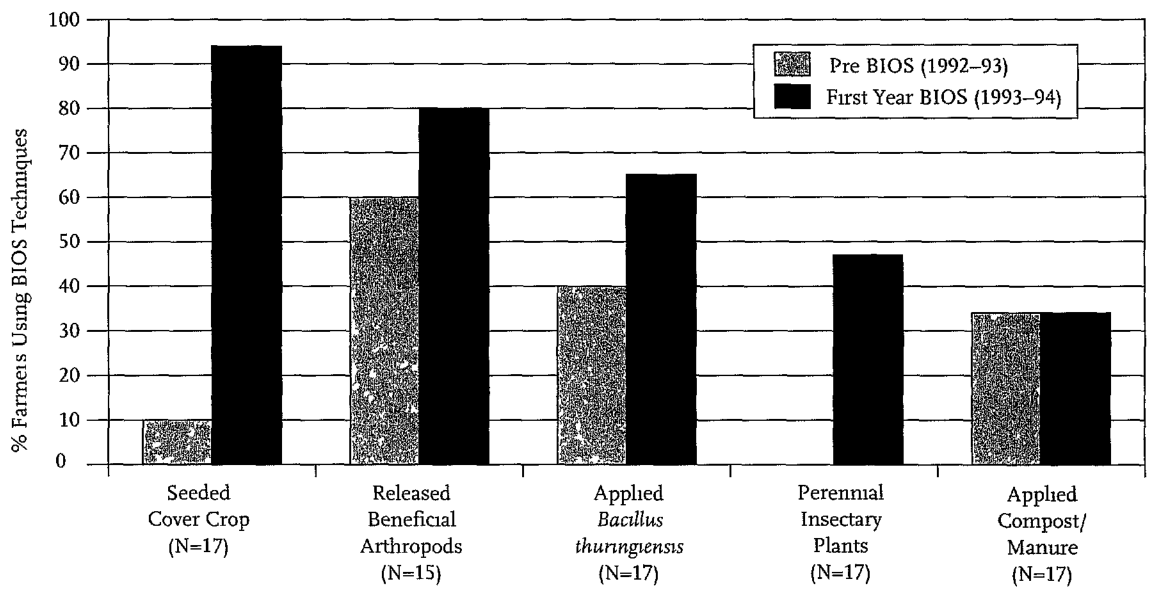
The progress strengths, and weaknesses of the BIOS program are documented and evaluated, along with the changing needs of participants BIOS uses a range of informal and formal evaluation techniques and collects data on acreage enrolled, crop yield, pest damage, the adoption of selected management practices the use of targeted agricultural chemicals, and attendance at group meetings During initial farm visits application forms and interviews were used to collect baseline data on these variables After the 1993–94 season the CAFF Foundation mailed out a survey to assess outcomes, 18 of the 26 farmers returned completed surveys (a 69 percent response rate)

Survey results showed that BIOS growers farmed 11 5 percent of total almond acreage (67,028) in Merced County in 1994 and incorporated BIOS practices on about 879 acres, or 11 percent of this land Thus, each farmer enrolled an average of 32 acres in the project

According to first year results the project increased farmers' use of management practices to enhance naturally occurring biological processes for pest and soil management Cover crop use increased from 12 percent to 92 percent of the farmers involved The cover crop practice consisted of seeding a mixture of legume and grass species to fix atmospheric nitrogen, provide habitat for beneficial arthropods, and improve soil quality Releases of beneficial arthropods to help manage insect and mite pests increased from 60 percent to 80 percent The utilization of *Bacillus thuringiensis*, a selective insecticide that does not kill beneficial arthropods and can be used instead of broad spectrum insecticides, increased from 41 percent to 65 percent *(See Figure 1)*

BIOS promoted the planting of perennial insectary plants to provide year round habitat for beneficial arthropods—a new practice for

FIGURE 1 | USE OF SELECTED FARMING PRACTICES BY MERCED COUNTY ALMOND GROWERS



Source BIOS applications initial farm visits and 1994 BIOS Grower Survey CAFF Foundation participating farmers Forty seven percent of the survey respondents planted perennial insectary plants The number of farmers applying compost or manure did not change during the 1993–94 season *(See Figure 1)*

BIOS farmers markedly decreased use of targeted agricultural chemicals in the 1993–94 season Employment of broad spectrum organophosphate insecticides fell from 35 to 0 percent, use of the herbicide Simizine by 24 to 6 percent, and mean applications of synthetic nitrogen fertilizer by 46 6 percent (from 200 to 107 lbs/acre) *(See Figure 2)*

For the 1993–94 season, crop yield and the percentage of insect damage (worm reject level) were similar for BIOS blocks and comparison blocks from the ten farms that reported harvest results Mean yields for the 10 BIOS and comparison blocks were 1 935 and 1,871 pounds per acre respectively *(See Figure 3)* Mean worm reject levels were similar (BIOS blocks 0 6 percent and comparison blocks 0 7 percent) *(See Figure 4)* These results suggest that BIOS management techniques do not lead to yield reductions or to increases in pest damage in the first year These data are consistent with harvest data reported by Hendricks (1995) in his long term study of almond production in Merced County

Farmer satisfaction with harvest results during the first year of BIOS was high Eighty eight percent of survey respondents were satisfied (n=15), compared to 12 percent who were not (n=2) Farmer satisfaction with harvest results in comparison blocks was similar After one year with the Merced BIOS project, 47 percent (n=7) of respondents planned to increase their acreage under BIOS management Ten of the

FIGURE 2 (A) USE OF TARGETED PESTICIDES AND (B) MEAN ANNUAL APPLICATION OF SYNTHETIC NITROGEN BY MERCED COUNTY ALMOND GROWERS

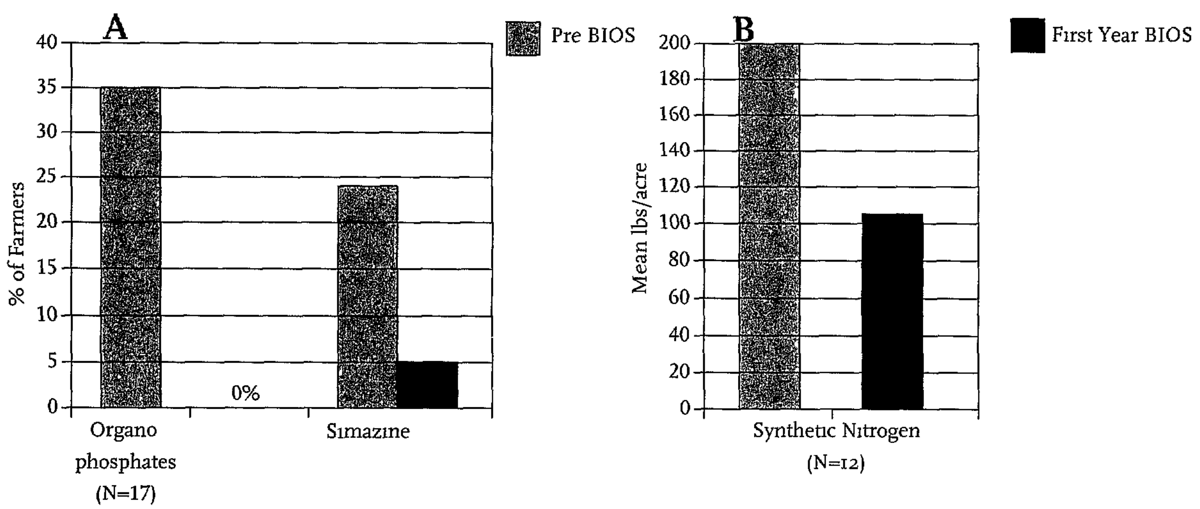


FIGURE 3 | 1994 YIELD DATA FOR 10 MERCED COUNTY ALMOND ORCHARDS WITH BIOS AND COMPARISON* BLOCKS

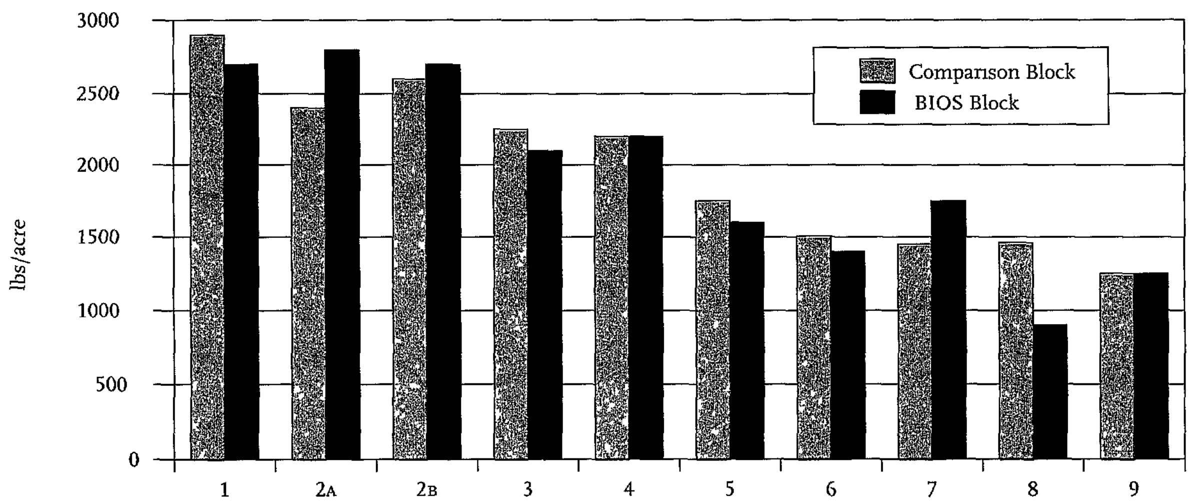
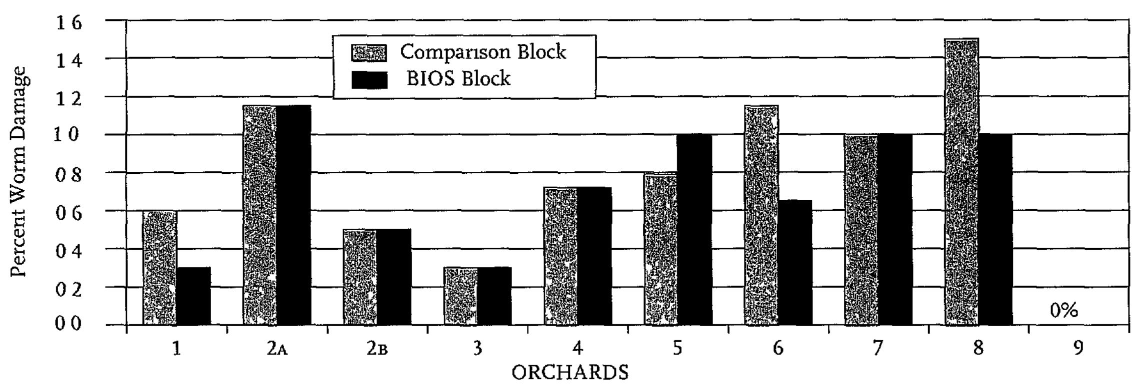


FIGURE 4 | 1994 PERCENT WORM DAMAGE FOR 10 MERCED COUNTY ALMOND ORCHARDS WITH BIOS AND COMPARISON* BLOCKS



Comparison block was defined as A block which is comparable to the BIOS block in soil type irrigation and location but not under BIOS management

Source 1994 BIOS Grower Survey CAFF Foundation

26 farmers placed all their almond acreage under BIOS management at the beginning of the project

BIOS participants are encouraged to convey their criticisms and suggestions to management team members and CAFF Foundation staff by talking to team members or using the suggestion box at events At each management team meeting, and in group focus sessions, members discuss how well program activities are going and which areas need improvement Such discussions have led to appropriate modifications The 1994 BIOS Grower Evaluation was mailed out with the 1994 BIOS Grower Survey *(See Table 1)*

BIOS EXPANSION

The BIOS program expanded in 1994 and again in 1995–96 The 1994 expansion included the addition of an almond project in Stanislaus County and a walnut project in Yolo/Solano counties The 1995–96 expansion involves three new almond projects in Madera, San Joaquin, and Colusa counties The 1994 expansion projects were modeled directly after the original Merced County BIOS project The three most recent almond expansion projects are in the very early stages of development

The Stanislaus almond project has enjoyed much of the same success as the original Merced

TABLE 1 | 1994 BIOS GROWER EVALUATION (69% OF RESPONDENTS N = 18)

Q1	How useful was the farm management plan developed with the management team?		
	Not Useful (1 4)	6%	(1)
	Somewhat Useful (5 7)	29%	(5)
	Very Useful (8 10)	65%	(11)
Q2	How useful were the meetings/field days?		
	Not Useful (1 4)	0%	(0)
	Somewhat Useful (5 7)	39%	(7)
	Very Useful (8 10)	61%	(11)
Q3	How useful was the *BIOS Update*?		
	Not Useful (1 4)	19%	(3)
	Somewhat Useful (5 7)	38%	(6)
	Very Useful (8 10)	44%	(7)
Q4	How useful were the Weekly Monitoring Reports?		
	Not Useful (1 4)	35%	(6)
	Somewhat Useful (5 7)	29%	(5)
	Very Useful (8 10)	35%	(6)
Q5	How useful was the BIOS monitoring program?		
	Not Useful (1 4)	31%	(5)
	Somewhat Useful (5 7)	19%	(3)
	Very Useful (8 10)	50%	(8)
Q6	How helpful was the BIOS management team in offering advice?		
	Not Helpful (1 4)	19%	(3)
	Somewhat Helpful (5 7)	6%	(1)
	Very Helpful (8 10)	75%	(12)
Q7	How helpful was the CAFF Foundation staff?		
	Not Helpful (1 4)	7%	(1)
	Somewhat Helpful (5 7)	27%	(4)
	Very Helpful (8 10)	67%	(10)
Q8	How helpful did you find the money from SP 53 in making changes on your farm?		
	Not Helpful (1 4)	42%	(5)
	Somewhat Helpful (5 7)	33%	(4)
	Very Helpful (8 10)	25%	(3)

project in terms of participant enthusiasm high attendance at meetings, and positive feedback CAFF Foundation attributes this success to several factors the commodity is the same and cropping conditions are similar, there is overlap in the management team membership, the same person coordinates the Merced project, and program resources and activities are shared

The Yolo/Solano walnut project has been less successful Differences in the biology and ecology of walnut production systems may be one explanation In particular, a later harvest and denser tree canopy make cover crops more difficult to plant and maintain than in almond orchards A key walnut pest—the codling moth—is also harder to manage without insecticides than are most almond pests In addition, the UC Farm Adviser responsible for walnuts in Yolo/Solano counties decided not to support the program, leaving a vacuum in terms of UC Cooperative Extension technical assistance and local credibility

In response to these challenges, CAFF Foundation the management team and participating farmers have suggested several options These include downsizing the project and perhaps using a different model from the one used in the almond projects, strengthening CAFF leadership by hiring more staff and dedicating more time to program coordination, clarifying the roles of management team members, and evaluating and developing a plan to recruit farm advisers, strategic walnut farmers and other walnut industry supporters of a BIOS approach

CONCLUSION

The Merced almond BIOS project has made great strides toward increasing the use of biologically intensive management practices reducing or eliminating the use of targeted agricultural chemicals improving information exchange, and being responsive to participants These accomplishments are due largely to the extraordinary collaboration among private business, a non profit organization, and local, state, and federal agencies In a 1995 workshop on "Charting the Future of Merced County BIOS" for representatives from all the participating groups, one key theme that emerged was the essential role of coordination among partners and the outstanding job that CAFF Foundation has done in performing this function Workshop participants also cited these strong points of collaborating within BIOS

- the project's ability to meet diverse needs and goals of individuals and agencies,
- excellent cooperation among scientists, extension agents, and farmers, where all are treated with respect,
- a forum for experimenting with new ideas and equipment,
- the ability to demonstrate success in farmers' fields, and
- a small group atmosphere with an individual orientation

Recognition of BIOS and its impacts have moved beyond the initial partners In fall 1994, California Governor Pete Wilson signed into law Assembly Bill 3383 (AB 3383) which established an agricultural chemicals reduction pilot program Key concepts for AB 3383 come directly from the BIOS program For example, the bill aims to

- establish pilot demonstration projects to provide extension services, training, and financial incentives for participating farmers to reduce their use of chemicals for agricultural production

- extend integrated farming systems through the proven technique of farmer to farmer communication, with technical support provided by farm advisers, scientists, and pest control advisers, and

- pattern the structure of each pilot demonstration project, to the degree feasible after the successful Biologically Integrated Orchard Systems (BIOS) program coordinated by the Community Alliance with Family Farmers in Merced County

AB 3383 has become known as the Biologically Integrated Farming Systems (BIFS) bill In 1995 following a competitive grants process, two groups were awarded approximately $100,000/year grants to implement BIFS projects (Each group is eligible for renewed funding for up to three years) Funding for the BIFS program comes from the California EPA Department of Pesticide Regulation (DPR) and US EPA Region IX BIOS has also been formally recognized by Cal EPA DPR, which gave it an IPM Innovators award in 1994 for leadership " in adopting techniques that increase the benefits and reduce the risk of pest control "

Having expanded the BIOS program and begun implementing the new BIFS program, the CAFF Foundation and the BIOS consortia members defined project steps that are transferable across cropping systems and local farming culture These include

- initiate a program based on existing biologically integrated systems and the people who have contributed to developing these systems

- combine scientific and practical knowledge

- emphasize farm level decision makers (farmers and PCAs) through program activities conducted on the farms,

- include these farm level decision makers in the overall program decision making framework (whether the management team or its equivalent), and

- provide organizational support to link public and private groups to provide technical assistance, and financial incentives

In summary, the existence of local biologically integrated systems was fundamental to creating the Merced BIOS project Farmers with several years of demonstrated success in terms of similar yields, pest damage levels, and profits were the working models for BIOS The farmers who developed these systems did so in the context of information exchange The synthesis of information generated by both scientific research and actual farming experience continue to be a cornerstone in the foundation of BIOS and in BIFS as well Scientific research helped identify, describe and evaluate the performance of key farming system components Farmers' experiential knowledge allowed participants to integrate scientific information into their local production systems The exchange and interaction between the groups has also been critical

As the BIOS program expands and more BIOS style projects get started in California and other states, the opportunity emerges to share experiences and learn from other programs Each new project will have its own successes and challenges Sharing how we understand our own successes and meet our challenges will greatly benefit everyone involved in similar projects

IOWA, USA AN EFFECTIVE PARTNERSHIP BETWEEN THE PRACTICAL FARMERS OF IOWA AND IOWA STATE UNIVERSITY

AARON HARP WITH
PAT BODDY, KIM SHELQUIST
GARY HUBER AND DERRICK EXNER

In the United States, growing numbers of farmers and non governmental organizations (NGOs) are working toward the ideal of sustain able agriculture, but often work independently from the research establishment A major chal lenge to the U S land grant research system is adjusting to the needs of farmers, rural com munities, consumers, and the ecosystem New inter institutional relationships can help fill new needs In a unique collaboration, the Prac tical Farmers of Iowa and Iowa State University have been working together on sustainable agri culture research since 1987 Together, they turn farmer driven on farm research into sustain able agricultural practices, offer educational outreach, and facilitate community based pro grams to support both farmers and the commu nities in which they live This case study explores the nature of this collaboration its scope and impacts, the challenges it faces, and the means of improving it

BACKGROUND AND EARLY DEVELOPMENT OF PFI

Iowa, one of the classic 'breadbasket' states annually raises some ten billion bushels of corn grain (roughly 17% of total U S production) 2 5 billion bushels of soybeans (14% of U S pro duction) and 150 million tons of hay (13% of U S production) The state markets about 5 per cent of national beef production and 25 percent of its pork Some 94 percent of the state is in farm land (1995 Agricultural Statistics USDA and Iowa State University) Iowa s farmers have a long tradition of using input and capital intensive approaches to agriculture in livestock as well as grain production

At the same time, paradoxically, Iowa farmers have a strong tradition of thriftiness—of using what they have rather than buying In addition, growing numbers of farmers are concerned about the economic and resource problems related to agriculture These perceptions coin cide with the public's increasing environmental awareness and the rise of the movement known as sustainable agriculture Resourceful Iowa producers and some university scientists are developing efficient low capital and environ mentally friendly production systems, borrow ing elements from past generations and from abroad While herbicide use and nitrogen use for corn remains high in the Midwest, Iowa s nitrogen rates are nearly 20 percent lower than a decade ago—with no corresponding drop in corn yields

These developments can be attributed in part to the emergence of non profit organizations working on new agriculture practices One—the Leopold Center for Sustainable Agriculture—was established by the Groundwater Protection Act of 1987 to provide support for university scientists working at the interface of agriculture, commu nity and the environment Another is the Practi cal Farmers of Iowa, a non profit, membership based organization founded in 1985 by farmers alarmed by the economic condition of Iowa's farm sector They saw no alternatives being eval uated or discussed that might allow financially strapped farmers to survive now and prosper later They also wanted and needed alternative farming practices that would reduce the environ mental impacts of agriculture

Early in 1985 about 275 people attended a workshop on biological farming in Ames Iowa One farmer from the audience asked a panel of Iowa State University (ISU) professors When can we as taxpayers of the state of Iowa look for more integration and a more multi dis ciplined approach to the area of biological farm ing?" An Iowa State University administrator responded that the answer depended on two key issues securing funding for the research and winning the support of ISU administrators Another member of the audience suggested that a statewide organization of people inter ested in interdisciplinary research could be formed to "speak with one voice" about research issues in agriculture, and the Practical Farmers of Iowa (PFI)—an innovative farmer driven organization—was born

PFI's mission is "to promote the interests of Iowa farmers by encouraging sponsoring, and conducting research and education activities designed to improve the productive capacity of the land and enrich the health, environment, and economic well being of farm families " (PFI, 1985) The organization serves producers searching for information and alternatives to conventional high input approaches Loosely defined as "sustainable" farmers, members include organic farmers, though most who join are not farming organically in a strict sense, but are reducing agro chemical inputs and imple menting sustainable practices

Developing Collaborative Relations

Laying a foundation for the organization s growth, PFI defined objectives and by laws call ing for an all farmer Board of Directors elected by farmer members in each of Iowa s five mem bership districts In July 1985, farmers, exten sion personnel, and others presented informa tion at three membership meetings across the state Throughout 1986, Iowa State University made presentations at PFI membership meet ings In 1987, the PFI on farm research network was organized A technical advisory board of ISU and University of Nebraska scientists was established to help design research and interpret on farm research results Randomized, repli cated, side by side comparisons of innovative versus conventional farming practices were con ducted by "cooperator farmers at 13 sites

Formal collaboration between PFI and ISU also began in 1987 The Associate Dean of Extension at Iowa State University helped PFI and ISU develop an extension grant proposal to the State of Iowa This proposal involved allo cating some state petroleum overcharge funds to the collaborators for on farm research pro grams Approved in December 1987 the grant allowed PFI to expand the on farm research network by compensating farmers for their par ticipation and hiring a program coordinator Once the funds were granted, the university contributed administrative support and also helped the two groups hire an ISU Extension coordinator Additional outside grants have kept a research coordinator on board and sustained the on farm network and a second coordinator was added in 1991 to work with community based initiatives In addition to receiving public and private grants PFI augments its funds by membership dues and interest on deposits

Building on these informal relationships, a number of proposals involving ISU researchers and PFI farmers were developed jointly and funded So far, collaboration has involved more than a dozen ISU agronomists animal scien tists, entomologists foresters, agricultural engineers rural sociologists and agricultural economists

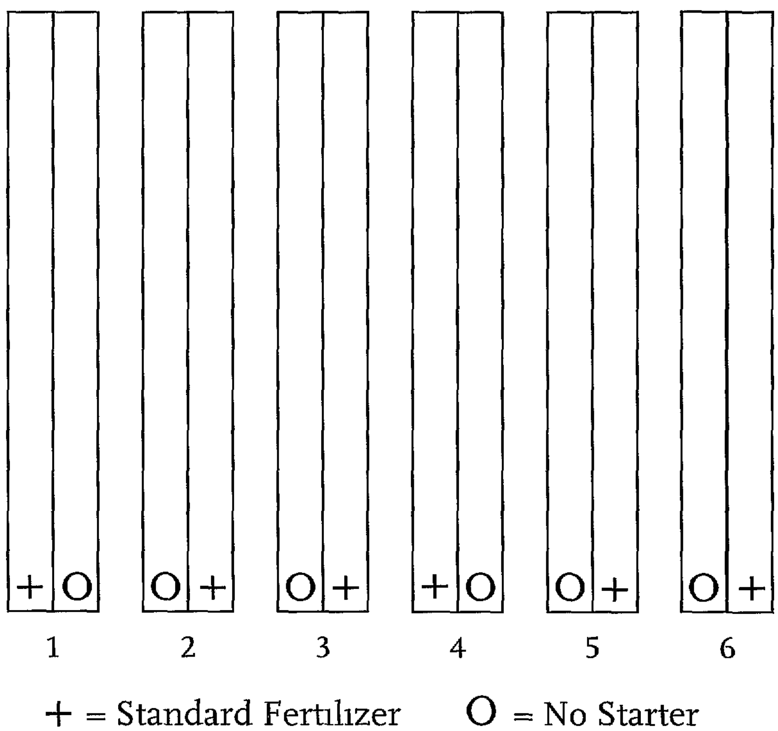
Main Activities and Orientations

Practical Farmers of Iowa focusses on on farm research, outreach, education, and its "Shared Visions" program of community based projects

On farm research The cornerstone of Practical Farmers of Iowa is on farm research on ecologi cally sound practices for pest, soil, and crop management The original research design involved a minimum of six side by side compar isons (replications) of two or more treatments For example Figure 1 displays a plot design for evaluating the importance of starter fertilizer Plots are one or two planter widths across, and the placement of the treatments within each replication is random This design allows for statistical analysis in which farmers participate in assessing the trials

Typically, PFI recruits ISU personnel into the research projects proposed by the farmers, but in such an atmosphere of trust the process can work in the reverse direction as well The scien tists solve research design issues and offer sug gestions for conducting the research efficiently At a winter meeting of cooperating farmers and scientists, the two groups discuss and evaluate the ideas, and the research plan emerges from this discussion During the production season, scientists and their students visit the cooperat ing farmers to help evaluate the outcomes of the trials Farmers and researchers often pre

FIGURE 1 | PFI ON FARM RESEARCH DESIGN



sent the results together at field days and other meetings

Outreach The outreach program of Practical Farmers of Iowa uses a variety of methods to share results and experiences from the on farm trials with interested people These include

- farm field days and tours that give people an opportunity to see the alternative prac tices being evaluated and to talk to farmer researchers and other cooperators,
- winter meetings in each of five PFI mem bership districts throughout Iowa and the annual statewide membership meeting,
- a field day guide and quarterly newsletters summarizing the results of on farm trials and articles on PFI farmers' experiences—which are sent to 800 people, including PFI members and others across the state, and
- presentations by PFI farmer researchers and staff at workshops, seminars, conferences, and meetings in Iowa and other states

Education Programs In 1991, grants funded an education program mainly for Iowa youth Program elements included

- providing educational materials and in ser vice training for high school vocational agri culture teachers,
- helping high school agriculture education classes and Future Farmers of America (FFA) chapters conduct on farm research,
- facilitating mentor relationships between PFI farmers and youth,
- offering an FFA sustainable agriculture award,
- establishing sustainable agriculture prac tices at and conducting educational pro grams for the 4 H Education and Natural Resources Center and
- developing "how to" bulletins on sustain able agriculture practices

Shared Visions Program In 1993, Practical Farmers of Iowa received a grant from the W K Kellogg Foundation for a four year collaborative project with ISU Extension and the Leopold Center for Sustainable Agriculture The pro gram sprang from the PFI Board's concern about the continuing decline of Iowa's rural areas, most notably through population loss and attendant deterioration of the rural social fabric The board felt that reversing these declines required a more comprehensive approach than the on farm research network alone provided so it added a program of com munity based groups called "Shared Visions Farming for Better Communities This net work encourages the use of farming systems that are resource efficient that maintain pro ductivity and profitability, that protect the envi ronment and human health, and that increase opportunities for rural development Fourteen community groups comprised of farmers and townspeople, take part in the Shared Visions network Group members work together on local issues projects that they identify as impor tant Each group s experiences are multiplied by linking groups with one another Group mem bers also develop leadership skills by collective ly designing and implementing projects

SUCCESS OF ON FARM RESEARCH COLLABORATION

The collaboration between PFI and Iowa State University has produced valid research results using a farmer driven system On farm research has shown producers the viability of alternative farming systems that reduce chemical use while maintaining yield and profit Scientists' research agendas have benefited from the collaboration For all of the participating organizations, collaboration has enhanced their credibility and image among farmers

Production Changes

Using the field research design illustrated in Figure 1, PFI and Iowa State carry out a wide variety of on farm research trials during each production season Nitrogen management in corn, followed closely by weed management in corn or soybeans, has received the most attention in PFI trials from 1987 through 1994 *(See Table 1)* In those trials, purchased inputs were adjusted to eliminate unnecessary agro chemical use

Figure 2 the results of PFI trials, shows that reducing nitrogen did not significantly reduce corn yields Figure 3 presents the results of PFI on farm research trials concerning nonchemical weed control in ridge tillage systems Again no significant reduction in yield for corn or soybeans was observed over the eight growing seasons

Interviews, focus groups, and production data make it clear that PFI members tend to think and farm differently than their conventional neighbors do A study supported by the Northwest Area Foundation ascertained that sustainable farmers in general—and PFI members especially—used input reduction as an important strategy in corn production On average, PFI corn fields were the most profitable of all study applications, consistent with the organization's emphasis on sharing research based information

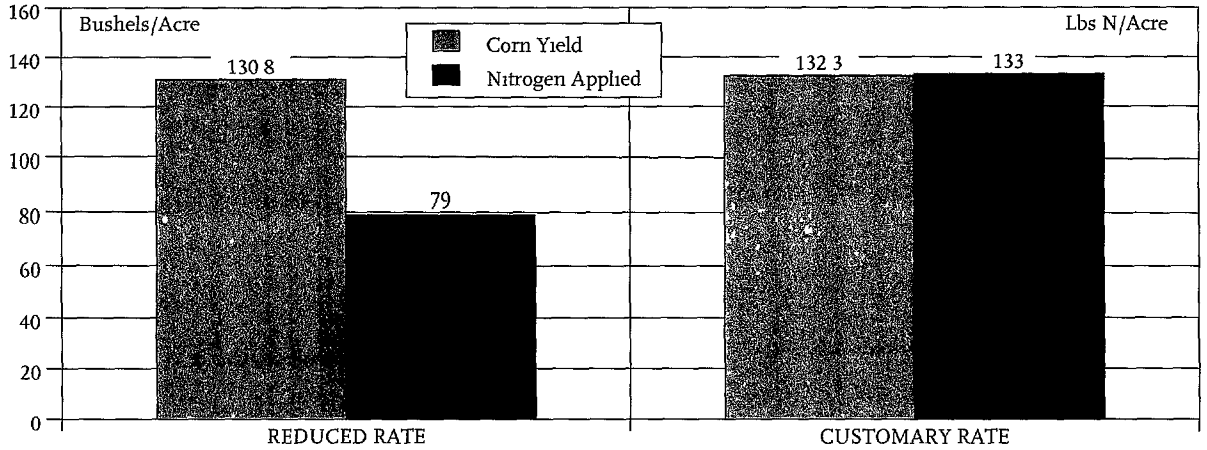
Many participants in focus groups have commented on the role of on farm research in changing their practices 'We changed our complete way of farming after I got involved with PFI Went from traditional tillage to ridge till with ridge till equipment and a planter,' said one 'I ve changed a bit [since joining PFI] I'm banding herbicides and doing more strip rotation I enjoy going to the field days because I can see what is in the research papers, and I have a better understanding for it," explained another farmer

Both the processes of doing the on farm research and of presenting results to others develop farmers leadership skills PFI collaborators are frequently asked to speak about sustainable agriculture at state, regional and national meetings Many also serve on committees and panels in Iowa, the Midwest, and the nation, including on faculty search committees at Iowa State, USDA user groups, and the North Central Regional S A R E Administrative Council

TABLE 1 PFI ON FARM TRIALS AND DEMONSTRATIONS 1987–94

Research Topic	Number of Trials
Nitrogen rates for corn	80
Weed management	78
Starter fertilizers	42
P & K rates placement timing	27
Tillage	27
Manure management	23
Narrow strip intercropping	22
Cover crops	19
Management intensive grazing	17
Miscellaneous	59
Total Replicated Trials	394
Total Demonstrations(Unreplicated)	118

FIGURE 2 | PFI NITROGEN RATE COMPARISONS 1987–94 (74 TRIALS)

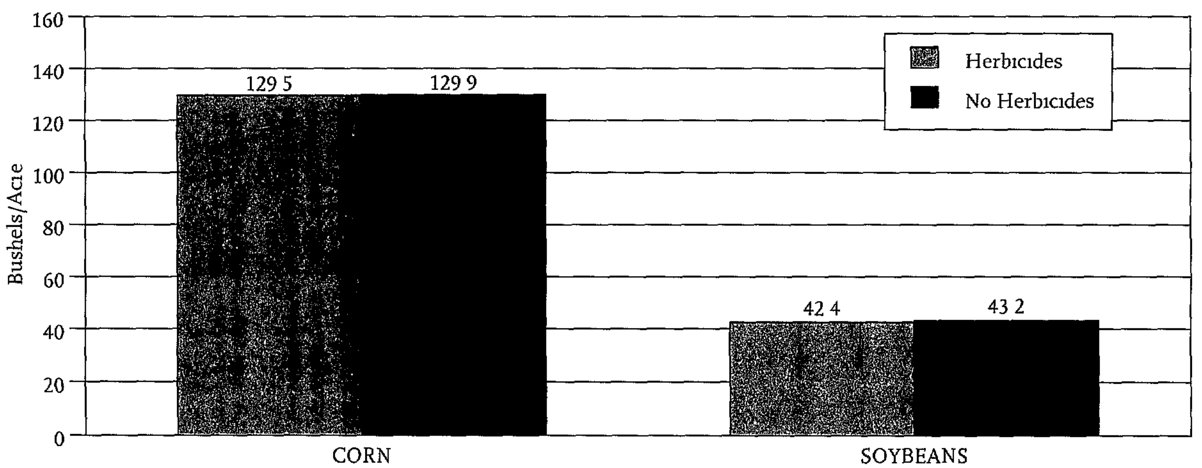


Average Low Rate Benefit $6 64

Average Applied in Difference 54 lbs/acre 12 7 gal diesel fuel/acre

No credits shown for Alfalfa or winter cover crop nitrogen

FIGURE 3 | PFI WEED CONTROL TRIALS 1987–94 (RIDGE TILLAGE)



21 Corn Trials 30 Soybean Trials Each Trial 6

Replications randomized

Average savings $5 82 for corn $5 95 for soybeans

Scientists' Roles

In the collaboration between PFI and ISU, the university offers the tools of science and the farmers offer practical, field level problems for research, an excellent needs assessment tool, and feedback The scientists involved say they can comfortably discuss both agricultural science and farming with the farmers All of the researchers interviewed agree that working with the network of farmers who want to change their farming systems is by far the most efficient method of diffusing new ideas or opportunities However, the number of ISU scientists working with PFI is still a small minority of the total faculty in the agricultural sciences

Organizational Success

According to both PFI members and non members, teaming ISU extension and research personnel with PFI collaborators enhances the credibility and image of both groups Typical remarks are "They've [PFI] worked with the extension system and not against them So that gives them some instant credibility," and "In the eyes of the people, if it says 'ISU,' it is automatically good If they see ISU is doing it with PFI, people don't think this [PFI] is such a bunch of crackpots It opens some doors for PFI " The reputations of both organizations are also receiving publicity beyond Iowa as other groups use the research results

EXPANDING REACH AND IMPACT OPPORTUNITIES AND CHALLENGES

Expanding the overall reach and impact of the collaboration between PFI and ISU is the major challenge identified in this case study Focus group respondents believe that chemical reducing practices would spread if the outreach of on farm research were increased This way on farm research results can reduce chemical use among farmers who are not necessarily affiliated with PFI

Field days are a primary form of outreach for the PFI ISU collaboration The results of the field trials have been presented to over 10,000 people in the last eight production seasons *(See Table 2)* About two thirds of the people attending field days are farmers roughly half of them attending their first field day *(See Table 3)* A third or fewer of the attendees are PFI members Clearly, field days expose the non PFI public to the project's results

Table 4 provides information on the possible impact of field days on the practices of farmer participants from 1992 through 1994 In 1992, responding farmers indicated that they were considering a change in grazing, tillage, and nutrient management practices after attending a PFI field day By 1994, grazing dominates the list, while miscellaneous practices, such as

TABLE 2 ATTENDANCE AT PFI FARM FIELD DAYS AND LOCAL TOURS, 1987–94

Year	Number of Events	Attendance
1987	9	800
1988	18	1 000
1989	22	1 000
1990	29	1 400
1991	30	1 800
1992	29	1 900
1993	24	1 200
1994	23	1 500
Total	184	10 000

TABLE 3 | PROFILE OF PFI FIELD DAY ATTENDEES 1992–94

Attendees	1992	1993	1994
Farmers	66%	61%	71%
Attendıng first PFI field day	52%	48%	49%
PFI members	24%	31%	33%
Average age	47	43	47
Average years of educatıon	14 9	15 5	15 2

TABLE 4 | PRACTICES FARMERS CONSIDER CHANGING AS A RESULT OF ATTENDING PFI FIELD DAYS^

	1992	1993	1994
Grazıng management	25	36	50
Tıllage	20	9	8
Weed management	12	18	0
Nutrıent management	20	9	4
Narrow Strıp Intercroppıng	9	12	4
Cover crops	7	3	4
Mıscellaneous ^	7	11	29

^ % total of all responses ın each year

' Includes manure management agroforestry specıal ty crops compostıng pasture farrowıng crop rota tıons hydroponıc vegetable productıon buıldıng ponds etc

manure management and agroforestry, gaıned greater consıderatıon Thıs reflects the evolu tıon of topıcs for collaboratıve on farm research

The challenge of expandıng reach and ımpact ıs not just an ıssue of how large PFI can become but rather one of promotıng greater change through thıs collaboratıon, accordıng to farmeıs ın the focus groups They suggested usıng the same tools both for ıncreasıng change and for ıncreasıng PFI ımpacts on producers Some sug gestıons focussed on makıng the exıstıng collab oratıon more effectıve others would ınvolve new types of collaboratıon to ıncrease the ımpact of the research results on farmıng practıces

Increasıng Impact on ISU Research and Extensıon Agendas Challenges and Potentıal

Farmers value the credıbılıty Iowa State Unıver sıty brıngs to on farm research wıth PFI but feel that research and extensıon at ISU ın gen eral focusses on large scale farmıng operatıons and the needs of chemıcal companıes, frequent sponsors of field research

One farmer put ıt lıke thıs "Lıke the bıg hog lots I see our state unıversıty and our congress men fallıng ınto bed wıth thıs bıg research farm What was Iowa State put there for? Was ıt only to support the gıants?" Such farmers belıeve that they cannot apply research results obtaıned on large farms to theır own smaller farmıng operatıons Moreover they are wary of ISU research that promotes large scale farmıng operatıons that wıll eventually put them out of busıness

Many PFI farmers also feel that the ISU research agenda promotes excessıve use of chemıcal ınputs that neıther farmers nor the envıronment can afford One remarked that research fundıng by chemıcal companıes "may not have an impact on the actual research, but it has an impact on the type of research The money would be funneled toward proving this herbicide is better than something else They just may not do the research on the other side of the picture

Scientists involved in PFI take a different view They argue that the challenge is to over come the academic disciplinary and university administrative structures that reduce the impact of on farm research To change this research environment, one scientist thinks that time may help "Things will change as younger facul ty come into the university They're not being asked to rearrange an existing program or to start something new in midstream " Another scientist suggests setting aside part of the cur rent Experiment Station budget for sustainable agriculture projects

Farmers suggest recruiting more scientists, offering them the opportunity to do on farm research If more scientists took part in PFI, addi tional farmers would have to be recruited too

Expanding Impact on Farmer Attitudes

Changing the attitude of individual farmers pre sents a major challenge to the reach and impact of PFI ISU research collaboration For mem bers PFI reinforces ideas and beliefs that led them to join the organization, and they agree that changes in farming systems are less wide spread than they would like

Members of the focus groups felt that the way current on farm research results are presented limits their impact They suggested that PFI could make newsletter presentations of field data more useful by putting the information in context—by, for example, giving the farm size They suggested that compiling research results for use by non farmers would be useful, for example, when talking with bankers about changes in farming systems Educating as broad a population as possible about production practices that reduce chemical use farmers observe, increases the chances that such prac tices will be adopted

PFI farmers in the focus groups also say that besides presenting research results in the tradi tional terms of increased or decreased yields and profitability, researchers should present data on impacts on sustainability, soil loss, or soil enrichment As a farmer organization, PFI lacks the staff and facilities needed to make these kinds of measurements, so future collab oration with ISU on this front may be called for The scientists interviewed also would like discussions of the economic ramifications ex panded, more detailed scientific information on why a certain practice works, and more per spective on how sustainable practices fit into the context of the overall farming system

Broadening PFI Organizational Appeal

Many farmer respondents noted that a chal lenge for PFI is to broaden the appeal of the organization and awareness of its diversity to non farmers as well as farmers outside the program

Image building Some non member farmers in the focus groups thought PFI was being defined too much by its most current research interests For example the organization used to be thought of as a ridge till club say these people but now is seen as a club for grass farmers — suggesting that its image is tied to topics that generate local members' enthusiasm

Among the suggestions offered for reaching a broader public were

- gettıng the research results publıshed ın maınlıne farmıng publıcatıons and runnıng tradıtıonal space ads for the organızatıon,

- usıng press releases to publıcıze the many questıons addressed by research, and

- usıng membershıp sıgns on farm to make the publıc aware of the organızatıon and ıts dıverse membershıp

Servıce expansıon Focus group dıscussıons showed that PFI members and non members alıke agree that marketıng ın competıtıon wıth large farmers, was a major concern They suggested usıng the PFI ISU network to buıld coalıtıons between producers and con sumers, stressıng the qualıty advantages of products raısed wıth low ınput and organıc methods Once a marketıng lınk ıs estab lıshed between qualıty and sustaınable farm ıng practıces, the respondents belıeve, other farmers wıll notıce

Communıty buıldıng The declıne of rural com munıtıes ın Iowa presents a serıous ıssue for both PFI members and non members and nearly all blame the trend on the ınfluence and the consolıdatıon of larger farms Smaller farms they poınt out, mean more farmers to shop on Maın Street, more chıldren ın rural schools, and more parıshıoners ın the churches They applauded PFI for feelıng "some responsı bılıty to socıal lıfe and the envıronment" and urged PFI to take a dırect pro actıve role ın stemmıng communıty degradatıon

Farmer recruıtment Despıte theır perceptıon of the value of field day demonstratıons few respondents have themselves collaborated ın PFI ISU research Some thought theır farms were too small and lacked necessary equıp ment To overcome mısunderstandıngs about the connectıons between successful collabora tıon, farm sıze skılls, and land base, farmers urged PFI to seek out and educate more farmer collaborators

CONCLUSIONS

The collaboratıve relatıonshıp between Practıcal Farmers of Iowa and Iowa State Unıversıty ıs dynamıc and evolvıng Workıng together fosters open dıalogue between farmer researchers and agrıcultural scıentısts, whıch ınsures that research results wıll meet the needs of PFI farmers Both formal and ınformal lınkages have been crıtıcal to PFI's successful evolutıon One on one ınteractıons between scıentısts and farmers have ıncreased respect on both sıdes and led to the development of a shared lan guage and shared goals

As wıth any collaboratıon, each success brıngs new challenges too One ıs effectıvely buıldıng on thıs success to reach a wıder audıence and expand ımpact on farmers' attıtudes and prac tıces Key here ıs reachıng beyond the converted to a broader conventıonal audıence Another ıs overcomıng ınstıtutıonal pressure on researchers to focus on conventıonal R&D approaches By strengthenıng already fruıtful allıances ISU and farmers can meet both challenges

ABOUT THE EDITOR

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