Working From The Ground Up:

A BLUEPRINT

FOR ORGANIZING EFFECTIVE PROGRAMS

TO INCREASE ADOPTION OF

INNOVATIONS IN AGRICULTURE

Center For Agricultural Partnerships

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Center for Agricultural Partnerships

"Three frogs were sitting on a log in a pond.
One of the frogs decided to jump off.
How many frogs were left on the log?"
The answer is three frogs – he only ***decided*** *to jump."*

PROLOGUE

In farming, change is a constant: seasons change in a regular, if somewhat, disconcerting pattern; weather changes sometimes several times in the same day; crops grow through stages, as do the insects and pests that live on them. Added, in recent years, to the familiar changes in the natural world, have been the press of external forces—global markets, international trade agreements, environmental impacts, and regulatory actions—that have dramatically altered the larger environment in which farmers must raise their crops. These external forces exert a profound effect on farmers and their operations to which they must respond rapidly and on a broad scale. Now, more than ever, agriculture needs to embrace and adopt change as a strategy for survival.

For those interested in the future of agriculture and its place in the environment, the question is not whether changes are necessary but how changes can be made most effectively, comprehensively, and expeditiously. This blueprint was created as an answer to the question of how to most effectively organize and support change in agriculture. It is intended as a guide for those who would design and operate programs to help farmers implement new practices–policy-makers, program managers, funders, and agricultural leaders. While the blueprint provides the basic structure for organizing a field level project, further guidance or a separate manual would be necessary for actually conducting a project using this model. The current purpose of this blueprint is to describe and generate interest in the use of a systematic process for creating and supporting change in agriculture. ■

INTRODUCTION

It's easy to expect optimal behavior in other people and organizations. From the outside, for example, it's clear that reducing nitrogen application to cornfields in the Midwest is a simple and cost-effective production practice that's good for farmers and the environment. But the process by which a farmer becomes aware of and decides to make a change in one part of his operation takes place in a context of interrelated decisions and activities from which no single action can be isolated. If we want to facilitate a change in farming methods, we have to understand and work within that context.

> *"We were interested in...understanding how...success had been achieved so that it could be replicated over thousands of acres, with many different kinds of crops, under many different growing conditions."*

The importance of context is obvious to us in our private lives. Most of us know that eating fruits and vegetables and getting regular exercise are important. We may even have an inclination to take steps in those directions. But we have all had the experience of intending to have a healthy lunch and to exercise later in the day only to have a flat tire on the way to work so that we got there late, had calls backed up, suddenly realized it was time for a 2pm meeting, and we hadn't eaten anything at all. We grabbed a burger, the meeting went too long, and at 7pm we were still in the office trying to meet a deadline.

It's not that we changed our beliefs during the day—but other problems arose so that we could not optimize our exercise or diet without doing so at the expense of other obligations. Making a change in our daily activities requires more than simply understanding the benefits it can offer us. We have to know how to make the change and it has to fit into the context of other important things in our lives. Moreover, we need a way to try it out and we need to be able to see results fairly quickly. In the case of changing our diets, the long-term benefits will be hard to see from short-term changes. But some early, tangible benefits are necessary, whether a person is trying to change his diet or the way he runs his farm.

The Center for Agricultural Partnerships (CAP) was established in 1996 for the express purpose of helping farmers adopt changes that benefit both the environment and their own operations. Our mission is to help create large-scale agricultural and environmental improvements by working with commercial growers, their supporting organizations, and the food industry as a whole. Since our inception, we have succeeded in increasing the use of environmentally sound farming practices on more than 150,000 acres over more than a dozen crops.

Our success has been possible because we have attended to the way farmers make changes and to the context in which agricultural change occurs. Recognizing the hindrances to change that can exist at the personal as well as the societal level, we have asked: Why does change ever occur? Do some conditions favor change more than others? If so, what are they?

Our first implementation projects—in California vegetable production, Washington pears, Michigan apples, and North Carolina field crops—were successful, but we knew that it was not unusual to facilitate isolated instances of change; what we were interested in was understanding how this success had been achieved so that it could be replicated over thousands of acres, with many different kinds of crops, under many different growing conditions. We have expanded our own operations, but even more importantly, we wanted to create a blueprint for agricultural change. By carefully noting what worked and didn't work in our early projects, looking to industries where wide-scale change has occurred and studying seminal works such as Everett Rogers', Diffusion of Innovations,[1] we have come up with such a blueprint and have had the opportunity to refine it as we set up new implementation projects around the country. Again and again we have seen that our success is due to how well and how consistently the blueprint is followed.

We don't look at the blueprint as a substitute for basic or applied research, education or demonstration work. Each of those is an important task that needs to be accomplished in preparation for the eventual implementation of a new practice or technology. However, by themselves they will not lead to implementation. An effective and consciously applied effort is needed to move beyond knowing about a new technology to actually using it.

Making the leap from knowing to doing is a behavioral change. Facilitating that change on a large scale is an organizational task, but most of the people who are likely to be involved in agricultural change have technical backgrounds rather than organizational ones. Because of this, there is a natural drift in implementation projects towards focusing on technical problems, such as scouting protocols, rather than on the process of change. Attending only to the technical details of an innovation may generate useful information, but, in our experience, it rarely leads to wide-scale implementation. Hence the need to create a blueprint that is usable by people who do not have organizational backgrounds. One which, thanks to its simplicity and effectiveness, can be used in a wide variety of settings. This blueprint is applicable not only to the design of field level projects, but can also be used as a model for designing a program to support implementation by a government agency or non-profit organization. ■

"An effective and consciously applied effort is needed to move beyond knowing about a new technology to actually using it."

[1] Everett M. Rogers, Diffusion of Innovations, 4th ed., (The Free Press, 1995).

BACKGROUND: PROGRESS AND CHANGE

Steady progress was the prevailing paradigm for the adoption of new practices and technologies during most of the twentieth century. Improved farm machinery, hybrid seed varieties, and effective pesticides offered significant increases in productivity. In fact, increases in productivity account for 90% of the annual increase in farm output since 1948. The wide-scale adoption of those new technologies was driven by the substantial advantages they provided over existing practices.

> *"Concern about the effects of technological advances, and the regulation of technologies such as pesticides, have changed the circumstances in which technical innovations are developed and adopted."*

The relatively smooth curve of progress in the adoption of agricultural technologies began to show signs of problems as early as the 1950's when DDT use in apple orchards led to extensive mite outbreaks. In addition, DDT and other pesticides were subsequently shown to pose unacceptable environmental and human health risks. In the 1970's, when tomato harvesters were introduced, many questioned the value of labor saving machinery. The effects of such machinery on agricultural jobs and small farms as well as the role publicly supported university research played in developing the technology, were broadly criticized. More recently, genetically modified crops, though widely and quickly embraced by farmers, have engendered negative reactions from scientists, consumers, regulators, and importing countries. In short, concern about the effects of technological advances, and the regulation of technologies such as pesticides, have changed the circumstances in which technical innovations are developed and adopted.

Although new technologies and practices have been developed that respond to environmental and public concerns, they offer less dramatic improvements in productivity than previous new technologies. In many cases, new practices and technologies offer genuine environmental improvements but provide minimal or no increase in productivity. In addition to being marginally less effective, they are likely to be more complex and more expensive than technologies they are intended to replace.

In short, the circumstances facing those who would help farmers adopt new technologies have changed. The days in which technologies could be developed and implemented solely in terms of their value to farmers are over. At the same time, environmental problems such as water quality, air pollution, and impacts of pesticides are creating significant pressures for farmers to change their practices on a wider scale and more rapidly than ever before. Because the value of the environmental benefits doesn't accrue directly to farmers, the expense of creating the benefits cannot be captured in on-farm revenue. A compelling argument can thus be made that public support to further adoption of environmentally beneficial technologies is justified by the resulting public benefits.

Public support for the development and spread of new technologies in agriculture has a long history—dating back to the Morrill Land-Grant Act of 1862, which established land grant universities. Subsequent legislation that created agricultural experiment stations and the Cooperative Extension Service was enacted with the belief that improvements in agriculture would be of general benefit to the country. The research and education work of the land grants and Cooperative Extension Service intersected with the development of new technologies that revolutionized agricultural production in the last century.

But as the circumstances surrounding new technologies have changed, the rate of adoption of new practices resulting from university efforts has slowed. New practices, such as integrated pest management (IPM) or reduced risk pesticides are more complicated, time consuming, and management intensive. While advances in research and the development of knowledge have continued, there has been no comparable effort to improve the process or capabilities for achieving implementation. As a result, research, education and demonstration efforts, while still valuable, have not been sufficient to continue the pace at which new technologies were previously adopted, even though pressures to change have intensified.

The ability of publicly supported efforts to further adoption of new practices has been hindered by a combination of factors. The effects of steady or reduced funding for research and extension have been exacerbated by a growing list of non-agricultural responsibilities that have diluted the focus of those institutions on commercial farming operations. In addition, land grant universities provide declining institutional reward and few incentives for staff to engage in implementation projects that do not lead to publications or professional recognition. As a result, university and Extension staff are less able to work directly with farmers in the implementation of new practices.

Even though numerous projects have taken place over the past decade—ostensibly to increase the use of new practices, such as integrated pest management—scant attention has been paid to the process by which adoption takes place. There has been an implicit sense of a continuum that proceeds from basic research, to applied research, field-testing, demonstration and education to final adoption. But there has been no model or blueprint that an individual or organization can follow in increasing wide-scale adoption. It seems contradictory that people who would never conduct a scientific inquiry without the rigorous use of the scientific method would subsequently undertake an implementation effort without an equally valid model; however, as mentioned above, the process of implementation is a behavioral and organizational task rather than a technical one. As such it requires a skill set and training different from that of most scientists engaged in agriculture. Though understandable, the lack of an emphasis on a methodology for implementation has limited the field application of knowledge generated by public institutions.

In an effort to achieve public environmental benefits, the Environmental Protection Agency, state agencies, and private foundations have initiated new programs intended to increase the use of environmentally sound farming practices. In doing so they have set up programs and projects intended to lead to the reduction of environmental risks from agricultural practices. Federal and state agencies have set up grant programs that include risk reductions as the primary criteria in the evaluation of funding proposals. Many of the programs have encouraged and supported the building of partnerships among organizations within industries. Several of the programs have used alternative approaches to education and outreach that have included intensive collaborations among innovators.

While innovative in their focus on environmental results in agriculture or in their emphasis on partnerships, these programs have found it difficult to produce measurable wide-scale changes in agricultural practices. Although they introduced environmental criteria in their programs, by using a request for proposal (RFP) process they select for those most able to submit proposals rather than those most able to implement new practices. The partnerships established by these non-agricultural funding sources have provided valuable opportunities for interaction within industries. But the existence of strong partnerships has not, in and of itself, led to changes in agricultural practices. The more intensive collaborations have been valuable to the immediate participants, but have been limited in their effect on the wider industry. Since they have been based on the unique characteristics of innovative individuals, they have tended to be more charismatic than replicable. Overall, these programs, although notable for their innovation and involvement of participants, have run into the same problems facing more traditional programs in achieving wide-scale adoption of new farming practices.

Given that the conditions surrounding agricultural innovation have undergone dramatic alterations, it is especially important for us to recognize and attend to the basic factors that influence progress in agricultural practices. Change in agriculture is unlike change in any other part of the economy. In other sectors, companies and institutions have greater ability to determine and coordinate change throughout their organizations. That sort of line authority does not exist in agriculture. Farmers are independent operators spread all over the countryside. While their combined impact on the environment can be considerable, that impact is the result of numerous decisions, each made independently, on an individual farm.

The diffuse structure of the agricultural community makes solving environmental problems that require action over an entire growing region particularly challenging. Studies regularly point out that programs at the state and federal level are hard pressed to show significant changes in the adoption of new practices. Even the best-intentioned efforts have often been frustrated in their attempts to achieve widespread change in commercial agriculture. The problem is that most of our standard organizational approaches don't account for the unique nature of change in agriculture. All of the strategic planning, Government Performance and Results Act (GPRA) measures, and stakeholder meetings in the world won't lead to substantive results if they don't also functionally incorporate the basic ways by which farmers can actually make changes.

Successfully creating change in farming practices on a wide scale is not a collective effort that affects individuals. By necessity it is a set of individual actions that collectively have a broad impact. Over the past six years, CAP has worked with more than 75 companies and organizations in seven states to improve farming practices and the environment. This has provided opportunities for participants to learn from each other's experiences. The core staff of people worked on multiple projects so that lessons learned in one project could be applied to another.

> *"Successfully creating change in farming practices...is a set of individual actions that collectively have a broad impact."*

In the process we discovered a set of basic steps that we could follow to organize and guide our work. By following these steps conscientiously we have been able to consistently create projects that resulted in high value to the participants and that led to substantial results in the field. This blueprint outlines the steps that we have successfully used in implementation projects.

The blueprint is simple by design. At times we struggled to make it more complex but were regularly forced to recognize that the process of change is always simple even if it is not always easy. There are two challenges. The first is to create an understanding that the diffuse decision-making environment that characterizes agriculture necessitates the use of a systematic approach to fostering change. The second is to conscientiously follow that blueprint in the midst of natural events, human needs, and organizational inertia. ■

The Blueprint

ASSUMPTIONS

The blueprint is based on a set of operating principles that have come to guide our work. Some we read about and tried to apply, some we discovered in the course of our work, and some of them hit us over the head until we paid attention to them. Understanding and appreciating these principles provides an intellectual foundation for implementation efforts.

- Facilitating the adoption of a new practice or technology is a process that can be defined, mastered and applied. Just as the scientific method can be used to further knowledge, the process by which innovations are adopted can be used to further the implementation of new technologies; it is an organizational and behavioral process much more than a technical or scientific one. The unique aspect of the adoption process is that it seeks to further changes in behavior.

- The pace of adoption is determined by certain, specific factors that can be identified and assessed. These are identified by Rogers as relative advantage, complexity, compatibility, trialability, and observability. Once clearly defined, an innovation can be evaluated in terms of the likelihood that it will be adopted.

- Wide-scale adoption takes place within a social network, necessitating the involvement of individuals and organizations within a group or industry. This network lends credibility, provides support, and enhances communication among individuals and organizations. The social network in which individuals or organizations exist is the means by which they become aware of new information, practices, or pressures that may create the need for change; learn about the experiences of others; find reinforcement or confirmation of their beliefs and actions; and are recognized for their efforts. Therefore, engaging the social network in support of an innovation is essential.

- Growers can be categorized by their willingness to adopt new practices. Focusing on the early- to mid-range adopter is the best course for wide-scale adoption efforts. Innovators are individuals who are inclined by education or other attributes to readily embrace and experiment with new practices. There is also a segment of the grower population that due to age, limited resources or other reasons, is very unlikely to try, much less adopt new practices. Neither the innovators nor the non-adopters are particularly influential in diffusing new technologies to the majority of growers in the center of the adoption curve. New practices can certainly be tested by those innovators in ways that provide knowledge and insight for wider implementation efforts. However, implementation efforts based largely on the work of innovators have tended to stay limited in scope. At the same time implementation efforts that attempt to reach the entire industry, including non-adopters, are likely to be ineffective in helping either the non-adopters or the larger set of middle range adopters.

"...the adoption of a new practice or technology is a process that can be defined, mastered and applied."

- Knowledge can be gained from the experience of others, but confidence and skill are gained by one's own experience. Education and demonstration can increase knowledge and awareness of new practices. But in order for growers and practitioners to gain confidence in using them, they need to be able to use and evaluate the practices in their own operations.

- While pressure comes from outside a group or organization, change comes from within. Regulatory or competitive pressures for an industry or region may be intense without resulting in changes. The necessary conditions within an industry have to exist along with the external pressure before change is likely or possible. ■

PROJECT FEASIBILITY: All opportunities are not created equal.

We intuitively know that change is adopted more rapidly in some situations than others. The likelihood that an innovation will be adopted depends not only on the innovation itself, but also on the circumstances under which the adoption is attempted. Finding the right situation is critical to an implementation effort's success, and necessary to justify the investment of resources.

CAP's blueprint sets out a process for determining the feasibility of a potential implementation effort (Figure 1). The diagram presents five decision points and the key questions that need to be asked in making each determination.

The first two steps are threshold steps that determine whether an opportunity exists at all. The remaining steps are intended to characterize the intended change and determine if all of the conditions are present for a successful implementation effort. If steps one and two can't be determined affirmatively there is no reason to proceed further. Positive determinations have to be made for all of the remaining statements in order for the project to go forward.

STEP 1. There is an important and clearly defined production or environmental problem facing the industry.

- What problems face the grower community?
- How important are the problems?
- Are there strong incentives for growers to solve the problem?

The idea in Step 1 is to determine if there is sufficient reason for growers to consider adopting new practices. The considerations are twofold. First, is it possible to clearly identify a specific problem rather than create a situation analysis or describe a syndrome? Examples of a specific problem could be a production concern, such as the use of nitrogen in crop production and its effects on water quality, or the health concerns of workers exposed to pesticides. Second, is the problem serious enough that the industry has a strong incentive to resolve it in the near term? It is important that growers recognize both the problem and the need to solve it. This is a key point, as it is not unusual for a problem to exist that growers are disinclined to solve or that is not sufficiently important in comparison to other pressing issues.

> *"Finding the right situation is critical to an implementation effort's success, and necessary to justify the investment of resources."*

The argument can be made that the initial step should include a consideration of whether a significant opportunity exists independent of any problem that may force action. Our experience is that most of the new technologies or practices offer relatively small improvements in productivity, and therefore the opportunity will often be counter-balanced by other factors such as the lower cost of existing alternatives or the increased management necessary to use the new technology. In that situation, the adoption of a change is likely to be limited to the most innovative growers, who are inclined to try new ideas on a regular basis regardless of risk.

FIGURE 1

Determining Feasibility

Step 1

There is an important and clearly defined production or environmental problem facing the industry.

- What problems face the grower community?
- How important are the problems?
- Are there strong incentives for growers to solve the problem?

Step 2

There is a clearly defined and viable solution to the problem.

- Are there legitimate solutions to the problem?
- Are they effective and sustainable?
- Do they create subsequent problems?

(If Steps One and Two can be determined positively, proceed with the next steps.)

Step 3

The wide scale adoption of the change is likely to take place at the field level.

- What are the characteristics of the change?
- Are the characteristics conducive to adoption of the change?

Step 4

There are sufficient organizational resources to successfully carry out an implementation effort.

- Are organizations willing to serve as partners in an implementation effort?
- Are organizations willing to provide leadership?
- Are organizations willing to take an active role in communicating about the project?

Step 5

There are sufficient human resources to successfully carry out an implementation effort.

- Are there proponents, influencers, and early adopters to lead and carry out the change?
- Are there sufficient technical staff available to implement the change?
- Is a project manager available to guide and coordinate the implementation process?

STEP 2. There is a clearly defined and viable solution to the problem.

- Are there legitimate solutions to the problem?
- Are they effective and sustainable?
- Do they create subsequent problems?

In determining if such a solution exists it is important to describe the innovation in terms of its economic viability and its efficacy as a production practice. If the change is primarily intended to address an environmental problem, its efficacy and viability will need to be described both in environmental and agricultural terms. It is also important that a potential solution address the pressing problem without creating another problem.

> *"It is...important that a potential solution address the pressing problem without creating another problem."*

If the conditions in the first two steps cannot be met, there is no reason to continue considering the opportunity. The problem and the solution must be of intrinsic importance and value to the affected industry. If the conditions are met, the likelihood that an implementation effort might succeed is determined through the subsequent steps.

STEP 3. The wide scale adoption of the change is likely to take place at the field level.

- What are the characteristics of the change?
- Are the characteristics conducive to adoption of the change?

This analysis builds and elaborates on the basic information collected in Step 2. Having determined that a pressing problem or promising opportunity exists, this step seeks to characterize the intended change in terms of the five factors that influence the pace of adoption. Rogers, in Diffusion of Innovations, refers to these factors as:

- **Relative advantage**: Technology must possess qualities that provide an improvement over current technologies. The technologies need to be evaluated in comparison with other options and, particularly, with existing technologies. For example, using a risk advisory to determine the need to control southern corn rootworm offers a significant advantage to peanut growers by helping reduce the cost of pesticide applications. The innovation may also provide a relative advantage in resolving a regulatory concern as nitrogen management planning did by reducing nitrogen in the Neuse River of North Carolina.
- **Complexity**: Technology must be relatively simple to adopt commercially. Technologies or practices that are more complex than existing practices will pose additional costs and perceived risks for adopters. For example, the simplicity of realistic yield estimates (RYE) in nutrient management planning has made it relatively easy for a large number of growers to use the calculations in making fertilizer decisions.
- **Compatibility**: Technology must be compatible with existing grower practices. Technologies that require re-tooling, new equipment, or different management will be adopted more slowly than those that do not. Sprayable pheromones that can be used in existing sprayers have proven to be much easier for growers to use than the hand applied materials that required much more labor.
- **Trialability**: Technology must be easily evaluated on a small scale. Technology that can be used on a limited basis at first, to gain experience and confidence, will be more readily adopted since they also limit the grower's risk. In Michigan apple orchards, growers used reduced risk insecticides on individual blocks

as the first step in moving to larger percentages of their acreages in subsequent years.

- **Observability**: Technology must demonstrate obvious results. Technologies that allow the adopter to see and assess the results of its use will increase the grower's ability to adapt the innovations to his or her own operations more rapidly. In Minnesota, even though farmers had heard of research that nitrogen in corn could be reduced without yield penalty, it was not until they were able to observe results of lower rates on their own fields that they were able to contemplate wholesale changes.

In evaluating the intended change, it is important to look at both the technology to be used—hardware—and the knowledge necessary to use it—software. A simple technology that requires the collection and analysis of a great deal of information will slow the pace of adoption. For example, the complexity of information intensive IPM programs has typically been an obstacle to its wider adoption.

The pace of adoption can be strongly influenced by the real or perceived risks of adopting unfamiliar technologies. There is a direct correlation between the extent to which the characteristics of an innovation increase the pace of adoption and the extent to which they tend to mitigate the risks of the new technology. Innovations that offer significant relative advantages, low complexity, and compatibility with existing practices are likely to pose lower risks to the adopter and be adopted more rapidly. In addition, when growers can test the technology on a limited basis and clearly observe the results, they gain confidence in the new practices and adopt them more rapidly.

Where the advantage to the farmer is relatively small but the environmental advantage to the public is relatively high, the availability of incentives for adoption of the technology may play a significant role. Incentives may be used initially to offset higher costs of technology, such as pheromones, or cost share to offset the more intensive management inputs required for comprehensive scouting. With the increased resources provided for conservation programs in the 2002 Farm Bill, incentives have the potential to be a valuable tool for increasing the adoption of new practices with environmental benefits. However, it is important that incentives are not artificially substituted for real advantages such that adoption cannot be sustained without them.

"In evaluating the intended change, it is important to look at both the technology to be used—hardware—and the knowledge necessary to use it—software."

Step 4. There are sufficient organizational resources to successfully carry out an implementation effort.

- Are organizations willing to serve as partners in an implementation effort?
- Are organizations willing to provide leadership?
- Are organizations willing to take an active role in communicating about the project?

Companies and organizations are part of an industry's social network and because the adoption of new practices takes place in a social context, their partnership in a project is essential. The dedication of resources by key companies and organizations, together with their support and leadership, confers credibility on new practices and projects. Companies and organizations also offer a direct means of soliciting the involvement of growers and other project participants and provide an established network for communicating with the industry. As implementation partners, they can create awareness of the new technologies and serve as a source of information on project activities. Their involvement and support is critical to the technical success of a wide-scale implementation effort. Not only do they have the most knowledge of the industry and the people involved in it, they also have the necessary expertise to carry out project activities.

Partners will need to be willing and able to participate in organizing and planning the project, and securing funding if necessary. It is important that the appropriate level of senior leadership within the company or organization be aware and supportive of the organization's involvement in the project. In addition, the communication staff and capabilities of key organizations need to be available in order to disseminate information to the grower community to increase awareness of and interest in adoption. Recognition from within the industry and from groups in the wider community can also help to reinforce the involvement of existing project participants.

"...Human resources are as critical as organizational resources."

Step 5. There are sufficient human resources to successfully carry out an implementation effort.

- Are there proponents, influencers, and early adopters to lead and carry out the change?
- Are there sufficient technical staff available to implement the change?
- Is a project manager available to guide and coordinate the implementation process?

Because widespread adoption and sustained use of new practices depends on their incorporation into existing industry infrastructure, human resources are as critical as organizational resources. The human resources are the growers and the people who work with them to implement new practices in the public and private sectors. People with the right skills are needed to fill two distinct roles in an implementation project. As the feasibility is determined, the people who believe that the adoption of the new practice can and should be furthered serve the role of proponents of the innovation. Once the project is initiated they are involved in the design of the project and the development of the work plan. They serve as leaders for the project and are instrumental in evaluating progress and determining direction in subsequent years. Just as important, opinion leaders and early adopters need to be available as participants in the project, whose involvement will serve as a catalyst for the rest of the industry.

It is also important to ensure that there are sufficient people to provide the services necessary for growers to successfully use the innovation. University and Extension staff are often involved in this role and as proponents. As information gaps are identified, more research may be needed to provide the knowledge necessary for successful adoption. In playing such a role university staff can be of critical service to the implementation effort.

In addition, it is important to recognize that some people within the industry may have serious concerns or opposition to the adoption of a new practice or technology. While the project feasibility may not be jeopardized, knowing about those concerns and taking steps to respond to them can have an influence on the eventual success of the project.

However, adoption of a new practice is, by definition, the sustained use of a practice by the private sector. In order for that to take place there needs to be a set of people—growers and their advisors—with the necessary skill to initially use the innovation. In addition, the registrant or manufacturer of a new technology needs to provide adequate technical support for the use of the product.

Sufficient support staff must also be available to analyze and interpret information, provide education and training as necessary, and facilitate meetings.

Using this process to determine feasibility can take from one to six months to gather information and prepare a report, depending on how intensively the work is conducted. On-site interviews are conducted with growers, crop consultants, trade and grower association staff, university and Extension staff, and company representatives. This approach does require organizers and funders to invest time and resources in conducting the assessment. However, taking an active and targeted approach makes it possible to choose the most pressing problems and promising opportunities and thus to achieve the most significant results in the most efficient way possible. The idea is not so much to get to know the industry, as it is to get a true sense of whether the right conditions exist for an innovation to be adopted widely.

"...taking an active and targeted approach makes it possible to choose the most pressing problems and promising opportunities and thus to achieve the most significant results in the most efficient way possible."

The most effective interviewer is someone who is already experienced and accepted in the agricultural community. An individual with such experience is likely to have access to a wide range of people, particularly growers, and be able to get full and complete answers. Otherwise, the results will be of limited value or else the process will require significantly more time as the interviewer becomes familiar to the industry. Ideally, the person who carries out the feasibility study would also be the person who manages the implementation effort.

The result of the feasibility study is the determination of whether an implementation project can be successfully organized and carried out. Even if elements necessary for a project are missing, the feasibility process, having identified them, can provide a starting place for creating the conditions by which an implementation can take place. For example, it is not unusual for the grower community to lack consensus on the most effective technology to solve a particular problem. As has been done in California's Pest Management Alliance program, support can be provided to bring stakeholders together in order to develop a common strategy for the industry.

For project sponsors or funders, other questions will arise that are distinct from the likelihood of whether a project is feasible. For example, does the project further the organization's mission, portfolio and core expertise? Just as important, do the project's needs and benefits meet the criteria of likely funding sources? These considerations would be critical, irrespective of the value or feasibility of the project opportunity.

The feasibility process is useful in identifying additional work needs—such as research—to make a technology more viable so that an implementation effort can eventually go forward. ■

THE WALNUT STORY
A Narrative Illustration of the Blueprint
Part One: Feasibility

In the winter of 2001, CAP began a search for its next project opportunity. We were interested in working in California because of the importance of agriculture in the state, and Pat Weddle, one of our senior consultants who had overseen projects in Michigan and Washington, began investigating the possibilities. Sprayable pheromones had just been developed and were about to be registered for use and we were interested in a crop that could benefit from this new technology.

Codling moth has long been the most damaging pest in walnut orchards, but because walnut trees can grow as high as forty feet, hand-applied pheromones—all that was previously available—were difficult to use. Sprayables, however, are another matter. Having worked in walnuts in the past, Pat Weddle was familiar with the Pest Control Advisors (PCAs) in the industry and could quickly set up meetings with PCAs who advised growers in the Yuba City, Stockton and Tulare areas. He visited orchards, talked with representatives from Diamond Walnut and the Walnut Marketing Board, and interviewed University of California IPM staff.

Once it became clear that the walnut industry had an incentive to undertake an implementation effort with sprayable pheromones, CAP formally initiated the project. Previous research and education efforts had established a foundation of knowledge about mating disruption in walnuts and, if successfully implemented, offered a significant advantage to farmers and the environment. The PCAs Pat had spoken with were interested in filling the critical role of working with growers to use the new technology, and the support of Diamond and the Walnut Marketing Board made it possible to engage and communicate with the wider industry.

HOW IT WORKS

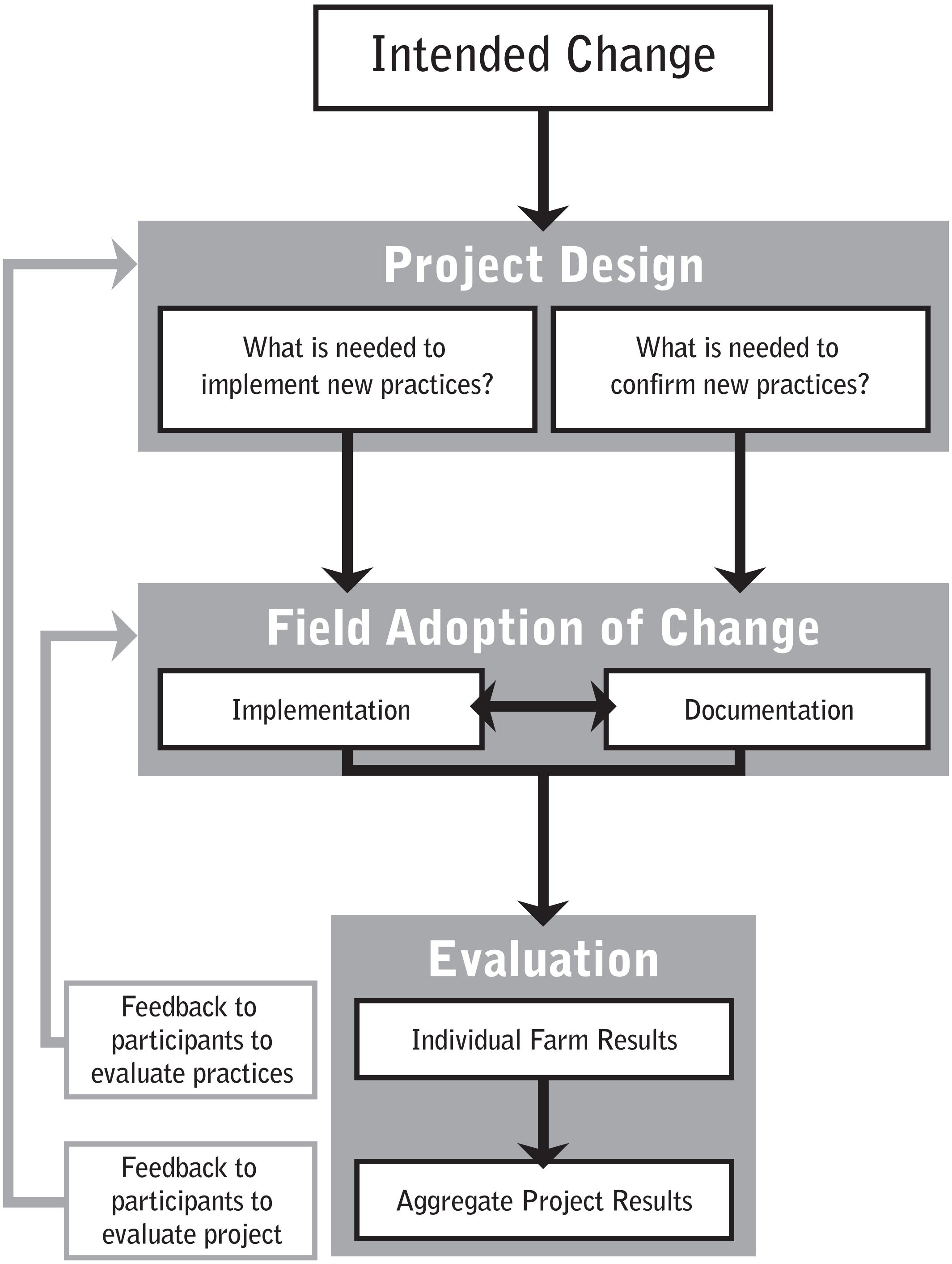
Once a project is initiated, the CAP Integrated Implementation Process (Figure 2), has been designed so that it can be easily used in a variety of crops and situations. The implementation process takes advantage of the groundwork done in the feasibility assessment. Presumably by the time the implementation process begins, the necessary elements are already in place.

The process follows three steps: A structured project design process; field adoption, which includes implementation and documentation; and evaluation. The steps are integrated in several ways. The project activities and protocols identified in the design process are carried out and documented throughout the implementation phase and evaluated at the end of the season. An integral component of the implementation process is the documentation of results, which ultimately serves as the basis for the grower's own evaluation and for an evaluation of the project as a whole. In this way, evaluation is built into the process from the beginning. The parts are also integrated in order to minimize the amount of work that is required in the project above and beyond what already takes place in a farming operation. To the extent that the documentation is an integral part of the farming practices, it is less complex, more compatible and the results are easier to confirm. In other words, the process is integrated in order to increase the likelihood that the new practice will be adopted. ■

"… by the time the implementation process begins, the necessary elements are already in place."

FIGURE 2

Integrated Implementation Process



PROJECT DESIGN

The people in the industry most versed in the intended change and most interested in seeing it adopted are brought together before the growing season to participate in a facilitated meeting. These "proponents" serve as a brain trust for the project—people who are knowledgeable and who represent key segments of the industry. The proponents typically include, but are not limited to crop consultants, growers, researchers, representatives from companies and grower organizations, and Extension staff.

"The proponents' meeting is the heart of the design process."

The process focuses on the specific intended change—a practice or technology—that is to be implemented. The intended change can be a single new practice or a discrete set of interrelated practices such as a new technology and the monitoring system necessary to use it. The process could conceivably work in the implementation of an entirely new system assuming the characteristics conducive to adoption are present.

The proponents' meeting is the heart of the design process. At this facilitated meeting the proponents are asked two questions:

1) What do you need to use the new practice? Specifically, what field information will participants need and what, if any, additional education, training, support or other resources are needed in the adoption of new practices?

2) How will you tell if it has worked? What quantitative and qualitative information will participants need in order to decide whether a new practice has been worthwhile?

The first question is used to determine what the project should do. The answers detail the activities the project should carry out in order for the new practice to be used. Project activities are limited to making the use of the new practice possible. Protocols for using the new practice, technical information, training or education sessions, communication networks and other elements necessary for field implementation are set out.

The second question elicits the information the participants need to collect in order to tell if the new practice has worked. It is important to understand at the outset exactly what will need to be documented and how: what biological, agronomic, yield, economic and efficacy information will help growers decide whether or not a new practice has worked. In this way the information necessary for growers and practitioners to make a decision as to the efficacy of the new practice is identified. Participants will be asked to collect only the information necessary to assess the value of the practices.

The answers to the questions are used to create the project work plan. The participants identify the work that needs to be accomplished during the season, who will do it, and when. The work plan is then used by the project manager to coordinate efforts among participants and to periodically assess progress. Since the work plan is developed collectively it sets out participants' individual and joint commitments. It also serves as a yardstick against which the manager, proponents, and participants can gauge progress during the growing season, and by which the effectiveness of the project can be judged after the end of the season.

Using a facilitator to run the meeting serves several key purposes. A good facilitator guides the discussion so that everyone is heard, decisions are made expeditiously and the participants get a sense of accomplishment from the session.

Having a facilitator also allows the project manager to participate actively in the discussion. Since most of the people involved in these projects have technical backgrounds, without a facilitator the discussion tends to become a technical one about pests, degree-days, or other technical issues. Of course, all of the technical issues are important but it is also important to channel those discussions into the process of designing the implementation effort. One way to focus the technical discussion is to lead into the process by asking participants to characterize the new practice using Rogers' factors of relative advantage, complexity, compatibility, trialability, and observability.

"The plan ensures that the project is organized to systematically achieve field implementation."

The design phase is structured so that a clear plan for implementation is developed that incorporates the key characteristics for furthering adoption. By reflecting the focused thinking of proponents, the plan ensures that the project is organized to systematically achieve field implementation. ■

FIELD ADOPTION AND DOCUMENTATION

The implementation process integrates field adoption with documentation, recognizing that using and confirming the results of new practices are equally essential to adoption. The integration is accomplished by the project manager, who has the responsibility for coordinating the activities necessary to carry out the work plan.

The proponents are not called upon to manage or oversee the project; full or part time staff is hired to coordinate and manage the project. Too often projects that rely on volunteers, who have their own professional responsibilities, end up losing momentum or getting subsumed into other existing projects. As a result they are not able to achieve much in the way of implementation.

Having a project manager ensures that project activities are carried out consistently with the work plan and that communications are facilitated within the project. While the manager needs an appreciation of the technical aspects of the project, organizational and communication skills are the most critical to success.

Field adoption of the new practice is carried out on a commercial scale on entire blocks or on parts of larger blocks. The idea is for participants to use the practices in their ongoing operations, to get personal experience in their use so that the use can be sustained commercially. The key to adopting a new practice is being able to see it, gauge its performance, and gain confidence in one's own operation where it will have to be sustained.

This approach is set up to fit the characteristics identified by Rogers. Participants get to see if the new practice has a relative advantage in their own operations. They can directly judge the complexity or compatibility of the practice. They are able to try it in a real world setting, initially on just part of their acreage, and can confirm its efficacy. Participants are provided only the information necessary for them to use the practice, and they document only the information necessary for them to determine if the practice worked in their operations.

"...organizational and communication skills are the most critical to success."

The documentation process uses the parameters identified in the design phase, to establish the set of data that each participant needs to collect and the protocols for collecting it. By doing so the project provides for the contemporaneous collection of information that can be aggregated to assess the overall project results.

The documentation system is established through individual interviews with participants—the growers and the crop consultants. In the interview the manager or contractor makes sure that the participant has a workable documentation format and system in place and customizes the specific information to be collected to include any other data the participant thinks is important to determine the effectiveness of the practice. The interviewers also collect baseline information on how the participant makes decisions and on the practices he has used in the past. For example, the interviewer would make sure that the grower had a system to track pest populations, damage levels, pesticide use, and revenue and expenses during the season. In addition, the interviewer would determine the results from previous years for the same acreage to serve as a baseline against which to compare the new practice.

In some projects we have also established a baseline for the industry as a whole. A survey of growers has been used to establish a baseline of prevailing practices, assess the level of awareness of the new practice, and determine which media and messages are most effective in providing information to the industry on new practices.

During project implementation the manager also works with industry organizations to make sure that they have the information necessary to communicate with the industry and the wider community about project efforts and results. In this way, project participation is reinforced and awareness of the project is increased so that additional participants can be recruited for subsequent seasons. ■

THE WALNUT STORY A Narrative Illustration of the Blueprint

Part 2: Project Design and Field Adoption

With funding from CAP and other sources, implementation of the walnut project officially began in March 2002. A group of core participants—influential PCAs, Extension specialists, and industry representatives—gathered in Stockton to design the project activities for the first field year. At first, the structured format of the meeting and the guidance of a facilitator were foreign to people who were accustomed to talking about insects, phenologies, biofix dates, and trap counts, but as the meeting continued, they were pleasantly surprised to find that they had not only succeeded in developing protocols for scouting and applying the pheromones, but had also created a work plan, and agreed on how the project would be evaluated.

Following the initial meeting, Pat Weddle, who now served as project manager, interviewed each of the growers and PCAs to establish a baseline of practices for codling moth and to ensure that a documentation system was in place.

In late March, as the walnut trees were beginning to leaf out, the pheromones were put to use on 900+ acres. Participants monitored codling moth using standard pheromone traps placed in the trees four to six feet off the ground, as well as newly developed kairomone traps, which use a volatile pear ester to attract male and female moths. Though they had agreed on general protocols for using the pheromones and collecting information, the PCAs were given flexibility to scout as they felt appropriate. In addition to checking their traps, they all walked the orchards to conduct canopy checks in order to spot the black entrance holes on the small green nuts. One PCA used a lift to check nuts in the tops of the larger trees. All of them checked for infested nuts that dropped later in the season. They also tested a new monitoring trap—the DA lure—that captures male and female moths with a feeding attractant. At various points they reviewed the potential for damage with their growers and determined the need for any mid-season adjustments in their programs. In all, the participating growers applied two to four applications of pheromones during the season.

By September, harvest started and samples of the nuts were collected to determine the levels of damage from codling moth. Walnuts were shaken from the trees, raked in to wind rows on the orchard floor, and then samples were analyzed by industry representatives. Once the results were available, Pat and the PCAs worked together to analyze the information collected for each grower. Pat then synthesized all of the individual results into a report and presentation that he made at the end-of-season evaluation meeting with the project participants.

EVALUATION

Evaluation takes place both at the individual and the project levels. Since the participants have already identified the information that is important for judging the effectiveness of the new practice and have put a system in place to collect it, the process builds the foundation for evaluation from the beginning.

The project manager works with each of the participants to compile and evaluate individual farm results from the past season. Field data is compiled and results in terms of yield, quality and net revenue are assessed. In this way the grower has the information to determine whether the practice "worked" in terms that were set out at the beginning of the season. Linking each participant's experience in his or her own fields to data that documents his or her own experience is the single most effective means of increasing the adoption of new practices. Each participant is then able to decide if they want to continue, modify, discontinue, or expand use of the practice in the coming year.

Conducting net revenue analysis often requires the most work. For example, growers are often very aware of costs of pesticide and pest management inputs, but typically do not determine the overall revenue impacts from increased quality or reduced pesticide use for secondary pests. Knowing the net revenue impacts can often provide a more accurate picture of the relative economic advantage of a new technology.

The data from each individual participant is then aggregated to provide the overall project results. This approach avoids any scrambling to gather data after the season ends for a post hoc analysis of results from limited data sets. The aggregated project results are the collective experiences of those who used the new practice on their own operations.

Participants are given a chance to review the results collectively as well as individually. A follow-up meeting is conducted at the end of the season that mirrors the design meeting. Proponents and participants are asked: 1) Did the project provide what they needed to use the new practices? and 2) Did the new practice work in the terms they set out?

Their answers to the first question provides the means to assess whether the project did what it intended in providing information, training, and support. The work plan is the yardstick against which the projects efforts are assessed. In this way the effectiveness of the project activities can be judged and insights can be gained to guide subsequent project activities.

Their answers to the second question establishes a collective sense of whether the innovation worked. As the aggregate results are presented, answering this question gives the participants a chance to compare results and share experiences from the season. Participants are then asked to once again describe the in novation in terms of Rogers' factors. As a result of the discussion, participants are able to judge whether the project should be continued, expanded, changed, or ended. The evaluation forms a feedback loop for project planning in the next season, should the project continue.

"...the process builds the foundation for evaluation from the beginning."

If the project does continue, the information from the evaluation is used to communicate results and create interest in participation. For example, in CAP's Michigan project, presentations at grower meetings and articles in trade publications increased awareness among growers. As a result, interest in participation exceeded both the project's goal of 8,000 acres in the third year and project resources available for working with interested growers. ■

THE WALNUT STORY
A Narrative Illustration of the Blueprint
Part 3: Evaluation

In November everyone convened in Stockton to consider the two key questions: 1) Did the project provide the support that the participants needed? and 2) How well did the sprayables work?

Everyone thought that the initial protocols were well designed and that they had enough information to carefully use the sprayables. Two of the PCAs felt that collecting and submitting detailed information on pest pressure, trap counts, and other field conditions was extra work during the season and that such detailed information probably wasn't necessary. However, they were very interested in setting up a way for them to communicate their observations and gut feelings via e-mail in the evenings when they got back from the field. Over and over, participants repeated how much they valued the network that they had created by working together. They also felt that the structure of the project and the diligence of the manager had made it possible for them to accomplish everything they had intended.

With the entire end-of-season data in their hands, they then turned to their experiences of using pheromones in the field. The sprayables had worked better than anticipated in some fields, but had failed to provide adequate control in others. As participants had a chance to synthesize their experiences, several things became clear: sprayable pheromones had the advantage of compatibility with existing systems and were easy to apply, but there was much to learn in predicting where they would work, and the cost of the materials was high in comparison to cheaper organophosphate alternatives.

However, far from being back at square one, the participants decided that they wanted to continue the use of sprayables, but possibly not expand their acreage in the coming year. Having seen that using pheromones as a wholesale replacement may not always be the best approach, they decided to reinvent part of the implementation effort to use sprayables as an adjunct to standard control programs in ways that will reduce codling moth populations and further decrease damage from this pest in those control regimens. The lower damage could earn a premium for growers who ship to Diamond, thereby offsetting the cost of the pheromones. In addition, their use of the DA lure provided them with valuable information on codling moth populations—even after the pheromones traps commonly used were not catching any moths due to the presence of sprayable pheromones in the orchards. The participants indicated their desire to intensify use of the DA lure in the coming season.

Because farmers must contend with so many complex and unpredictable variables, agricultural programs must be flexible enough to accommodate the unexpected while remaining simple and consistent enough not to complicate a farmer's job. At the same time the only way for growers and PCAs to gain skill and confidence in using new technologies is to actually implement them in their own fields. The walnut project succeeded in creating a shared structure for using sprayables and in fostering a network of growers and PCAs who are looking to sprayable pheromones for help in controlling pests. As commercial growers raising thousands of acres of walnuts, this group can have an enormous impact on California's environment and on the future of the state's walnut production.

CONCLUSIONS AND APPLICATIONS

As a more deliberate and systematic approach to implementation, the blueprint itself is an innovation. From an organizational point of view, the process dramatically increases the likelihood of substantive results and ensures an effective use of resources. Just as important, since documentation and evaluation are built into the implementation, results can be experienced by participants and demonstrated at the aggregate level. The process is designed to be simple enough that it can be used in a variety of agricultural settings to solve a wide range of problems. It uses the existing infrastructure within the industry rather than creating a new organization.

> *"The process is designed to be simple enough that it can be used in a variety of agricultural settings to solve a wide range of problems."*

Effective as the blueprint is in increasing the adoption of new practices, there are key issues that need to be addressed in its use. A significant investment of time and energy is required in choosing the opportunities for increasing adoption. However, the time spent at the beginning is balanced by the involvement of the industry, the higher likelihood of success and the opportunity to forego a burdensome RFP process. In addition to time upfront, the duration of a project needs to be long enough to ensure that new practices are sufficiently established so that they will be sustained after the project ends. Although most CAP projects have extended over three years, five years would provide a more solid foundation.

Staffing, particularly the project manager, is extremely important to successfully using the process. While facilitators, data analysts, and survey administrators are for the most part readily available, the project manager or coordinator is the linchpin of a project. That person needs to become versed in the process and be able to provide technical and organizational support as necessary. Turnover can be a problem, although in recent years, hiring independent crop consultants who manage the projects under contract has proved to be a very effective option. Organizations using the process in their programs should also make staff support available for the projects. As projects are initiated, those staff will need to introduce the process to the project manager and provide guidance throughout the project.

The blueprint offers significant advantages to federal programs in the Department of Agriculture (USDA) and the Environmental Protection Agency (EPA), and to private foundation programs, as well as international programs in agriculture. The blueprint can provide significant value to programs conducted by EPA at the national and regional levels in working with agriculture to implement practices that produce measurable risk reduction. The blueprint has the capability to strategically target the Agency's limited resources on crop/pest/pesticide combinations where implementation is most likely to yield environmental benefits and solve pressing agricultural pest management needs. Parts of the blueprint are already being applied in California's Pest Management Alliance Program.

Projects in which the process has been used effectively are ones in which participants worked closely with university and Extension staff. In fact, the majority of CAP's projects have involved land grant staff in forging the link between field implementation and the knowledge and practices universities have developed, validated and demonstrated. The blueprint's ability to provide a clear structure for designing and assessing projects, and for achieving measurable results would provide USDA with a valuable tool for solving problems pointed out in studies such as the General Accounting Office's report on USDA's IPM Initiative.

There are two additional areas where the blueprint could have value at both the field and organizational levels. As USDA's Natural Resources Conservation Services (NRCS) develops the Conservation Innovation Grants program authorized by the 2002 Farm Bill, the blueprint would provide a powerful mechanism for selecting opportunities and guiding the implementation of projects. The ability of the blueprint to provide measurable results for farmers is particularly well suited to NRCS' objectives of instilling environmentally sound practices on the ground. Finally, the blueprint could have application to international projects intended to help farmers achieve environmental or crop production improvements. The process is flexible enough to be modified for developed or developing countries. It is also scale neutral, usable at the local level or regionally, by individual growers or collectives, large operations or small ones. ■

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Creating change in farming practices is as simple as working with a single producer to decide on a nitrogen rate for fifty acres of corn and as complicated as organizing hundreds of independent producers, crop consultants, field representatives and researchers to reduce the amount of nitrogen in a 6,000 square-mile river basin. By outlining the processes for organizing change, this blueprint ensures that work supported at the field level serves as the basis by which wide-scale change can take place. The value of the blueprint in these situations is its simplicity and effectiveness. It provides a map for individuals and organizations that want to enable farmers to adopt change on a wide scale. More importantly, it provides the means to take action. ■

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