RESOURCE MANAGEMENT IN A DEVELOPING COUNTRY CONTEXT: IMPROVING DECISIONS BY CONFRONTING DIFFICULT TRADEOFFS IN COSTA RICA

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ABSTRACT

RESOURCE MANAGEMENT IN A DEVELOPING COUNTRY CONTEXT: IMPROVING DECISIONS BY CONFRONTING DIFFICULT TRADEOFFS IN COSTA RICA

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Though laudable and necessary, the international development field's recent shift toward more holistic approaches and methods presents a significant challenge to governments and stakeholder groups throughout developing regions of the world. The presence of critically important—but often conflicting—social, economic, *and* environmental objectives in decision making for international development point to the inevitability of some difficult tradeoffs; the need to give up something valued in order to gain something else that is also valued but for different reasons. This dissertation seeks to better understand, and gauge the effectiveness of, two approaches for confronting these kinds of tradeoffs in an international development context. Presented in three chapters, the dissertation begins by using insights from the decision sciences to discuss ways to address common pitfalls in decision making about the environment. The second and third chapters then report results from research that draws on these concepts and explores two approaches for confronting environment-development tradeoffs in Costa Rica: (1) a stated choice (SC) approach that relies upon conjoint analysis and (2) a decision analytic method based on insights from multiattribute utility theory. In addition to responding to policy oriented research questions, the second and third papers also set the stage for future analysis of both approaches from a methodological perspective.

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INTRODUCTION

For more than half a century, research and practice in international development has focused on improving the quality of life of people living in developing regions of the world. More recently, development agencies and organizations have recognized the need to also include priorities associated with environmental sustainability as part of their mission. This expansion of international development to include environmental objectives makes sense: in all regions of the world—developed and developing—human health and quality of life are directly linked to the health of the environment and the sustainable use of natural resources.

While entirely justified, this more holistic approach to international development presents a significant challenge to governments and stakeholder groups throughout developing regions of the world. On one side, communities must contend with rural poverty due in part to un- or underemployment. To address this problem, there is significant pressure in many countries—Costa Rica being but one example—to harvest forests and develop large stretches of land to produce agricultural products for export. On the other side is the recognition that socio-economic objectives must be balanced with environmental considerations. Adding to this complexity, the development of rural watersheds threatens many community water supplies, creating a conflict between local residents, farmers, developers, and governmental agencies.

The presence of these critically important—but often conflicting—social, economic, *and* environmental objectives in decision making for international development point to the inevitability of some difficult tradeoffs; the need to give up

something valued in order to gain something else that is also valued but for different reasons. This dissertation seeks to better understand, and gauge the effectiveness of, two approaches for confronting these kinds of environment-development tradeoffs in an international development context.

To start the discussion about methods, the dissertation begins by using insights from the decision sciences to discuss ways to address common pitfalls in decision making about the environment, then reports results from research that draws on these insights and explores two approaches for confronting environment-development tradeoffs in Costa Rica: (1) a stated choice (SC) approach that relies upon conjoint analysis and (2) a decision analytic method based on insights from multiattribute utility theory.

The first paper, *Five propositions for improving decision making about the environment in developing communities: Insights from the decision sciences*[1], presents the theoretical basis for the research. Decisions focused on managing natural resources in developing areas present some of the most imposing challenges to policy makers, scientists, and stakeholders alike. The response of policy makers and the technical community in the face of these challenges has been significant. However, I argue that the lack of attention devoted to supporting the underlying processes used to make these complex decisions is cause for real concern. To this end, I present five propositions based on work in the decision sciences that I believe stand out as essential for improving decision-making processes in developing communities.

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[1] This chapter is currently *in press* in *The Journal of Environmental Management.*

The second paper, *A choice experiment to address environmental, health, and economic development conflicts about pineapple production in Costa Rica*, discusses the results of the stated choice (SC) treatment conducted in the Atlantic Region of Costa Rica where decision makers and other stakeholders are faced with the need to confront challenging tradeoffs regarding pineapple production and environmental management.

A stratified random sample of 451 heads of household responded to a conjoint survey in which they were asked to choose among alternative pineapple production scenarios so that I could estimate weights associated with each of the presented attributes. Consistent with previous work on SC methods, these weights served as proxies for the tradeoffs across attributes (and associated resource management objectives) that people were willing to make.

The primary objective of this research was to help inform policy decisions by eliciting preferences for competing management scenarios from people living near pineapple plantations. Specifically, I sought to determine: 1) whether residents, when given a choice, would prefer current production practices or an alternative to the status quo; 2) if residents prefer alternatives to the status quo, what are the attributes and levels that most strongly influence their selection of an alternative?; and, 3) what tradeoffs—if any—would residents be willing to accept across various aspects of production?

The analysis suggests that most residents would prefer an alternative to the status quo if given the choice; that three of the six pineapple production attributes appear to most strongly influence community members' selection of an alternative,

although there is variation depending on where they live; and that residents are, for the most part, willing to make tradeoffs in terms of the kind and magnitude of improvements in pineapple production scenarios that they would find acceptable in order to see even a moderate reduction in negative environmental and human health impacts.

The third paper, *Structuring decision making in developing communities: Informing land use policy in Costa Rica*, discusses the results of the deliberative treatment carried out with 95 heads of household in the Limón Province of Costa Rica. Just like the participants in the SC study presented in paper 2, these respondents were also asked to evaluate alternative pineapple production scenarios, but they did so using a deliberative analytic swing weighting method.

Decades of research in the decision sciences tell us that these kinds of multiattribute decisions should be extremely challenging for decision makers. However, recent studies of structured decision making (SDM)—and, indeed the research reported in this paper—suggest that the quality of stakeholder input can be improved by ensuring that people address a series of basic principles relating to the clarification of objectives and their associated attributes, and directly confronting tradeoffs that arise during the evaluation of management alternatives when these objectives conflict.

Therefore, the objectives of this research were twofold: First, I sought to help inform policy decisions by eliciting land management preferences regarding the pineapple industry from people living in communities surrounding plantations. Second, I also studied the effectiveness of the SDM approach in a developing community context with a specific focus on whether this method might hold promise as a decision aid to

practitioners and policy makers working in other international and community development contexts.

The results suggest that although statistically significant differences appear to exist across respondents in terms of their priorities, these differences are not strong enough to impact the selection of preferred pineapple production scenarios. That is, the data indicate that most community members would find the same production scenario acceptable, even though they would all be required to make slightly different tradeoffs in order to arrive at the this decision. The experience from this research indicates that the SDM approach holds great potential for supporting complex decision-making processes in Costa Rica and other developing community contexts.

In addition to answering the policy oriented research questions presented in the second and third papers, another goal of my dissertation research is to better understand and improve the quality of decision-making processes in international development settings that increasingly must account for multiple stakeholders, conflicting objectives, and tradeoffs across development and environmental objectives.

Both SC and deliberative tradeoff analysis methods have strengths and weaknesses in developing community contexts, therefore, my next step will be to analyze these pros and cons from a methodological perspective and make recommendations for integrating more deliberation into conjoint surveys, and making deliberative methods like the swing weighting exercise described here, a more efficient data collection tool.

CHAPTER 1

FIVE PROPOSITIONS FOR IMPROVING DECISION MAKING ABOUT THE ENVIRONMENT IN DEVELOPING COMMUNITIES: INSIGHTS FROM THE DECISION SCIENCES

1. Introduction

Decisions focused on managing the natural environment, and the resources within it, present some of the most imposing challenges to policy makers, scientists, and stakeholders alike. Ecological systems, by their very nature, possess a high level of structural complexity. In some cases, management interventions aimed at addressing one aspect of a system will inadvertently affect many other components of the system leading to unintended—and sometimes unwelcome—consequences. In other cases, components of the system interact over large spatial or long temporal scales making it difficult to fully understand, or even recognize, interconnected phenomena. Making matters even more difficult, many ecological systems have endured repeated insults that have chipped away at their resiliency; as a result, there is the very real risk that certain management interventions may "break" some systems leading to irreparable collapse. All of this leads to a high degree of uncertainty surrounding ecological systems with respect to how they may—or may not—respond to management interventions.

Adding to these challenges, decisions about the environment are not simply decisions about the environment; they affect individuals, communities, business and commercial interests, and in many cases, entire nations. As a result, these decisions must contend with multiple, conflicting, and frequently poorly understood values that, in

turn, are linked to social, cultural, spiritual, economic, as well as other objectives or concerns. Complicating matters further is the fact that these decisions must often be made under severe time pressure, either because of impending environmental damage (e.g., as in the case of an acute stressor such as contamination) or because of political constraints faced by decision makers (e.g., the need to act under a given mandate). These challenges are particularly significant in developing communities[2], where most decisions about the environment directly influence the livelihood of one or more stakeholder groups. Due to the precarious socio-economic status of people in these areas, these direct—and even indirect—influences can have devastating effects on the ability of resource-dependent individuals and communities to sustain themselves.

For example, one of the countries in which we work, Costa Rica, takes great pride in being one of the 20 most biologically diverse countries in the world despite covering just 0.03% of the earth's surface. The country is also noted for its dedication to natural resource conservation, which has resulted in the establishment of numerous environmental laws and 160 continental protected areas. But, despite Costa Rica's environmental riches, its educated citizenry, and its proactive government, a series of poor decisions regarding land use and resource development over the past several decades have led to persistent environmental degradation in the form of significant problems with erosion, water contamination, and the loss of biodiversity. In turn, these problems have led to increased poverty and public health concerns in agriculture-

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[2] We use the term *developing communities* intentionally to encompass both developing countries as well as communities within developed nations (e.g., the Inuit in the Canadian Arctic) that, because of their local or cultural customs, or socio-economic situation, are largely detached from their post-industrialized parent nations.

dependent rural communities, while simultaneously threatening overall ecosystem health (Ballestero 2006; Sauma 2007).

We have encountered similar challenges when working in arctic communities. In the Nunavut Territory of Canada for example, climate change has resulted in visible physical changes that include increased melting rates of glaciers, sea ice, and permafrost. These changes have led to dramatic declines in arctic vegetation, indigenous wildlife, and—as a result—the health and safety of residents (as the stability of traditional food sources and built infrastructure erodes). When combined with pervasive poverty, extreme isolation, and a desire to maintain cultural traditions developed over centuries, resource management decisions in the north have taken on an aura of virtual impossibility.

The response of policy makers and the technical community working in these developing areas—including ecologists, environmental scientists, economists, sociologists, political scientists, and many others—has not been trivial. For example, much has been written—and indeed, much work has been done—to address the need for more comprehensive (in terms of how they are derived and understood) science-based inputs that better address key uncertainties and inform and improve the quality of decision-making processes in developing communities (National Research Council 2007). Development economists have worked to understand, and in many cases to help construct, conventional and contingent markets so they can better obtain the values that affected stakeholders associate with environmental degradation and protection (Whittington 1998). And, other social scientists have worked to bridge the

gap between these technical assessments and communities by promoting participatory approaches as a means of improving environmental decision making (Ostrom 1996).

There is no doubt that these are necessary and important steps toward providing both higher quality data inputs to decision makers and a more transparent, participatory backdrop for decision making. However, our experiences as researchers and facilitators of group planning and decision-making processes leave us concerned about the lack of explicit attention devoted to supporting the decision-making process itself. While some high-profile efforts have taken up this issue from a theoretical perspective (EPA 2000; NRC 1996; NRC 2008), many important questions and obstacles persist. For example, very little attention has been given to developing cross-disciplinary methodologies that would help to focus technical analyses and their associated outcomes on the stated needs of decision makers and stakeholders involved in resource management consultations. Likewise, there has been only limited work on how this information is used (or misused) by decision makers when designing management alternatives or when informing tradeoffs when management objectives conflict. And, importantly, there have been few comparative studies of competing decision support approaches.

We view the barriers to achieving more effective processes for combining analysis and deliberation through the lens of the decision sciences. From this perspective, many of the problems typically encountered as part of unsuccessful resource management processes (involving both expert and non-expert participants) stem from the absence of a cohesive framework that brings together often disparate technical and social threads during the process of decision making. Such a framework

helps diverse participants to clarify and express their issue-specific values and concerns; have a voice—and, if necessary, a hand—in setting technical agendas aimed at characterizing resource management problems and their potential solutions; be involved meaningfully in the development of a recommended resource management alternative (or alternatives); and think carefully about the costs and benefits of competing alternatives. At the same time, such a framework helps decision makers to account for and confront well-known cognitive limitations and judgmental biases that are associated with highly complex and uncertain management contexts.

Using these concepts as a guide, this paper presents five propositions based on work in the decision sciences that we believe stand out as essential for improving decision-making processes in developing communities. These propositions, each one building on its predecessor, are based on findings from research and practical work that has taken place in a variety of developing communities and across a wide range of resource management contexts.

2. Five propositions for improving decision making in developing communities

2.1 Decision-making processes must account for the constructive nature of preferences.

One of the assumptions widely held by social scientists and policy analysts is that people possess a pool of pre-existing preferences that they consult during the process of making judgments. Just as people are assumed to have preferences for things like foods, drinks, pets, and political parties, they are assumed to also have preferences about alternative strategies for economic development and environmental protection. Indeed, survey research—whether based in sociology, political science, economics, and related disciplines—would not be possible were it not for the assumption that these

kinds of preferences preexist and can be consulted by respondents during elicitation processes.

It is true that, in a variety of contexts, such preexisting preferences can indeed be indentified. For example, developmental psychologists have shown that people spend their lives establishing preferences based on past experiences. Some of the resulting and well-established preferences tend to be quite broad like preferring dogs as pets to cats. Others are much more specific, like preferring greyhounds to beagles. Moreover, these established preferences can quite easily be consulted during the processes of judgment and decision making (Slovic & Lichtenstein 2006).

However, recent research in the decision sciences has demonstrated that there are also many situations where existing preferences or preference orders needed to inform required decisions are insufficient or absent altogether (Arvai et al. 2006b; Gregory & Slovic 1997; Slovic & Lichtenstein 2006). Generally, these decision contexts share one or more of the following three characteristics: *First*, the decision context may be foreign with the implication that preexisting preferences simply cannot exist. In this case, it is impossible for a decision maker to consult preexisting preferences for decision problems that they are unfamiliar with or for alternatives that they have never been exposed to before. *Second*, decision makers may be faced with the relatively common situation in which the evaluation of competing alternatives causes two or more preexisting preferences to conflict. In evaluations of resource management plans in developing communities, for example, it is not uncommon for one alternative to be particularly strong in terms of promoting economic development opportunities but weak in the area of protecting the environment. If other alternatives under consideration

provide the opposite suite of benefits and costs, then decision makers who would otherwise prefer alternatives that provide opportunities for economic development *and* environmental protection will be required to confront a challenging and potentially uncomfortable tradeoff. *Third*, people tend to have a difficult time translating qualitative expressions of preference into numeric ones. While it may be the case, for example, that some decision makers strongly prefer management alternatives that emphasize environmental protection, how would they express these preferences on a Likert scale? Alternatively, how would a relatively weak preference translate into decision makers' willingness to pay for programs that promote environmental protection?

Under these very common conditions, people are unable to evaluate decision problems and alternatives by simply drawing upon preexisting and stable preferences. Instead, they must *construct* their preferences—and by extension, the decisions that result from them—on the spot, largely in response to cues that are available to them during the decision-making or elicitation process itself (Payne et al. 1993). From this point of view, deliberative processes convened by researchers and development practitioners—be they experimental or practical, or employed by individuals or groups—have the *de facto* purpose of serving as architects of judgment and decision making rather than as tools for simply revealing, as would an archaeologist, a person's preexisting preferences.

The implications of preference construction for decisions about the environment in international development contexts—and elsewhere—are far reaching. But at the most basic level, this view of constructed decision making calls into question the generally accepted tenet in environmental management that better science (i.e., more

rigorous qualitative and quantitative findings from a wide spectrum of technical disciplines) and broader public participation will yield higher quality decisions. We won't argue against the philosophy behind these guiding principles; indeed, better science *should* be preferred to worse science just as broad participation *should* be preferred to an absence of it. However, neither of these ingredients account for what happens within the decision-making process itself. In other words, in addition to better information and deliberation, more attention must be paid to what happens within the process of decision making itself.

Facilitators (i.e., researchers, policy analysts, development practitioners, etc.) of decision-making processes must, therefore, do a better job of accounting for how both information about problems and deliberative processes are used—or misused—during the construction of preferences. And, recognizing that decision makers rely heavily upon contextual cues that are available to them during elicitation procedures as they construct preferences, it is the responsibility of facilitators to provide the best possible context—or structure—for decision making (Arvai et al. 2001; Gregory et al. 2001). Essentially, we believe it is the role of those who facilitate decision-making processes to help people construct the highest quality preferences—i.e., preferences that are well informed, deliberated, and defensible—that are possible under given resource constraints (e.g., time, information, cognitive or computational abilities).

It is worth noting that many advocates of broad-based participation worry that too much structure will lead to biased input and unnecessarily constrain the breadth of public involvement (e.g., see a review by Fischhoff 2005). While we agree, we would also argue that more is needed than just an invitation for interested parties to

participate, respond to information, and deliberate. Such an approach, which is typical of many participatory environmental management efforts, possesses substantial shortcomings in terms of helping people to construct thoughtful and comprehensive preferences in complex or unfamiliar contexts. For example, decision researchers have long demonstrated that, in these kinds of loosely structured situations, both individuals and groups grapple with a relatively predictable set of difficulties when making complex decisions. Many relevant examples come from work on framing effects (Tversky & Kahneman 1981), prospect theory (Kahneman & Tversky 1979), economic valuation (Kahneman & Knetsch 1992), heuristics and biases (Tversky & Kahneman 1974), affect (Wilson & Arvai 2006), and uncomfortable tradeoffs (Tetlock et al. 2000). One of the fundamental conclusions from these lines of research is that people often end up making decisions that—at best—only partially address the full range of their concerns because they do not fully consider or comprehend information that is available to them and, subsequently, fail to confront required tradeoffs when evaluating competing alternatives.

Such findings suggest that along with the provision of information about a problem coupled with opportunities for participation and deliberation, an overall framework for decision making is needed to help structure relevant information so participants can better understand often complex issues (Arvai & Gregory 2003). A comprehensive decision making framework focuses on helping people to address one or more of five[3] basic needs, with each individual element supporting the next, as required by a specific decision context. These are: (1) clearly defining the decision

[3] We will discuss these further in subsequent sections.

problem that is to be the focus of analysis while taking into account the boundary conditions under which the decision must be made; (2) identifying objectives that will guide the decision-making process; (3) creating logical and internally consistent alternatives that directly address these objectives; (4) establishing the predicted consequences that are associated with alternative courses of action; and (5) confronting inevitable tradeoffs when selecting among alternatives (Hammond et al. 1999; Keeney 1992).

Some decision contexts in developing communities—e.g., comprehensive tourism planning efforts (e.g., see McDaniels & Trousdale 1999) and the design of payment for environmental services (PES) programs (Engel et al. 2008; Pagiola 2008)—will likely require explicit attention to all five elements of this framework. Other more tightly bounded (but not necessarily simpler) decision contexts, such as the application of contingent valuation methods and social surveys will likely require only certain component parts (e.g., clarifying objectives and addressing tradeoffs). Regardless of the context, it is our view that without explicit knowledge of and attention to these details during decision making, input from people—including interested and affected stakeholders, policy makers, technical experts, etc.—may not accurately reflect their carefully constructed preferences and judgments.

2.2 The basis for development decisions must be realistic and relevant.

Policy makers and researchers increasingly recognize the need to conduct development work in a way that engages local decision makers and stakeholders in a more open and participatory manner for both normative and instrumental reasons (Dietz & Stern 2008). But despite this growing awareness—which has contributed to and is supported by a

rich interdisciplinary literature—most community development decisions continue to be based on the perceptions and objectives of outside researchers, practitioners and donors (typically foreigners from developed countries or nationals who are unaware or, worse, disrespectful of the local context), instead of the needs of local stakeholders and managers. This discrepancy, in turn, leads to decisions that are largely insensitive to on-the-ground constraints and realities (e.g., regarding the specific nature of problems, management objectives, alternatives, and desired tradeoffs). Often, the result is development decisions that are short-lived or ineffective because they are *unrealistic* or *irrelevant* to those for whom resources are being managed. In practice, these failures to adequately address local realities and needs may transform well-intentioned efforts that have real potential for effecting meaningful and positive change into projects that ultimately fall well short of meeting this goal.

First, development decisions risk being unrealistic or irrelevant if decision makers fail to appropriately define the scope of decision problems (or opportunities) or recognize the boundary conditions under which they must be made, implemented, and monitored. It's one thing to approach development decisions with high ambitions about protecting a given resource and the communities that rely upon it. However, to do so without accounting for local legal, political, economic, institutional, ecological, or cultural constraints represents a significant barrier to successful implementation, monitoring and enforcement.

This is not to suggest that high aspirations during decision making for community development should be blindly curtailed. Work by other decision analysts in developing communities (Gregory & Keeney 1994; McDaniels & Trousdale 1999) has been explicit

about the need to think carefully about the scope of problems and openly question apparent constraints in terms of how decision problems are defined or bounded. Particular emphasis has been placed on challenging and expanding problem statements that needlessly narrow the range of alternatives that managers and stakeholders might consider. The same is true of expanding resource management initiatives to account for both the full spectrum of stakeholders that should be involved in development decisions and linked decisions, which are those that may influence parallel or future decision-making processes. In our experience, a failure to include key stakeholders or consider linked decisions, which might be folded into ongoing development efforts with relative ease, often results in a cascade of other significant problems that may appear only after time-limited development efforts have come to an end.

At the same time, however, it is crucial that managers and local stakeholders determine the appropriate scope and scale for problem statements that will be the focus of decision-making efforts. Doing so means ensuring that the problem statement that is to be the focus of development decisions is relevant to the people who will be affected by it and, importantly, realistic given the resources that can be brought to bear on addressing it. Development decisions must also be robust enough to survive and thrive in light of political changes—e.g., changes in local, regional, or national leadership—that tend to occur both quickly and often in many developing areas, especially at the regional level. If these conditions cannot be met, managers should be prepared to either allocate additional resources (e.g., time, money, expertise, etc.) to the decision-making process or simplify it by reducing its scope.

Alternatively, an overly narrow problem statement can just as easily render technically sound resource management efforts unrealistic, and therefore, ineffective. This often occurs when the management problem is developed in the absence of key stakeholders. The resulting lack of diverse knowledge tends to allow the problem to be oversimplified to the extent that resource degradation is attributed to one sector or group of people. This overgeneralization of what is usually a complex issue makes it difficult for stakeholders to address the problem in a holistic manner. In Costa Rica's Osa Peninsula, for example, resource managers dedicated to protecting biodiversity originally viewed the local population's resource and land use practices as the principle threat to the area's flora and fauna. As is typical in this kind of situation, the overly narrow problem definition (i.e., deforestation, poaching) contributed to the exclusion of local people from the decision-making process that was intended to respond to threats to biodiversity. The absence of these legitimate stakeholders from resource management efforts was subsequently seen as unproductive and ethically unacceptable, and efforts have been made to improve this situation. In the meantime, however, many opportunities to both make the problem statement more realistic and address multiple linked decisions related to the issue of biodiversity protection (i.e., rural economic development, land use planning, cultural preservation, local knowledge) have been missed (Jimenez-Elizondo 2004).

Development decisions also risk being *unrealistic* or *irrelevant* if they do not respond directly to stakeholders' problem-specific concerns and related objectives. Being clear about the objectives that will drive management efforts will help to identify those who should be involved in the decision-making process. In most consultations,

for example, it will be important to include both local residents and technical experts (who might be from industry, government, or the academy) and to include representatives of a wide range of viewpoints. To the extent that key participants are omitted, critical concerns and objectives are likely to also be ignored. The scale of the initiative also matters. Selecting participants for a small local project may be relatively easy. But, for a larger, more complex undertaking—such as one with national or international implications—some limits will need to be placed on the set of participating stakeholders (Gregory et al. 2001).

Thorough elicitations of management objectives from key experts and stakeholders also helps to differentiate between means and ends. *Ends objectives* are those that fundamentally matter in the context of the decision-making process. *Means objectives*, by contrast, matter primarily because they influence one or more of the ends objectives (Keeney 1992). These objectives can be visualized—e.g., using means-ends networks, value trees, or influence diagrams—which can help to clarify the set of concerns that are central to the majority of stakeholders. Even though the weights placed on the various ends objectives—in other words, their relative importance to each participant—may be quite different, the knowledge of these means-ends relationships helps to focus and give direction to subsequent deliberations; this, in turn, can greatly assist in the identification of a prioritized list of adaptation or mitigation actions (e.g., what to do first, what to do later, etc.).

Failing to accurately account for these objectives during decision making, however well intentioned, may lead to significant problems for managers, development professionals, and donor agencies for two main reasons. On the one hand, they stand

to lose credibility and local support because their work is judged as irrelevant in many communities. On the other, resources may be wasted on addressing problems that miss the mark in terms of what matters most to affected stakeholders.

During one of our projects in eastern Costa Rica, for example, we learned from local stakeholders about a recent U.S. university-funded study that focused on estimating the economic value (e.g., to inform the design of a PES initiative) of protecting community access to drinking water sources. The objective that guided this work—protecting community *access* to local water sources—had been identified by a well-intentioned foreign research team without consulting local stakeholders. Only at the end of the project did it become clear that while *access* was of concern to a very small group of residents, it was largely irrelevant to the vast majority of people in the community. Most people enjoyed easy access to water but were much more concerned about its safety as a result of what they perceived as unacceptably high and unregulated levels of pesticide runoff from adjacent pineapple plantations. The research team in the field realized, too late, that they were not helping local stakeholders to address their primary objective, which was to ensure clean and safe drinking water. Community members, in turn, did not hesitate to express their frustration that resources (including money, their time, and expertise) were being spent on an issue that they considered to be of secondary importance. And importantly for the local community, the proposed PES initiative—which could have been designed to address the objective of *safe* drinking water—was abandoned.

In addition to being an inefficient use of scarce resources, these kinds of breakdowns in decision making also demonstrate the practical difficulties that arise

when insufficient attention is paid to the knowledge, concerns, and objectives of local stakeholders. Importantly for developing communities, these breakdowns in process can lead to further harm to already vulnerable people, communities, and ecosystems.

2.3 Expand deliberative processes to account for the expertise of local communities.

In our experience, the problems described above occur to a large degree because foreign researchers, practitioners, and donors working in developing communities rely too heavily on their own beliefs, expertise, and past experiences when diagnosing—and then addressing—resource management problems. This is not to belittle the knowledge, ideas, or past work of these individuals and groups. But, while their expertise can be valuable—and their resulting ideas and insights well intended—outside experts frequently fall short of directly addressing the problem-specific concerns of local people and communities. As we note above, one way to address these shortcomings is to consult meaningfully with community stakeholders during the early stages of project development. But beyond working with communities to fully define decision problems and elicit objectives, recent work in the risk and decision sciences points to the importance of expanding the definition of "expertise" in community development efforts. Doing so levels the playing field between local people and those with specific technical training, and accounts for the value and community-specific expertise of local communities.

One way to achieve this goal is to engage community stakeholders in decision making in a way that moves well beyond the consultative role advocated by earlier, influential studies on deliberative democracy (Arnstein 1969; Renn et al. 1995) and more recent work—which we outline above—on eliciting objectives that will guide

decisions. The US National Research Council (NRC) has written thoughtfully about this issue, framing it as a matter of implementing what it terms an “analytic-deliberative” process. The premise of the NRC’s analytic-deliberative framework is relatively straightforward with community members and scientists (social, behavioral, physical, natural, etc.) working together to jointly define decision problems and, importantly, set the research agendas that will be used to develop the information base aimed at addressing them (National Research Council 1996).

At the start of an analytic-deliberative process, preliminary data describing the current state of an at-risk human-natural system informs an initial phase of inclusive deliberations aimed at helping to define the overall decision problem (expressed in terms of the likelihood or extent of harm to the system as well as its measured or predicted consequences) to be assessed and managed. This first round of deliberation then provides important and much-needed insight to the scientific community and analysts about ways in which the ongoing assessment—including methods for data collection and, to the extent it is possible, the attributes and measures used to characterize incoming data—and its subsequent interpretation for decision making ought to take place. This, in turn, provides the information on which to base these and future decision-focused deliberations (National Research Council 1996).

One of the frequently ignored aspects of decision making is *operationalizing* the objectives that will guide a given choice. It is of little help to a decision maker to express an objective—such as improving the health of the environment or enhancing the stability of communities—without having a very clear and appropriate sense of exactly how to measure it. In order to complete this important step, decision makers

must identify the *attributes* of the objective that will be the focus of measurement (i.e., data collection). The process of establishing the attributes and related measures that will be used to evaluate the performance of alternatives requires analysts, stakeholders, and decision makers to consider what kinds of data exist or could be obtained, and where information is lacking or highly contested. It is at this point that evaluations, which should focus on information to support decisions, can—and often are—confused with assessments of "expert knowledge". This confusion typically results in the designation of attributes and measures based more on what kind of data and inputs are readily available, easy to obtain, or familiar rather than on the insights of stakeholders and decision makers regarding what kinds of information could best help them to evaluate how well proposed alternatives address stated objectives (Keeney & Gregory 2005).

As the complexity and uncertainty surrounding a risk to be managed increases, so to does the degree to which the analytic-deliberative process becomes recursive. As envisioned by the NRC, a typical analytic-deliberative process would proceed through several successive rounds of deliberation and analytic work by stakeholders as part of a purposeful march towards a management decision. Each round of analysis and deliberation is meant to yield an improved understanding of both stakeholders' objectives as they relate to a given decision problem and anticipated responses of a system to alternative management options. In this sense, the analytic-deliberative process is not simply a means for synthesizing the information obtained through a set of unrelated risk assessments; it is an important shaper of a long-range risk assessment and decision-making process (National Research Council 1996).

The analytic-deliberative process has been endorsed widely by researchers and practitioners; the four common findings that underlie most endorsements are that: (1) The results of the associated technical analyses will be more decision-relevant insofar as they are framed in terms of measures and attributes that make the most sense to, and are most desired by stakeholders and decision makers; this presumably makes it easier for decision makers and interested and affected parties to recognize and respond to changes within a system; (2) The process fosters greater trust in the overall risk management process; this includes greater trust by stakeholders in the analytic community and greater respect on the part of the analytic community for the level of sophistication in thought displayed by stakeholders and decision makers; (3) Analytic-deliberative processes lead to a higher degree of learning about the social and technical drivers of at-risk systems by all of the parties involved—stakeholder and analyst alike—and by extension, work to reduce uncertainty (also see Section 2.5, below); and (4) Analytic-deliberative processes lead to more defensible and thus, higher quality risk management decisions insofar as they are specific to a well-defined problem, responsive to the objectives and concerns of stakeholders, and informed by decision-relevant science.

The net result is that, within this analytic-deliberative framework, decision-relevant “expertise” is not defined by years of training or the highest degree held by an individual. Instead, expertise is reflected in the ability of people—be they community stakeholders or outside analysts—to contribute meaningfully to the setting of objectives that will guide decisions as well as the attributes of these objectives that will help decision makers to distinguish between alternative courses of action.

Importantly, this definition of expertise recognizes the importance and relevance of local and traditional ecological knowledge, which refers to the collective and indigenous wisdom about the local environment which is gained by people over generations (Berkes 1999). Nearly all developing areas are home to indigenous or long-standing populations in addition to more recently established local stakeholders who bring with them their own traditional knowledge and experience. It is well documented that these individuals and communities often hold important insights with regard to understanding ecological processes and determining effective resource management options based on their unique environmental and socio-economic knowledge and experience (Wynne 1992). This acknowledgment of the importance and relevance of traditional ecological knowledge, we believe, represents an encouraging step forward in terms of improving natural resource management decisions that are inextricably linked to long-term environmental resilience and the socio-economic well-being of vulnerable communities.

We acknowledge that, in many cases, analysts and development practitioners may resist the idea of incorporating traditional ecological knowledge alongside inputs from more mainstream, western science. Indeed, we have seen firsthand—e.g., in Costa Rica, Ecuador, Tanzania, and Nunavut—many cases where decision makers and program managers have been vocal in their concern about the credibility of traditional knowledge. However, it has also been our experience that multi-stakeholder decision-making processes are flexible enough to account for the inclusion of objectives, attributes, and measures that are based on insights from traditional knowledge holders. Indeed, including information based on traditional knowledge often serves as an

important reality check for decision makers in that it helps to verify objectives used to guide community development processes. If, for example, information provided by local or traditional knowledge holders cannot be matched with a specific objective, then we can be reasonably certain that some objectives—which might otherwise help to guide the decision-making process—have yet to be considered. Moreover, it has been our experience—as well as that of others (Berkes 1999; Kerr & Sanghi 1992)—that traditional sources of knowledge often provide the best and sometimes only source of information about historical environmental and cultural conditions, as well as the desired balance between community development and environmental protection.

2.4 Rethink the goals of participatory decision-making processes.

It is difficult to find a researcher or practitioner who disagrees with the principle of involving local stakeholders during decision making for international development – or any other decision of consequence for that matter. Several texts have focused generally on this aspect of international development (e.g., Chambers 1983; Fischer 2002). Specific research and practitioner-oriented projects have focused on an array of community-based approaches with examples of these falling under the banners of action research (McTagart 1997), participatory rural appraisal (Chambers 1994), co-management (Baland 1996), and integrated watershed management (Rhoades 1998). But despite a rich literature focusing on the importance of stakeholder-based decision-making approaches, many examples of practice often fall short of meeting expectations. In our view, there are two related reasons behind these shortcomings.

First, many stakeholder engagement initiatives proceed without a clear and decision-focused expression of the goals that participation is supposed to achieve. It is

frequently the case, for example, that stakeholder involvement in decision making is undertaken because it is a procedural requirement by government, research, or donor agencies. In many places, these stipulations are a well-intentioned response to legitimate concerns about a historical lack of meaningful participation in important policy-making processes. However, the guidance that typically accompanies these requirements—engaging stakeholders early and often or paying attention to criteria such as ensuring "fairness and competence" (Renn et al. 1995), for example—fails to connect very good work that has been done in fields that often depend on stakeholder engagement (e.g., rural development, sociology, anthropology, planning) with findings from disciplines that focus exclusively on the process of decision making (e.g., behavioral decision research, behavioral economics, psychology).

This disconnect is apparent in the way participatory processes are typically described in theoretical discussions (Grillo & Stirrat 1997; Li 2007), policy guidelines, and case studies (Blauert & Dietz 2004; IIED 2008). Authors typically discuss participation in terms of the way projects should be carried out (e.g., in terms of a recommended set of guiding principals). While these discussions are valuable, they rarely discuss how stakeholder engagement was or could have been structured to provide the inputs that are required of internally consistent decision-making processes. This lack of detailed guidance for decision makers and stakeholders about *how* to implement decision-focused participatory processes inadvertently sends the message that the biggest obstacles to successful implementation are (1) convincing decision makers—either through encouragement or obligation—to utilize a participatory process, whatever that might mean to them; and (2) getting resource managers, scientists,

decision makers and stakeholders to work together effectively (i.e., simply getting the "right" stakeholders around the table is enough).

Second, many participatory processes over-emphasize conflict resolution and consensus as necessary components of decision making. Such approaches assume that conflict is bad for decision making, consensus is a prerequisite for resolving a problem, and conflicts can be "resolved" and consensus is possible without coercion. The rationale behind this viewpoint is understandable in that a focus on reducing conflict and building consensus addresses long-standing inequalities (e.g., based on socio-economic status, ethnicity, gender, etc.) that are pervasive between individuals and groups. However, it has been our experience in the field that these assumptions often exacerbate the very problems that conflict resolution and consensus processes are thought to address (i.e., power inequalities; stakeholder marginalization).

We have been involved in several cases, most recently in Latin America and the arctic, where a focus on consensus has shifted—in some cases subtly; openly in others—key elements of group decision-making processes. For example, stakeholders, technical experts, and consultants have been invited to take part in these processes (while others have been excluded) on the basis of their ability to agree with one another rather than on criteria relating to their possession of required expertise or expressions of a diverse range of objectives. Likewise, problems and alternatives that were the focus of analysis were chosen, and intractable issues ignored, based on their potential to foster even short-term or shaky agreements. Methodologies for establishing the predicted consequences of problems, or management plans for addressing them, had been selected based on the extent to which they were easy to implement or document

rather than on their ability to answer fundamental questions or lend insight to impending choices. And importantly, we have observed cases where minority views within groups have been suppressed rather than explored, with conflict among group members viewed as a problem to be overcome or avoided rather than as an opportunity for providing additional clarity regarding the decisions at hand.

The previous discussion regarding the construction of preferences (Section 2.1), elicitation of objectives (Section 2.2) and then establishing appropriate attributes and measures for them (Section 2.3) begins to speak to our views about both the roles that stakeholder participation should play and how participatory decision-making processes should be structured. Our view mirrors the theoretical underpinnings of decision-aiding approaches (Arvai et al. 2001; Gregory et al. 2001)—i.e., in behavioral decision research and decision analysis—as compared to the basis for much of the current thinking and practice in environmental management and consultation in disciplines such as alternative dispute resolution and risk communication. In drawing on insights from work on decision aiding, we also believe that the goals of stakeholder participation should be expanded to include a formal exploration of conflicting objectives—which are reflected in the tradeoffs that stakeholders are willing to make—when people are asked to choose one alternative course of action over another.

Other researchers and practitioners share our views. Development economists, for example, advocate the use of stated choice methods (Adamowicz et al. 1998) to learn about the acceptability of certain tradeoffs from local community members and other stakeholders. In most cases, paper-and-pencil surveys are used to present respondents with a series of alternatives, which are composed of integrated (i.e.,

conjoined) combinations of different attributes (e.g., different levels of air quality, water quality, and local employment). These combinations generally reflect actual or projected variations in the attributes (e.g., different levels of air and water quality and local employment opportunities). In the more sophisticated conjoint surveys, often termed "choice experiments", the represented attributes are specified by an experimental design that estimates the separate and interacting effects of component attributes. Multiple regression or similar analyses of decision makers' choices among the presented options are used to estimate the relative contributions of individual attributes to the expressed preferences or other judgments for the conjoint alternatives. Essentially, the choices made by people in response to survey questions are used to reveal the tradeoffs that they are willing to make when comparing multiattribute alternatives.

While these approaches represent a step in the right direction, they have been criticized on the grounds that the resulting insights about tradeoffs reflect poorly constructed judgments. In other words, information about implied tradeoffs may be misleading because the judgmental processes that led to them were prone to judgmental inconsistencies. As we point out in Section 2.1, this problem is likely to be especially significant when the choice context is unfamiliar, as would be true for many environmental policy options. With stated choice approaches, for example, questions may be raised about the extent to which survey respondents are actually confronting tradeoffs across all of the attributes and levels that are being presented to them in choice experiments. If they are not—e.g., if they use a decision rule such as satisficing (Simon 1955) and focus only on a small subset of attributes—the implied tradeoffs,

which assume that *all* of the available attributes are being considered, may not accurately reflect what matters to decision makers. This in turn leads to spurious conclusions for policy makers and managers.

To address this problem, decision scientists have developed alternative methods for tradeoff analysis that can either be used to supplement conjoint surveys or on their own when people are asked to evaluate a small set of discrete alternatives. All of these approaches—swing weighting (Clemen 1996), even swaps (Hammond et al. 1998), pricing out (Borcherding et al. 1991), etc.—require that respondents consider and then weigh the relative importance of *all* attributes that differentiate the alternatives under consideration. These weights are then used to help decision makers establish preferences, or preference orders, across the options that are presented to them. A detailed accounting of these methods is beyond the scope of this article. However, all of these methods—including the conjoint methods deployed by economists—share in the philosophy that the goals of participatory decision-making processes should be expanded beyond engaging stakeholders in largely unstructured management deliberations.

2.5 Avoid decision paralysis.

The amount of effort and expertise required to reconsider the manner in which complex decision making approaches are structured is not trivial. Many development agencies, such as The World Bank, have taken specific steps to build institutional capacity in the area of decision support. But in the absence of the required effort and expertise, many decision-making processes have nevertheless been undertaken where the participants simply “muddle through” with varying degrees of success. In too many other cases,

however, important decisions have simply been put on hold, or abandoned altogether. Frequently, policy makers put off making important decisions because of the high levels of uncertainty and complexity that the required choices entail. They worry that they do not know enough to come to a responsible judgment or that the decision context will change in unpredictable ways, quickly outmoding a decision or rendering it inappropriate.

In taking this kind of wait-and-see approach, decision makers effectively define a responsible decision-making process as one that requires those who may be affected by a choice to wait until it is possible to make a decision under greatly reduced, or even better, *zero* uncertainty. To support this position, many decision makers invoke mantras like “do no harm” or the relatively popular precautionary principle (Raffensperger & Tickner 1999). But since *all* decisions about complex natural resource management problems will include some degree of uncertainty, these approaches are often unproductive and unrealistic because they do not account for the fact that in many fragile areas—ecosystems and communities—failing to act can also cause harm.

Ultimately, what often goes unrealized in these cases is the fact that failing to address a decision represents a decision in and of itself; i.e., people *choose* to avoid making a given decision. For this reason, decision researchers have encouraged people to evaluate discrete decision opportunities—to make a decision or to avoid one—as alternative courses of action. In this sense, people should approach these decisions in much the same way that we have discussed above: that is to identify objectives to help guide the choice, make judgments about the consequences associated with confronting (vs. delaying) a decision, and evaluating the risks and

benefits associated with choosing one option over the other. Supplementing these principals, there should be an institutional commitment to long-term monitoring of both decision-making processes and their resulting outcomes. By doing so, decision makers and stakeholders will be able to proactively assess how problems, objectives, alternatives, and tradeoff tolerances change as situations evolve. Likewise, they will be better positioned to adapt deliberative processes to changing social, environmental, and economic conditions.

Another useful way out of the trap of decision paralysis is to explicitly make learning over time a fundamental objective of development decisions (Gregory et al. 2001; McDaniels & Gregory 2004). The concept of adaptive management was born specifically out of the need to address this objective of learning from managed systems over time (Arvai et al. 2006a; Walters 1986). The central argument of adaptive management is that policy decisions are really research questions masquerading as answers. By taking this view, the management of complex environmental and social problems then can be regarded as a process of learning over time from policies designed to reduce uncertainty and improve management's ability to respond to inevitable environmental, social, or economic surprises.

To operationalize this effort, adaptive management calls for the design and monitoring of planned policy "experiments", with replication and comparison of management treatments at appropriate spatial and temporal scales. Rather than making one-time decisions on the basis of the best existing knowledge, adaptive management regards policy choices for complex environmental problems as part of an overlapping sequence of iterative policy trials. At the same time, adaptive management

emphasizes monitoring and learning as the system changes, both in response to external stimuli and in response to the manager's actions (Walters 1986).

It is important to note that, while adaptive management proceeds based on the philosophy of experimentation, the resulting trials need not proceed based on deliberate manipulation by managers. While there have been several examples of what is termed "active adaptive management"—e.g., within-season experimentation, complete with control regimes and replication, in coastal fisheries (Walters & Holling 1990)— "passive adaptive management" is also possible. Here, policy analysts monitor the results from a series of spatially varied management experiments that are underway at the hands of competing and overlapping sovereign political actors and institutions. In adaptive management for climate change impacts, for example, policy analysts may track different types of climate mitigation projects that have been undertaken in different regions of the world (e.g., forestry projects in Latin America versus agricultural projects in West Africa). In contrast to the active implementation of experimental treatments, these spatially varied experimental probes are not the result of intentional manipulation. Nevertheless, they represent varied policy treatments, the results from which can be compared to test clearly formulated hypotheses about the behavior of complex systems (Arvai et al. 2006a). Experimentation in this sense goes beyond management through trial and error and casual observation; it is structured and theoretically driven, so that new knowledge can be incorporated systematically into future treatments.

Overall, adaptive management presents an appealing framework for strengthening the relationship between policy makers and stakeholders. While an experimental focus is especially appealing to scientists, adaptive management reaches

well beyond the goal of simply enhancing technical understanding of natural systems independent of human systems. The approach also recognizes that managed systems present moving targets influenced largely by social drivers and, therefore, explicitly links these human factors to management initiatives (Arvai et al. 2006a). The added appeal of adaptive management, therefore, lies in its ability to help inform the judgments of policy makers who must address complex problems with high levels of ecological, social, and economic uncertainty.

3. Conclusion

While many examples of international development decisions have been widely critiqued for their perceived failure to meet linked environmental, social and economic goals (Agarwal 2001; Agrawal & Gibson 1999; Peet & Watts 2004), very little meaningful guidance has traditionally been available to decision makers regarding how best to address these concerns. The same is true of international and community development efforts that are supposed to be "participatory", but have been criticized for being unnecessarily insulated from those who will be directly affected by decisions. In the worst cases, a lack of effective collaboration between managers and stakeholders has led to the further marginalization of vulnerable communities (Castro 2004; Echeverría 2003; Jiménez 2005).

We have proposed that it will continue to be difficult for researchers, practitioners and policy makers to address complex, multi-objective decisions without first operationalizing decision-making processes in terms that go well beyond general recommendations (e.g., involve all interested parties early in the process, build on existing relationships, adopt a bottom-up management structure, etc.). Over

generalizing in this way has resulted in a failure to focus explicitly on several issues central to higher quality decision making: recognizing and adapting to the constructive nature of judgments; ensuring that the basis for decision making is both realistic and relevant; expanding the definition of expertise to account for local and traditional knowledge; adopting decision-focused stakeholder deliberation over public participation; and proceeding with decision making in the face of complexity and uncertainty.

If we were to summarize this argument, it would be that decision-making ought to be viewed as a *process* and not merely an *occurrence*. Just as improving communication between managers and stakeholders involves more than bringing people together and providing opportunities to hear opposing views, decision-making processes require much more than the right combination of public participation, better science, and lower uncertainty. Only when we accept that complex natural resource management problems ought to be addressed through well-structured, deliberative processes can we focus on developing decision support techniques to achieve more defensible decisions.

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CHAPTER 2

A CHOICE EXPERIMENT TO ADDRESS ENVIRONMENTAL, HEALTH, AND ECONOMIC DEVELOPMENT CONFLICTS ABOUT PINEAPPLE PRODUCTION IN COSTA RICA

1. Introduction

Costa Rica is a middle-income developing country located in Central America bordered by Nicaragua to the north and Panama to the south. Despite its small land area (approx. 51,100 km^2), Costa Rica is one of the 20 most biologically diverse countries in the world and forms an integral part of the Mesoamerican Biodiversity Hotspot. For this reason, the country is also regarded for its dedication to natural resource conservation, which has resulted in the establishment of numerous environmental laws and 160 continental protected areas (comprising 26% of Costa Rica's total land area).

But as a developing country, Costa Rica is also focused on economic growth. In addition to electric circuit manufacturing and tourism, which are its top two revenue generators, Costa Rica also relies heavily on agricultural exports to support economic development. Fertile land, regular rainfall, easy overland access to North and South American markets, and direct maritime access to the European and Asian continents have all greatly benefited the Costa Rican agricultural sector. While well known for coffee and bananas, Costa Rica's largest agricultural export is pineapple and its output continues to increase. As of September 2010, pineapple exports—which saw a 18.5 percent increase in tons exported over 2009—account for more than $1 billion in sales worldwide, with nearly $230 million worth of exports to the United States alone (PROCOMER 2010).

Unlike coffee and—increasingly—banana production, which are predominantly in the hands of domestic producers, pineapple production in Costa Rica is dominated by foreign-owned multinational corporations such as Del Monte and Dole. These corporations have invested heavily in pineapple production in Costa Rica; this includes the maintenance of hundreds of large plantations, packing facilities, storage warehouses, and transportation networks, as well as supporting infrastructure. In some cases, these investments have resulted in ancillary benefits for Costa Rican communities. Beyond providing a source of employment and income for tens of thousands, some pineapple producers also build and maintain infrastructure that members of communities use. Examples of the services provided by the pineapple producers include the provision of transportation infrastructure (road, bridges, and associated maintenance). Some of the larger pineapple producers also make packing, storage, and export infrastructure available to smaller scale operations, which allows them to get their products to market.

While clearly a boon to economic development in Costa Rica, the dramatic intensification of large-scale pineapple production over the last 10 years has also come at a significant price. In particular, to meet export demands and comply with phytosanitary requirements, the once low impact crop now requires significant amounts of pesticide and herbicide, which has resulted in a buildup of agrochemicals in groundwater near some large pineapple plantations. Not surprisingly, many residents of communities adjacent to plantations are concerned about the impacts of agrochemicals on their air and water. At the same time, a lack of adherence to appropriate soil conservation techniques by some producers has resulted in severe erosion problems.

There is concern among agronomists that if unchecked, the degree of soil degradation could cause a situation so critical that affected lands cannot be cultivated for decades. Additionally, improper post-harvest management of the crown and leaves by some producers has created a pest problem—predominantly in the form of *Stomoxys Calcitrans*—an aggressive biting fly that, if not controlled, can traumatize cattle and wreak havoc on beef and milk production (SEPSA 2010).

Given the competing costs and benefits of pineapple production, many Costa Ricans are beginning to call for more careful regulation of the industry. Policies being discussed range from more stringent regulation and monitoring of the existing pineapple industry to significant limits on the scale of production that would be allowed in the country. Some Costa Ricans have even begun to call for a ban on pineapple production in certain, sensitive areas. Given the range of options available, and the likelihood that decision makers will have to confront challenging tradeoffs, the objective of our research was to help inform policy decisions by eliciting preferences for competing management plans from people living near pineapple plantations.

To meet this objective, we used a stated preference survey—namely a choice experiment (CE)—where respondents are asked to make choices among pairs of pineapple management scenarios. Choice experiments have been used widely in developed country contexts. Traditionally, application of the CE method has focused on eliciting preferences for consumer goods (e.g., Green & Srinivasan 1978; Schupp et al. 2003). But, more recently, CEs have been applied to explore preferences and estimate non-market values in a variety of environmental management contexts (e.g., Boxall et al. 1996; Farber & Griner 2000). However, the use of CEs in developing country

contexts is only slowly gaining traction (for a detailed review, see Bennett & Birol 2010). For this reason, a secondary objective of the research reported here was to explore the effectiveness of the CE method—mainly in terms of participant comprehension of, and satisfaction with, the approach—in a developing country context.

Briefly, CEs are used to explore the role of both financial and non-market variables in people's preferences. They provide the added perspective of welfare economics, which places both environmental and social considerations alongside more commonly considered financial values. CEs are based on the argument that any good, service, policy, or program is best described and evaluated in terms of its component attributes *and* the levels that these attributes take (Lancaster 1966). For this reason, CEs rely upon survey instruments to present respondents with a series of alternatives, characterized as multidimensional composites or scenarios, that present integrated (conjoined) combinations of different attributes (e.g., the effects of alternative policies on contamination levels, employment, costs to consumers, etc.). These combinations generally reflect actual or projected variations in the attributes (e.g., different levels of water quality and local employment opportunities). In the more sophisticated CEs, the represented attributes are specified by an experimental design that estimates the separate and interacting effects of component attributes (Louviere 1988). Multiple regression or similar analyses of decision makers' choices among the presented scenarios are used to estimate the relative contributions of individual attributes to the expressed preferences. In other words, the choices made by people in response to survey questions are used to reveal both preference orders across alternatives and the

tradeoffs across attributes that they are willing to make when comparing these alternatives.

2. Methods

2.1 Choice Experiment Design

The survey instrument used in this research was developed after a series of in-depth discussions between the authors, pineapple producers, technical experts, and community stakeholders. Through these discussions, the researchers identified appropriate attributes, associated measures, and attribute levels that characterize the range of regulatory scenarios that may be available to policy makers. The resulting instrument, which was prepared in Spanish, was also extensively pretested in the field with individuals randomly selected from communities in the cantons where the CE was carried out (see Section 2.2, below) to ensure that the attributes and attribute levels made sense to respondents.

The final CE design consisted of six attributes that varied on between two and five attribute levels (Table 1). The attributes that, during the design phase, were found to be most relevant to survey respondents in the Atlantic Region included the following:

(1) The maximum plantation size that would be allowable. This value ranged from small (less than 50 ha) operations used by independent national producers, some of whom are organic producers, to the current large (greater than 250 ha) monocultures owned by nationals and foreign multinationals;

(2) Whether or not external buffer zones, comprised of trees and tall scrub, would be required between plantations and neighboring communities. Buffer zones serve two primary purposes, namely blocking unsightly views of the plantations from

neighboring communities and major roadways, and—importantly—creating a physical barrier between communities and plantations that make it difficult for aerosolized agrochemicals to pass;

(3) Whether or not appropriate soil conservation techniques (which would depend on factors such as the farm's soil characteristics and slope), to prevent erosion and to ensure the long-term viability of agricultural lands currently used for pineapple, would be required;

(4) The annual frequency with which highly leachable pesticides and herbicides, such as bromacil (i.e., agrochemicals that may pass through the soil into groundwater), may be applied on plantations. This value ranged from zero to four applications per year;

(5) The annual frequency, with which random compliance checks by governmental regulatory agencies would be conducted on pineapple plantations, regardless of their size. Monitors would help to ensure that agrochemicals were being applied at the proper frequency, that appropriate soil conservation techniques were being used, and that appropriate buffer zones were implemented. This value ranged from zero to three or more times per year; and

(6) The additional cost, in Costa Rican colones (₡), that would be borne (hypothetically) by households that would be willing to pay a fee in exchange for improved compliance monitoring of pineapple production practices (i.e., regarding buffer zones, soil conservation and agrochemicals), and/or to help pay infrastructure costs if pineapple plantations were to shrink in size. Essentially, the

cost attribute allows us to test the degree to which the other five attributes are viewed by households as amenities.

The rationale behind the increase in cost stems from the fact that large pineapple producers are financially able to help provide infrastructure used by the communities. If the scale of production was to shrink, producers' revenues would decrease as would their ability (and motivation) to provide ancillary community services. As a result, communities would be required to contribute to covering the costs of these services, which they do not wish to lose, through an increase in the local fee structure. At the same time, an increased desire at the community level for compliance monitoring would result in an increase in agency costs, which also would be partially passed on to citizens. However, not all households in the areas where we conduced this research pay property taxes, so we had to devise a method for them to contribute to the costs associated with increased environmental monitoring and smaller pineapple plantations. Since all households pay fees to *Grupo ICE*, the national electricity and telecommunications (television, as well as wired and wireless phones and internet) provider; bills from *Grupo ICE* were selected as the payment vehicle. After consulting with stakeholders and regulators, we established a means of including a "community service contribution" as a monthly addition to households' *Grupo ICE* bills. This monthly fee ranged from between ₡0 (the status quo) and ₡2,452.

An orthogonal, main effects experimental design comprised of these attributes and associated levels was constructed using the PASW (formerly SPSS) Conjoint module. A total of 25 unique alternatives were created, in addition to a "status quo"

alternative (which was labeled as such). Respondents were asked to compare a randomly selected alternative with the status quo alternative and then select their preferred option (see Table 2 for an example choice set); thus, a total of 25 choice sets (i.e., profiles) were possible. Each respondent received a total of five randomly selected choice sets, which were presented to them one at a time, on laminated cards.

Accompanying the CE was a short survey that was administered orally to all respondents. The purpose of the survey was to collect baseline demographic information about respondents, including information about whether they—or a member of their family—work on a pineapple plantation, whether they are a farmer, and whether they are a member of any local associations or committees. However, because CEs are used relatively infrequently in developing country contexts, we also used the survey to collect data about respondents' level of satisfaction with the method. All responses were recorded using 5-point Likert scales with neutral midpoints. The questions we posed asked for respondents' (1) level of satisfaction with their responses across the five choice sets (1=very unsatisfied, 5=very satisfied); (2) the level of ease with which the CE could be completed (1=very difficult, 5=very easy); and (3) the degree to which respondents' choices reflected their concerns associated with pineapple production (1=very poorly, 5=very well). Using similar scales, we also asked for respondents' self-reported knowledge level about pineapple production and their views on the importance of eliciting preferences about management options from the community members.

The CE and accompanying survey were administered orally, and in Spanish. Fieldwork was carried out by the first author and an experienced local research assistant, together with university students recruited from the National University of

Costa Rica's Sarapiquí Campus. At the end of each day, completed instruments were checked by the first author and the research assistant to ensure that the survey procedures were being followed correctly and without deviation over the course of the study. The complete instrument was administered in a manner consonant with human subjects requirements and took, on average, 30 minutes for respondents to complete.

2.2. Respondents

A bulk of Costa Rica's pineapple production occurs in the Limón Province of the country's Atlantic Region. Recently, this area has been the site of disagreement, as well as outright conflict, between pineapple producers, the government, and local communities. In an attempt to begin to resolve some of the conflict, a Presidential Commission was formed in 2008 and charged with developing a better understanding of the concerns of both community stakeholders and pineapple producers, and with making recommendations to the government about possible ways to address these concerns. EARTH University was asked to serve as a neutral mediator during the commission's work and one of the authors (León) was named as the commission's facilitator. For this reason, our research focused on the Limón Province and our results will be shared with members of the Presidential Commission, as well as with government representatives, pineapple producers and interested members of local communities. However, we stress that our research was neither requested, funded, nor sanctioned by the Presidential Commission, nor any of its members.

Within the Limón Province, we selected three cantons (Guácimo, Siquirres and Pococí) as our main sampling sectors because most of the pineapple production in the Atlantic Region is concentrated there. A stratified random sample of 451 households

was drawn from these cantons. Rather than sampling on a village-by-village basis, we worked with the National Institute of Statistics and Census (INEC) based in the capital, San José. In addition to our desire for a legitimately drawn stratified random sample, we wanted to mirror the sampling procedures utilized by the Government of Costa Rica (when conducting the census and other surveys of national interest) so as to add credibility to our research. We also wanted to avoid oversampling respondents, both from certain high-conflict areas where strongly negative feelings about pineapple production prevail, as well as from areas so removed from any production—much less conflict—that respondents might have no opinion at all about the issue.

During the draw of respondents, INEC took into account each canton's total population and its urban, semi-urban, and rural distribution in order to produce a representative group of sampling segments for each canton. Each of these segments was then rendered on cadastral maps. A random sample of 10 households was then randomly selected for interviews from each segment. Researchers visited a total of 650 houses (569 of which were eligible), collected 472 surveys, and ended up with a total of 451 completed surveys for a response rate of 0.79.

Interviews were conducted only with respondents who were responsible for making financial decisions, either jointly or alone, on behalf of the household. Seventy-three percent of these respondents were female, and the average age of respondents was 43. Fifty two percent of respondents were originally from the Limón Province, and of that group, the average length of residency is 43 years. Respondents not originally from Limón have lived in their community for an average of 24 years and in their canton for an average of 32 years. The majority of participants, 71 percent, were married or in

"free union" with their partner (47 percent were married and 24 percent in "free union"). The majority of respondents (66 percent) reported a monthly income of less than ₡218,433 (the poverty line), with 26 percent earning that income through farming. An average of 41 percent of respondents reported that they themselves (7 percent) or a family member (34 percent) currently work (or had previously) in some aspect of pineapple production. On average, respondents had completed about six years of education, and their spouses (including "free unions") had also completed about six years, while 23 percent of the respondents (and 21 percent of spouses) either did not complete six years of elementary school or had no elementary education at all. Eighteen percent of respondents self-identified as active members of a community, canton, or provincial committee or organization such as a school committee, community development association, or rural aqueduct association. (See Table 3 for summary sample characteristics.)

2.3 Analysis

Statistical analysis of the CE data was carried out using a binary random effects panel probit model in STATA/SE 10.0. Respondents' choices of an alternative over the status quo were regressed against the six choice attributes outlined in Section 2.1. Other explanatory variables, including standard demographic data (i.e., age, gender, education, income) and context specific information (e.g., whether the respondent, or anyone in his/her family, has worked on a pineapple plantation), were also tested, as well as numerous interaction terms. The complete model was interacted with the canton of study given that population demographics and the geographical distribution and intensity of pineapple production vary across the three cantons. Dummy coding

was used for categorical variables and continuous variables (i.e., cost) were not recoded.

Numerous models were estimated, but we will mainly report on the results of: 1) the choice model (choice variables only); 2) the complete model, which includes demographic variables and significant interaction terms; and 3) the complete model for each of the three cantons. There is a short description of choice model covariates in Table 4, and the estimation results for these models are presented in Table 5 and Table 6.

3. Results

Parameter estimates of the variables that are statistically significant in the two full sample models are consistently higher in the complete model with the exception of Monitoring_3, which stayed the same (see Table 4). The following discussion focuses on the results of the complete model regressed by canton (see Table 5).

As expected, Cost was highly significant at the 1 percent level with a negative linear effect on respondents' choice of an alternative to the status quo. It is worth noting that this result was consistent in all models except when the complete model was regressed for Siquirres. In this canton, Cost became less significant, with a slightly lower coefficient. This indicates that the negative linear effect of the Cost variable may not be quite as strong in Siquirres as it is in Guácimo and Pococí. Therefore, respondents from Siquirres may be slightly less influenced against choosing an alternative to the status quo as the Cost level increases. This is not surprising given the fact that this canton has been the location of some of the most contentious conflicts between communities and farms, mostly with respect to concerns over water

contamination from the application of agrochemicals. Siquirres is also the canton with the highest percentage of its area dedicated to pineapple production. Taking into account both of these factors, respondents in this canton might be more willing to make a financial contribution in exchange for improved pineapple production practices, especially (as we discuss below) improvements in agrochemical application.

Agrochemicals_2 was highly significant at the 1 percent level and its positive coefficient indicates that the inclusion of this variable in an alternative to the status quo had a significant positive impact on the respondents' selection of an alternative. The fact that a moderate level of agrochemical application had a greater impact than lower levels (i.e., level 0 or level 1) on the selection of an alternative to the status quo may speak to the fact that respondents were realistic—as opposed to idealistic—when evaluating this variable. This is understandable given that residents in the study area are familiar with production practices (not limited to pineapple production) and most people depend in some way on farming for their livelihood. Therefore, while they generally oppose high (i.e., status quo) application levels, which many see as unnecessary and avoidable, they tend to believe that moderate application is more realistic and necessary than none or very low levels.

When analyzed by canton, Agrochemicals_2 was highly significant at the 1 percent level in Siquirres, and at the 5 percent level in Guácimo, but not at all in Pococí. It is important to point out that the other Agrochemicals attribute levels (Agrochemicals_0 and Agrochemicals_1) were not at all significant in any cantons. This makes sense given respondents' knowledge of agricultural practices. Additionally, it is not surprising that respondents in Siquirres were so strongly influenced by the presence

of Agrochemicals_2 in the alternatives they evaluated considering that the most contentious conflicts over water contamination due to pesticides has taken place in that canton. To our knowledge, at the time of this data collection there had not been a conflict of this intensity in Pococí, which could at least partially explain why respondents from this canton were not strongly influenced by this attribute when deciding whether or not to select an alternative to the status quo.

Monitoring_3 was highly significant at the 1 percent level with a positive impact on selecting an alternative over the status quo. While Monitoring_1 is marginally significant, it is to be expected that Monitoring_3 would exert a stronger influence on the respondents' decisions to select an alternative than did Monitoring_1. When analyzed by canton, however, Monitoring_3 is only significant (and at the 5 percent level) in Siquirres. (It is barely significant at the 10 percent level in Guácimo.) Despite not being extremely significant in these two cantons, its positive high coefficients reveal that it does influence the selection of an alternative over the status quo. Interestingly, in Pococí, it is not at all significant. It seems possible that this attribute can be a least partially explained by the degree of environmental-production conflict experienced in Siquirres and lacking in Pococí. Another explanation could be that some respondents doubt that increased monitoring would actually be successful and were therefore not as influenced by this variable when deciding whether to select an alternative to the status quo.

Soil Conservation was significant at the 5 percent level with a positive coefficient in the complete model, so it appears that the requirement of soil conservation techniques in alternatives to the status quo does positively influence the respondents'

decision to opt for the alternative. When analyzed by canton, however, we see that Soil Conservation is only significant in Guácimo. That said, it is important to note that where it is significant, it exerts a fair amount of influence. In Guácimo, Soil Conservation has a slightly lower positive coefficient than does Agrochemicals_2 and Farm Size_150, and a slightly higher one than Monitoring_3. It is worth noting that respondents in this canton appear to have been influenced to an almost equal degree by all six of the choice attributes instead of anchoring on just two or three of them, as appears to be the case of respondents in Siquirres and Pococí (who in addition to Cost, anchored strongly on Agroghemicals_2 and Monitoring; and Farm Size and Buffer Zone, respectively).

It is important to point out that four variables that were not significant in the Choice Model do become significant in the Complete Model. These variables are: Farm Size_Small, Farm Size_Medium, Monitoring_1, and Buffer Zone. That said, only Farm Size_Medium is significant at the 1 percent level, while the other three are marginally significant at the 10 percent level. All have positive coefficients except for Buffer Zone. Given that the interaction term, Farm Size x Buffer Zone, is significant (at the 1 percent level) and has a positive coefficient, we can interpret that Farm Size_Medium (and to a small degree, on Farm Size_Small) has a strengthening effect on Buffer Zone regarding the impact that this variable has on respondents' selection of an alternative to the status quo.

Among the numerous demographic variables that were tested to further improve the model fit, significant effects emerged only when the following variables were included: Piña Worker; Age; and Low Income. In terms of impact on selecting an alternative to the status quo, Piña Worker has a positive impact, while both Low Income

and Age have negative coefficients. In the complete model all are significant at the 5 percent level, however, when run by canton, only Piña Worker was significant, and only in Pococí. No significant effect was found (and therefore also not presented in Table 5) for the other demographic variables, quadratic effects and interactions that were tested.

Finally, it is worth noting that when the Complete Model is analyzed by canton, some important changes in variable significance levels and coefficients occur. While five variables were no longer significant when the model is regressed for Pococí alone, the variables that remain significant are more so, and their coefficients are significantly higher. Especially notable is Farm Size_Small, which becomes significant at the 1 percent level (previously at the 10 percent level) with a coefficient of .944. Farm Size_Medium retains at the same significance level, but its coefficient also increases. Buffer Zone moves from a significance level of 10 percent to 5 percent, with an important increase in its coefficient. Regarding the demographic variables, Piña Worker stays at the same significance level (5 percent), but its impact is stronger. When the model is regressed in Guácimo, six of the variables are no longer significant, and while the significance levels of the variables that remain actually decrease, their coefficients increase. This is true of Farm Size_Medium, Agrochemicals_2 and Monitoring_3. Soil Conservation and Cost retained the same significance levels, and their coefficients also increased. In Siquirres, nine of the significant variables became non significant. Of the four that remained significant, Agrochemicals_2 and Monitoring_3 stayed at the same level, Monitoring_1 increased from the 10 percent to the 5 percent level, and all of their coefficients increased. However, only in Siquirres did Cost decrease in significance from the 1 percent level to the 5 percent level (no change in the coefficient). To

summarize, respondents in the three cantons are impacted differently by the choice attributes. In Guácimo, significant attributes are ranked as follows: 1) Cost; 2) Agrochemicals_2; 3) Farm Size_150; 4) Soil Conservation; and 5) Monitoring_3. In Siquirres, the order is: 1) Cost; 2) Agrochemicals_2; 3) Monitoring_3; and 4) Monitoring_1. Lastly, in Pococí: 1) Cost; 2) Farm Size_25 and Farm Size_150; and 3) Buffer Zone.

Regarding respondents' opinion of the elicitation method itself, our data show that, on average, respondents were: satisfied with their responses across the five choice sets ($\bar{x}$ = 3.6, sd = 0.8); neutral about the level of ease with which the CE could be completed ($\bar{x}$ = 3.4, sd = 0.9); and felt that their choices did a good job reflecting their concerns associated with pineapple production ($\bar{x}$ = 3.7, sd = 0.9). Respondents self-report a moderate level of knowledge about pineapple production ($\bar{x}$ = 2.6, sd = 0.9) and feel it is important that community members be consulted about their preferences regarding pineapple production practices ($\bar{x}$ = 4.3, sd = 0.9).

4. Discussion

This paper presented the results of a choice experiment conducted in the Atlantic Region of Costa Rica where decision makers and other stakeholders are faced with the need to confront challenging tradeoffs regarding pineapple production and environmental management. The primary objective of our research was to help inform policy decisions by eliciting preferences for competing management plans from people living near pineapple plantations. Specifically, we wanted to learn about: 1) whether residents, when given a choice, would prefer current production practices or an alternative to the status quo; 2) if residents prefer alternatives to the status quo, what

are the attributes and levels that most strongly influence their selection of an alternative?; and finally, 3) what tradeoffs—if any—would residents be willing to accept across various aspects of production?

Regarding the first question, this choice experiment indicates that residents would prefer an alternative to the status quo. Overall, the status quo option was the least popular of the 26 production scenarios, being selected only 28 percent of the time. When respondents had to choose between the status quo option and the most popular alternative, the status quo was selected just 10 percent of the time. Even when it was compared to the least popular option, it was selected only 52 percent of the time.

However, based on our sample, most community members do not want to halt pineapple production entirely, as has been reported in the media. Rather, it appears that many residents of the major pineapple producing cantons of the Atlantic Region see pineapple production as both beneficial and problematic and would prefer the industry to use more environmentally sound production practices while continuing to be competitive in the market, and therefore, continuing to provide jobs and contribute to the agricultural economy of the region. This may sound like an unrealistic goal, and it would be if people were not willing to make tradeoffs, but our data show that this is not the case. Second, despite important and policy-relevant variations in the preferences of residents from the three cantons, our data show that the attributes (and levels) that most influenced respondents' selection of an alternative over the status quo were: Cost (the lower the better); Agrochemicals (2); Monitoring (3), and Soil Conservation (Yes). Based on the variables making up our complete model, we can say that, on average,

households would be willing to pay approximately ₡190 if the following alternative production scenario were to be implemented:

Finally, our data show that respondents were willing to make tradeoffs with respect to the attributes they appear to care most about in order to see an overall improvement in pineapple production practices. The clearest indicator of this is the fact that alternatives to the status quo were selected far more often (72 percent of the time) than the status quo itself even though a cost of at least 105 colones was included as part of the alternative (versus no cost in the status quo). Another important example is that most respondents appear to have not been as influenced by the inclusion of a buffer zone unless an alternative also included a large farm. If the alternative did not include a large farm, respondents were far more influenced by the level of agrochemical application, the frequency of monitoring and the requirement of soil conservation techniques. However, if a large farm was part of the alternative, having a buffer zone became more important than some of these otherwise most influential attributes and levels. Lastly, even in the canton most impacted by agrochemical contamination, respondents were not extremely influenced by the "best" level of agrochemical application (i.e., none). To the contrary, most of these respondents—as well as those in the other two cantons—appear to be willing to accept a moderate level of application (i.e., 2 times/year), presumably in exchange for paying a lower cost or seeing a gain in another area, such as monitoring or soil conservation.

4.1 Policy Implications

This research was conceived with the joint goal of testing tradeoff analysis methods as well as contributing useful information about community members' preferences to the

current policy debate about pineapple production in the Atlantic Region. To this end, there are three main points that can be made about how these findings may be useful to the ongoing policy discussion. All three of them contradict what has typically been reported by the national and international press, which tend to portray the situation in terms of stakeholders representing extreme positions and entrenched ideals with no willingness to collaborate.

First, it appears that many community members in the study area are not opposed to pineapple production. They simply feel that it can, and should, be done in a way that better protects environmental and human health. Even among those who are staunchly opposed to large-scale monoculture in general, or to conventional pineapple production specifically, many recognize that the plantations provide much needed jobs, although they point out that labor conditions need to be improved (e.g., training for field workers on safe agrochemical handling and application; provision of proper safety equipment to field workers). Similarly, many community members do not think that most pineapple producers are in extreme incompliance with environmental regulations, but they tend to believe that the industry as a whole has not been held as transparent and accountable as it should be, and therefore has been slow to respond to environmental and health concerns.

Second, many community members are willing to make tradeoffs about how to address their concerns about pineapple production. A misperception exists that people who say anything negative about pineapple production, or even simply question a farm's practices, are environmental or labor activists who want to shut a farm—if not the entire industry—down. Our data reveal that most residents in the study area do have

significant concerns about the industry's environmental and human health impact, but that when given the opportunity to consider pineapple production in a more nuanced way than just whether it is "good" or "bad", they are willing to make tradeoffs. That is, they are willing to identify the aspects of production that concern them the most and consider the possibility of not having all of their concerns addressed immediately in exchange for seeing some real progress made with respect to one or two aspects at a time.

Finally, our research suggests that there is reason for the stakeholders involved in this conflict—who have tried formally on two occasions to address concerns about the region's pineapple production by working together on a multi-stakeholder commission—to be optimistic about their ability to make meaningful, yet incremental, progress toward addressing some of the most critical aspects of this extremely complex issue. While they might not be able to address the most contentious issues first, our research suggests that community members may be open to making improvements in a less contentious area (i.e., buffer zones) first. Ideally, that experience would help to build the trust and dialogue needed to take on the more complex aspects of pineapple production (i.e., agrochemicals).

Any stakeholder representatives who are truly willing to address concerns about pineapple production from a holistic perspective (i.e., production, environmental management, human health, worker safety and labor conditions)—and other phases of our research confirm that this willingness does exist—should feel confident that many community members from throughout the region are both knowledgeable (despite being overly modest in self-assessments of their knowledge) enough about agricultural

production and natural resources and, more importantly, willing to work with producers and government representatives to discuss and address concerns (of all stakeholders) in a strategic way. Essentially, instead of insisting that all of their concerns be resolved immediately and simultaneously, our research suggests that many community members would be willing to support efforts to make incremental improvements as long as they feel that their concerns and suggestions are being taken seriously. As stakeholders at the regional level have suggested, this kind of approach will probably be more effective if carried out at the regional level. Our research supports this idea since it reveals that while community members in the three different cantons are most likely concerned about the same things in general, they rank them differently in terms of importance based on the context specific realities of each canton.

In the interest of future work of this kind, it is worth reporting that implementing this choice experiment involved a few challenges. First, the fact that stakeholder groups in the study area had recently been—or were currently—engaged in varying degrees of conflict regarding pineapple production (with respect to concerns about production practices, environmental management, human health and labor conditions) could have introduced a bias in choice behavior favoring alternatives to the status quo. Similarly, over sampling in communities that do not feel impacted in any way by pineapple production could have biased respondents toward choosing the status quo. With this in mind, researchers worked with Costa Rica's National Statistics Institute (INEC) to develop a truly random sampling procedure that would be viewed as legitimate by government officials, pineapple producers, community groups and other stakeholders, and take into account the demographic characteristics and urban-rural population

distributions of the three cantons, in addition to helping researchers avoid over sampling in high- or no-conflict areas.

Second, there is a feeling among some rural residents in Costa Rica that governmental institutions do not provide reliable services in their communities. Since the payment vehicle for the Cost attribute is linked to a public institution (Grupo ICE), this feeling could have biased some people against being willing to contribute to help fund infrastructure projects, improved production practices, and environmental monitoring, despite the fact that we explained that ICE would not have anything to do with administering the funds and was simply an example of a potential form of collecting their contribution in a convenient manner. Along these lines, some people became so upset by the idea of paying anything when they view pineapple producers as wealthy companies and government officials as either unable (i.e., due to resource limitations and/or a central government bias toward supporting pineapple production at any cost) or not willing to do their job, that it was sometimes difficult for them to stop anchoring on the cost attribute and thoroughly evaluate the others. In short, trying to help respondents think in terms of a hypothetical, yet realistic, situation was sometimes challenging.

The third challenge was logistical. Due to the fact that the research area was large (sq. kilometers) and the segments chosen by INEC in order to ensure an unbiased random sample were at a very small scale, a great deal of work was required by the research team in order to simply orient the segments on larger scale maps of the cantons and then locate the areas in the field. This was further complicated by the fact that a number of the segments covered areas that were considered too dangerous for

the research team to conduct interviews due to increased violence (i.e., armed robbery, carjackings, other gang-related activity) in these areas. While these activities are very localized and easily avoidable with accurate information and a good knowledge of the local geography and road network, the safety of the interviewers was the researcher's main concern during data collection. Therefore, ensuring interviewer safety while also being respectful of participants and their time, and meeting data collection goals required considerably more logistical research, planning, and on-the-fly adjustments than is normally required when doing research in Costa Rica, which is, overall, an extremely peaceful and safe country.

APPENDICES

APPENDICES

Table 1. Attributes and levels used in the CE design (translated from Spanish).

Attribute	*Attribute Levels*				
Maximum plantation size	Small <50 ha	Medium 50-250 ha	Large >250 ha		
Requirement that external buffer zones be established	No	Yes			
Requirement that soil conservation techniques be used	No	Yes			
Allowed number of leachable agrochemical applications/year	0	1	2	4	
Number of random compliance checks/year	0	1	3 or more		
Monthly household fee on *Grupo ICE* bill	₡0	₡105	₡463	₡1,837	₡2,452

Table 2. Example choice set (translated from Spanish).

Attribute	*Alternative A (status quo)*	*Alternative B*
Maximum plantation size	Large >250 ha	Medium 50-250 ha
Requirement that external buffer zones be established	No	Yes
Allowed number of leachable agrochemical applications/year	4	1
Requirement that soil conservation techniques be used	No	Yes
Number of random compliance checks/year	0	3
Monthly household fee on *Grupo ICE* bill	₡0	₡1,837

Table 3. Summary sample characteristics.

	Full Sample	Guácimo	Siquirres	Pococí
Percent women (%)	73	70	77	73
Average age	43	42	44	42
Average years of residency in canton	26	27	28	23
Percent married or in “free union” (%)	71	68	73	71
Average income (colones/household /month)	Less than ₡218,433	Less than ₡218,433	Less than ₡218,433	Less than ₡218,433
Percent farmer (%)	26	36	21	22
Percent working/having worked in pineapple production (%)	41	50	41	35
Respondent’s average education level (years)	6	6	6	6
Spouse’s average education level (years)	6	6	6	6
Percent involved in community organization (%)	18	18	22	15

Table 4. Short description of choice model covariates.

Variable	Description	Nature	Min	Max
Attribute main effects				
Farm Size_Small	Farm Size of <50 ha	Dummy	0	1
Farm Size_Medium	Farm Size of 50-250 ha	Dummy	0	1
Farm Size_Medium	Farm Size of >250 ha	Omitted Dummy	0	1
Agrochemicals_0	Allowed number of applications/ year = 0	Dummy	0	1
Agrochemicals_1	Allowed number of applications/ year = 1	Dummy	0	1
Agrochemicals_2	Allowed number of applications/ year = 2	Dummy	0	1
Agrochemicals_4	Allowed number of applications/ year = 4	Omitted Dummy	0	1
Monitoring_0	Number of random compliance checks/year = 0	Omitted Dummy	0	1
Monitoring_1	Number of random compliance checks/year = 1	Dummy	0	1
Monitoring_3+	Number of random compliance checks/year = 3 or more	Dummy	0	1
Soil Conservation	Soil conservation techniques are required	Dummy	0	1
Buffer Zone	External buffer zones are required	Dummy	0	1
Cost	Monthly household contribution on ICE bill (Colones)	Contin-uous	₡0	₡2,452
Other covariates				
Gender	Male = 1	Dummy	0	1
Age	Respondent's age	Contin-uous	18	98
Years in Community	Years respondent has lived in the community	Contin-uous	0	98

Table 4 (cont'd)

Years in Canton	Years respondent has lived in the canton	Contin-uous	0	98
Education_ Elementary	Respondent has completed 0-6 years of school	Omitted Dummy	0	1
Education_High School	Respondent has completed 7-11 years of school	Dummy	0	1
Education_College+	Respondent has started or completed licentiate degree and/or graduate studies	Dummy	0	1
Farmer	Respondent is a full- or part-time farmer	Dummy	0	1
Plantation Worker	Respondent or a family member has worked or is working for a pineapple farm	Dummy	0	1
Low Income	Respondent's monthly household income falls below the poverty line (₡218,433)	Dummy	0	1
Married/Free Union	Respondent's civil status is: married or free union	Dummy	0	1
Community Group	Respondent is a member of a local or regional association or organization	Dummy	0	1
Interaction effects				
Farm Size x Buffer Zone	Interaction between Farm Size and Buffer Zone	Contin-uous	0	300
Agrochemicals x Monitoring x Soil Conservation	Interaction between Agrochemicals, Monitoring, and Soil Conservation	Contin-uous	0	6

Table 5. Estimation results (Choice and complete models).

	Choice Model		Complete Model	
Variable	Coefficient	St. error	Coefficient	St. error
Attribute main effects				
Farm Size_Small	-.026	.106	.364	.216*
Farm Size_ Medium	.039	.086	.367	.136***
Agrochemicals_0	.022	.101	.043	.141
Agrochemicals_1	.062	.118	.217	.150
Agrochemicals_2	.224	.117*	.511	.148***
Monitoring_1	.138	.103	.201	.121*
Monitoring_3+	.259	.105**	.332	.138**
Soil Conservation	.202	.077***	.256	.114**
Buffer Zone	.093	.077	-.390	.227*
Cost	-.000	.000***	-.000	.000***
Other covariates				
Gender			.228	.188
Age			-.012	.006**
Years in Community			-.004	.007
Years in Canton			.005	.007
Education_ High School			.078	.201
Education_ College+			.312	.290
Farmer			.152	.188
Plantation Worker			.390	.164**

Table 5 (cont'd)

Low Income	-.356	.181**
Community Group	-.168	.214
Interaction effects		
Farm Size x Buffer Zone	.003	.001**
Agrochemicals x Monitoring x Soil Conservation	-.065	.038*

*Note: *** 1% significance, ** 5 % significance, and * 10% significance*

Table 6. Complete model by canton.

	Guácimo		Siquirres		Pococí	
Variable	Coefficient	St. Error	Coefficient	St. error	Coefficient	St. error
Attribute main effects						
Farm Size_Small	.394	.401	-.266	.409	.944	.358***
Farm Size_Medium	.620	.279**	-.027	.246	.585	.221***
Agro-chemicals_0	.112	.278	.186	.276	-.033	.216
Agro-chemicals_1	.182	.314	.197	.276	.329	.234
Agro-chemicals_2	.655	.313**	.824	.268***	.189	.234
Monitoring_1	.331	.252	.486	.231**	-.052	.184
Monitoring_3+	.484	.289*	.687	.269**	-.024	.208
Soil Conservation	.564	.238**	.273	.211	.073	.178
Buffer Zone	-.478	.424	.110	.429	-.809	.371**
Cost	-.001	.000***	-.000	.000**	-.000	.000***
Other covariates						
Age	-.018	.013	-.009	.011	-.013	.010
Plantation Worker	.384	.340	.066	.300	.676	.275**
Low Income	-.139	.403	-.480	.325	-.401	.298
Interaction effects						
Farm Size x Buffer Zone	.004	.002*	.001	.002	.004	.002**
Agrochemicals x Monitoring x Soil Conservation	-.181	.078**	-.088	.071	.033	.061

*Note: *** 1% significance, ** 5 % significance, and * 10% significance*

Table 7. Alternative pineapple production scenario.

Attribute	*Status Quo*	*Preferred Attribute Levels*
Maximum plantation size	Large >250 ha	Medium 50-250 ha
Requirement that external buffer zones be established	No	No
Allowed number of leachable agrochemical applications/year	4	2
Requirement that soil conservation techniques be used	No	Yes
Number of random compliance checks per year	0	3
Monthly household contribution on *Grupo ICE* bill	₡0	₡190

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CHAPTER 3

STRUCTURING DECISION MAKING IN DEVELOPING COMMUNITIES: INFORMING LAND USE POLICY IN COSTA RICA

1. Introduction

For more than half a century, research and practice in international development has focused on improving quality of life for people living in developing regions of the world. Much of this work encompasses projects aimed at poverty reduction, encouraging democratic governance, facilitating private sector development, enhancing human health, providing sustainable infrastructure for basic education, and encouraging social justice and equality. The federal governments of almost every industrialized nation sponsor agencies and programs aimed at meeting these goals; the United States Agency for International Development, Canada's International Development Agency, the Swedish International Development Cooperation Agency, and the UK Department for International Development are high-profile examples. Several other countries and organizations participate in international development activities through representation in the United Nations (UN) or with donor agencies such as the World Bank.

Recently, these organizations have recognized the need to incorporate objectives associated with community participation and environmental sustainability—together with other, more traditional development objectives such as economic development, education, and human health—in decisions about international and community development. From a development perspective, the expansion of the international development mission to include environmental objectives makes sense: in all regions of the world—developed and developing—human health and quality of life

are directly linked to the health of the environment and the sustainable use of natural resources. And given that one of the goals of international development initiatives is to empower local communities through democratic processes, it also makes sense to involve community stakeholders in these decisions.

Successfully eliciting community input about environmental policies is not easy. Decades of research in the decision sciences have shown that getting input from people about these kinds of multiattribute decisions is extraordinarily difficult. Research dating back to the seminal studies of bounded rationality (Simon 1955) points out that people do not readily evaluate *all* of the available alternatives in a given decision in terms of the pros and cons associated with *all* of their associated attributes (e.g., economic impacts, human and environmental health, etc.). Instead, people focus only on a very small subset of the attributes—usually those that are the most salient or easiest to evaluate—and ignore others; this lexicographic process implies that choices made typically do not accurately reflect their full range of values and concerns. Other, related problems also persist. For example, people find it difficult to identify and characterize the objectives that matter to them and which, logically, should guide choices among the alternatives that are under consideration (Bond et al. 2008). And in the cases where people do attempt to balance multiple objectives when choosing among alternatives, they have a hard time balancing the pros and cons of competing alternatives when these objectives conflict (Keeney & Raiffa 1993; Tetlock 2000).

Complicating matters further are findings relating to the widespread use of a panoply of simplifying heuristics that reduce the amount of time and effort required by people to make a choice but introduce systematic biases. The seminal work in this area

has identified a series of judgmental heuristics that, when applied by decision makers, violate basic tenets of rationality; the availability and representativeness heuristics along with the faming effects associated with prospect theory (Kahneman & Tversky 1979; Tversky & Kahneman 1973; Tversky & Kahneman 1981) are commonly cited examples. Research in this area has continued, resulting in a profusion of scholarly articles (e.g., see Hsee 1996; Rivers & Arvai 2007; Slovic et al. 2002) and popular books (e.g., see Ariely 2008; Fishbein & Cappella 2006; Fishbein & Yzer 2003) that point out common flaws—and their consequences—in human judgment and decision making.

But while studies characterizing the cognitive processes that lead to poor decisions continue to proliferate, research focused on how to improve the quality of input from people lags far behind. The bulk of this work in the area of international and community development has been focused on two needs: improving decisions by providing better information to decision makers (Ajzen 2001; Millennium Ecosystem Assessment 2005), and creating more opportunities for stakeholders to become involved in decision-making processes (Chambers 1994; Ostrom 1996; Rhoades 1998). It's difficult to argue against either of these positions. Indeed, providing a solid foundation of supporting information to inform the judgments of stakeholders and decision makers should be preferred to the provision of an inferior one. Likewise, policy makers and analysts should make it possible for stakeholders to participate in consequential decision-making processes. But, equally important is providing empirically derived guidance about how to help effectively combine these needs with insights from studies about how people make decisions and, importantly, how to make these decision better (Ajzen & Fishbein 1980).

The question is, *how*? Recent studies of "structured decision making" suggest that in addition to the provision of information and stakeholder participation in decision-making processes, the quality of stakeholder input can be improved by ensuring that people address four basic principles (Arvai & Gregory 2003; Gregory et al. 2001): (1) thoroughly exploring and then defining what matters to affected stakeholders in the form of clearly articulated and agreed-upon objectives; (2) creating a set of attractive and, importantly, feasible management alternatives; (3) employing the best available technical information to characterize the impacts of these alternatives in terms of the agreed upon-objectives; and (4) directly confronting the value tradeoffs that inevitably arise when objectives conflict.

While these principles build upon the concepts of multiple criteria decision analysis (Clemen 1996; Hammond et al. 1999; Keeney 1992), it's important to stress that SDM is not simply "decision analysis *lite*". Rather, SDM—with its foundation in multiattribute utility theory—adds insights from good practice in analytic-deliberative processes (NRC 1996) while also reflecting findings from behavioral decision research. For example, being explicit about first exploring a full range of objectives and then narrowing the list based on those areas that are most relevant (vs. most salient) to the decision at hand helps to avoid problems associated with bounded rationality. Likewise, being clear about the impacts of the alternatives under consideration in terms of how they meet, or do not meet, stated objectives makes the direction of improvement from the status quo unambiguous; this, in turn, helps to negate problems associated with framing effects (Gregory & Slovic 1997). And, from the standpoint of both developing the information base for decision making as well as facilitating community involvement,

SDM processes are recognized for integrating disparate technical knowledge and stakeholder values while also democratizing decision-making processes.

Structured decision making (SDM) approaches have been applied to a range of problems in North America with positive results (Arvai & Gregory 2003; Barham 2002; Failing et al. 2007; Wilson & McDaniels 2007). There have been few applications—successful or otherwise—of SDM, however, in developing country contexts. Among the reasons for this are the limited time that stakeholders have to devote to these kinds of multi-party initiatives, the distances that people must travel in order to take part, the general lack of technical facilities where people can interact with computer-based decision support tools, and the language and cultural barriers that often exists between predominantly western SDM facilitators and local stakeholders. With the need for—and obstacles to—getting meaningful input from people about community development initiatives squarely in mind, the goal of the research reported here was to develop and test a SDM framework that could be used to elicit input from community members about land use decisions in developing communities of rural Costa Rica.

2. Methods

2.1 Context

Costa Rica is a middle-income developing country located in Central America bordered by Nicaragua to the north and Panama to the south. Despite its small land area (approx. 51,100 km^2), Costa Rica is one of the 20 most biologically diverse countries in the world and forms an integral part of the Mesoamerican Biodiversity Hotspot. But as a developing country, Costa Rica is also keenly interested in economic growth. In addition to electric circuit manufacturing and tourism, which are its top two revenue

generators, Costa Rica also relies heavily on agricultural exports to support economic development. Costa Rica's largest agricultural export is pineapple and its output continues to increase.

Pineapple production in Costa Rica is dominated by foreign-owned multinational corporations. These corporations have invested heavily the crop, including hundreds of large plantations, packing and storage facilities, and transportation networks. (In many cases, these corporations also make packing, storage, and export infrastructure available to smaller scale operations so that they may get their products to market.) In addition, they build and maintain other infrastructure that people in rural communities use, such as roads and bridges. They also provide employment for tens of thousands of people in rural Costa Rica.

Yet large-scale pineapple production in Costa Rica comes at a cost. In particular, to meet export demands and comply with phytosanitary requirements, the once low impact crop now requires significant amounts of pesticide and herbicide, which has resulted in a buildup of agrochemicals in groundwater near some large pineapple plantations. Not surprisingly, many residents of communities adjacent to plantations are concerned about the impacts of agrochemicals on their air and water. At the same time, a lack of adherence to appropriate soil conservation techniques by some producers has resulted in severe erosion problems. There is concern among agronomists that if unchecked, the degree of soil degradation could cause a situation so severe that affected lands cannot be cultivated for decades. Additionally, improper post-harvest management of the crown and leaves by some producers has created a pest problem—predominantly in the form of *Stomoxys Calcitrans*—an aggressive biting fly that, if not

controlled, can wreak havoc on cattle production, both in terms of beef and milk. As a result, farmers and other residents who live on lands adjacent to the pineapple farms, and who fail to benefit directly from these multinational operations, are carrying an unequal share of the costs.

In light of the partial accounting and uneven distribution of the benefits and costs of pineapple production, many Costa Ricans are beginning to call for more careful regulation of the industry. Policies being discussed range from more stringent regulation and monitoring of the existing pineapple industry to significant limits on the scale of production that would be allowed in the country. Some Costa Ricans have even begun to call for an outright ban on pineapple production in certain ecologically sensitive areas. For these reasons, the objectives of the research reported here were twofold: First, and foremost, we aimed to help inform policy decisions by eliciting pineapple production preferences from people living in communities surrounding plantations. Second, we sought to study the effectiveness of the SDM approach in a developing community context, to test whether the methods might hold promise as a decision aid to government officials in Costa Rica and other developing countries that are dealing with similar issues.

2.2 Design

Our research unfolded in two phases: (1) A series of individual meetings and small-group workshops conducted with technical experts (agronomists, soil scientists, etc.), regional officials from the Costa Rican Ministry of Agriculture and Ministry of Environment and Energy, pineapple producers, and community representatives identified through contacts with community development associations and municipal

government offices; and (2) one-on-one SDM sessions with residents of communities located near pineapple plantations.

Workshops: These workshops and meetings addressed the first three elements of the SDM approach (i.e., identifying the problem; eliciting objectives; and creating alternatives). A first round of workshops and consultations[4], which typically lasted between 2 and 6 hours, focused on eliciting from different stakeholders and expert groups a list of guiding objectives that participants felt should be addressed by any future management initiatives. These objectives included ensuring the economic viability of pineapple as an export crop, protecting human health and safety, maintaining environmental health, ensuring that land remains cultivable if or when pineapple production in the area ceases, creating realistic land-use policies that could be sustained though enforcement, and maintaining access to critical infrastructure by members of the public. All consultations and workshops were held at convenient area locations and discussions were conducted in Spanish.

Facilitated discussions in these workshops also focused on identifying the components of different pineapple production scenarios that would help to meet these guiding objectives. These included: (1) reducing in the number of leachable herbicide and pesticide applications per year as a means of protecting human and environmental health; (2) limiting the allowable size of plantations as a means of protecting environmental health; (3) requiring buffer zones to both prevent the airborne spread of agrochemicals (to protect human health) and to provide a visual barrier (an aesthetic improvement); (4) requiring that soil conservation techniques be employed by producers

[4] Initial meetings and workshops took place between March, 2008 and October, 2009.

as a means of ensuring long-term cultivability; (5) mandating monitoring and compliance checks to ensure that agreed-upon policies were being enforced; and (6) generating revenue, in Costa Rican colones (₡)[5], to ensure that local infrastructure was protected by the government if production capacity in the area was reduced, and also to help fund more intensive environmental monitoring. The rationale behind the increase in cost stems from the fact that large pineapple producers are helping to provide infrastructure used by the communities. If the scale of production was to shrink, producers' revenues would decrease as would their ability (and motivation) to provide ancillary community services. As a result, community members would be asked by the government to help cover the costs of these services, which they do not wish to lose, through a monthly contribution. Since few households in the areas where we conduced this research pay property taxes, we had to devise a method to pass the costs associated with smaller pineapple plantations on to local residents. All households pay fees to *Grupo ICE*, the national electricity and telecommunications (television, as well as wired and wireless phones and internet) and electricity provider; as a result, monthly bills from *Grupo ICE* were selected as the revenue collection method.

A final round of 1-day workshops[6] was conducted with experts and managers; these workshops were aimed at assembling a series of five realistic management alternatives, including the status quo (Alternative 1) as well as the expected impacts (or effort levels) associated with these alternatives on the objectives identified in our first round of workshops (Table 8).

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[5] During the period this research was conducted, $1 USD ≈ ₡ 523.

[6] The second round of workshops took place in November 2009.

SDM Sessions: The purpose of these sessions, which lasted 30 minutes on average, was to ask community members to evaluate the five alternatives and then rank them from *most* to *least* acceptable. To inform the evaluation process, we developed a software tool that ran on a laptop computer carried in the field by the research team. The software interface depicted the five management alternatives and included a values weighting module, which was used by respondents to prioritize objectives and rank alternatives. The software also computed the overall subjective utility, via a linear utility model, of each alternative based on the weights that each respondent assigned to the attributes.

The values weighting model made use of a swing weighting (SW) procedure (von Winterfeldt & Edwards 1986) which presented respondents with two hypothetical alternatives: one comprised the worst possible consequences associated with all of the alternatives under consideration and another comprised of the best possible consequences. Respondents were then asked to identify which of the attribute pairs they would most want to swing from the worst to the best in order to, in their minds, make the largest improvement to the system. Respondents repeated this procedure for all of the attributes in the set. Once all of the attributes were ranked, respondents were then asked to assign 100 points to highest ranking attribute with the others assigned a percentage of this weight (Table 9). A weight of zero was allowed when respondents judged an attribute to be irrelevant (Baron 2000; Clemen 1996).

After completing the swing weighting procedure, respondents were shown the rank order of alternatives that best reflected their stated priorities. If they desired, respondents were also given the opportunity to alter their priorities (i.e., re-weight)

which, depending upon the extent to which they changed their weights, could change the rank order of alternatives. Only the final weights, and their corresponding ranking of alternatives, were used in our analysis. After showing respondents the preference order implied by their weights, we also asked them to select their preferred management alternative.

When respondents were finished with the elicitation process, they were asked to complete a short follow-up survey. The survey, administered orally and in Spanish, consisted of 6 questions. These questions, with responses recorded on 5-point Likert scales, asked for respondents to provide ratings of: (1) their level of satisfaction with their resulting choices, specifically the rank order of alternatives (where 1=very unsatisfied and 5=very satisfied); (2) the level of difficulty associated with the decision-making process (where 1=very difficult and 5=very easy); (3) how well their ranking of alternatives reflected what mattered most to them in the context of pineapple production (where 1=very poorly and 5=very well); (4) the degree to which the decision-making process seemed realistic in light of their knowledge about agricultural production in the region (where 1=very unrealistic and 5=very realistic); (5) the extent to which the decision making process seemed biased in the direction of specific alternatives (where 1=extremely biased and 5=not at all biased); and (6) how certain they were in their ability to consider tradeoffs when making their choices (where 1=not at all certain and 5=very certain).

2.3 Respondents

We selected three cantons (Pococí, Guácimo, and Siquirres) within the Limón Province in the Atlantic region of the country as our study site because most of the pineapple

production in the Atlantic region is concentrated there. A stratified random sample of 95 households was drawn from these cantons. Rather than sampling on an ad-hoc village-by-village basis, we worked with the National Institute of Statistics and Census (INEC) based in the capital, San José to draw a stratified random sample of respondents (and because we wanted maximize the credibility of our research by following the sampling procedures utilized by the Government of Costa Rica when conducting the national census and other surveys of national interest). We also wanted to avoid oversampling respondents, both from certain high-conflict areas where strongly negative feelings about pineapple production prevail, as well as from areas so removed from any production—much less conflict—that respondents might have no opinion at all about the issue. During the draw of respondents, INEC took into account each canton's total population and its urban, semi-urban, and rural distribution in order to produce a representative group of sampling segments for each canton. Each of these segments were then rendered on cadastral maps which. A sample of three households was then randomly selected for interviews from each segment. Researchers visited a total of 287 houses (152 of which were eligible), collected 121 surveys, and ended up with a total of 95 completed surveys for an adjusted response rate of 0.63.

The SDM sessions described in this paper were conducted only with respondents who were responsible for making financial decisions, either jointly or alone, on behalf of the household. Thirty-eight percent of these respondents were male, and the average age of respondents was 44 years. Forty-one percent of respondents were originally from the Limón Province, and of that group, the average length of residency is 40 years. Respondents not originally from Limón have lived in their community for an

average of 26 years and in their canton for an average of 31 years. The majority of participants, 59 percent, were married or in “free union” with their partner (41 percent were married and 18 percent in “free union”). The average monthly income of respondents was below the Costa Rican poverty line—<₡218,433—with 18 percent earning that income through farming. An average of 43 percent of respondents reported that they themselves (27 percent) or a family member (16 percent) currently work (or had recently worked) in some aspect of pineapple production. The majority of respondents (59 percent) had only a primary school (i.e., completion of grades 1 through 6) education and 12 percent of respondents self-identified as active members of a community, canton, or provincial committee or organization (such as a local environmental committee or the Rural Aqueduct Association).

2.4 Analysis

Statistical analysis of the SW data was carried out using general linear models in PASW 18. Means weights assigned to attributes by respondents were compared using analyses of variance (ANOVA) coupled with Tukey’s post-tests (with appropriate Bonferroni adjustments included), and when necessary, independent sample t-tests.

3. Results

Based on the results from a separate stated choice survey (Kellon et al. 2011), we undertook several comparisons (see Tables 10 through 15) of respondents’ swing weights (i.e., priorities) that we believed would yield significant differences across attributes. A multivariate test of differences between groups using the Wilks’ Lambda criterion was statistically significant for all three 3-level comparisons; i.e., respondents’ region (canton) of residence ($p = 0.001$), age ($p = 0.015$), and level of education ($p =$

.001). According to the analyses of variance[7] that followed, respondents' priorities regarding the presence of buffer zones ($p = 0.004$), compliance checks ($p = 0.001$), and cost ($p = 0.011$) were significantly different across the three study regions (Table 10). Differences across respondents' priorities as a function of age (Table 11) were significant for the requirement that soil conservation practices be undertaken by plantation owners ($p = 0.045$). In terms of respondents' level of education (Table 12), respondents' priorities regarding the presence of buffer zones ($p = 0.001$), the requirement that soil conservation practices be undertaken ($p = 0.026$), and cost ($p = 0.039$) all differed significantly.

Independent sample t-tests were performed for three additional groups: respondents' gender and relationship to the poverty line, and whether the respondent or a close family member works on a pineapple plantation (Tables 13 through 15). By way of our comparisons concerning gender (Table 13), women placed a higher average weight on limiting both the frequency of pesticide applications ($p = 0.027$) and the size of pineapple plantations ($p = 0.011$) while men were more concerned about cost ($p = 0.001$).

When we considered respondents' level of income (Table 14), respondents who earn at a level that is below the poverty line tend to place greater emphasis on limiting the frequency of pesticide applications ($p = 0.038$). Those above the poverty line, by contrast, placed a higher average weight on limiting plantation size (0.019), ensuring

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[7] Within-attribute differences, determined using a Tukey's post-test, are shown in Tables 10 through 12. All post-test results shown are significant by a margin of *at most* $p < 0.05$.

that buffer zones be established between villages and plantations ($p = 0.006$), and enforcing a larger number of random compliance checks ($p = 0.006$).

Those respondents who work on pineapple plantations, or have a close family member that works on one (Table 15), placed a higher average weight on the requirement that soil conservation be undertaken ($p = 0.001$) and cost (0.039). Those respondents who neither work on a plantation, nor have a close relative who does, placed a higher average weight on limiting the number of allowed pesticide applications ($p = 0.001$) and the requirement the buffer zones be established ($p = 0.026$).

These results are not unimportant in that they are revealing of some key between-subject differences. However, of greater interest to us as decision scientists was the meaning of the average weights across groups in terms of what they might mean for respondents' preferences for different management alternatives. When respondents' mean weights were analyzed using a stepwise linear utility model, we found that differences in average weights of fewer than 20 points across individual attributes had virtually no impact on the overall preference order.

Specifically, an analysis of mean swing weights showed that Alternative 2 always performed best in terms of overall utility, followed by Alternatives 3 and 5, which were nearly indistinguishable. These alternatives were followed by Alternative 4 and Alternative 1, respectively. After completion of the weighting task, 66 percent of respondents told us they would select Alternative 2 if given the choice with 26 percent and 8 percent opting instead for Alternatives 5 and 3, respectively. Alternatives 4 and 1 were never selected by respondents when given the opportunity to choose.

4. Discussion

The primary objective of our research was to help inform policy decisions by eliciting judgments from stakeholders about different management options regarding the pineapple industry in Costa Rica. From the standpoint of our workshop participants, the SDM approach was viewed as adding much-needed precision and civility to a consultative process which, to date, had been fraught with inconsistency and conflict. In the workshops with experts and stakeholders, participants were able put aside long-standing conflicts and, instead, focused on a discussion of critical objectives and realistic management alternatives. Perhaps the best measure of success for these workshops lies in the reaction the objectives, attributes, and alternatives that were developed received from participants in the individual SDM elicitation sessions. Generally speaking, participants in these sessions felt that the information presented to them for analysis did not seem biased (Table 16, Question 5; $\bar{x}$ = 4.9, sd = 0.2); moreover, the decisions they were asked to make using this information felt very realistic to them (Table 16, Question 4; $\bar{x}$ = 4.3, sd = 0.7).

Still, with the individual SDM elicitation sessions, we did not observe any major differences in terms of the individual utility of the five management alternatives (Table 8) across any of the group-level comparisons we undertook (Tables 10-15). Specifically, across all of the group-level comparisons, neither Alternative 1 (i.e., the status quo) nor Alternative 4 (the organic option) were at all competitive in terms of their overall utility. Alternative 2, by contrast, performed the best across *all* of the groups we studied. This option mandates a moderate reduction in the allowable size of pineapple plantations, reduces by more than half the maximum number of agrochemical applications allowed

on pineapple plantations, and requires that both soil conservation practices be used and buffer zones be established between plantations and any neighboring communities. To ensure that these changes were implemented, Alternative 2 also calls for a moderate increase in the number of random compliance checks by government monitors that would take place each year. The overall cost to local households of implementing Alternative 2 is ₡463 per month.

Respondents were largely indifferent between Alternatives 3 and 5. Since these alternatives were substantially different from one another, we feel these results are worthy of attention. Whereas the utility of Alternative 2 was driven largely by a focus on reducing the number of pesticide applications and ensuring the implementation of soil conservation practices as well as the establishment of buffer zones, Alternative 3 tended to be favored by respondents who attached higher weights to a drastic reduction in the allowable plantation size. The utility of Alternative 5, by contrast, was linked most strongly to respondents' desire to increase the frequency of monitoring and/or minimize the cost of management, or increase farm size. In terms of the remaining options, there was a universal dislike of the status quo (the only option with no cost); even respondents who were most concerned about the cost of management agreed that a revision to the current management structure for pineapple in Costa Rica was needed. At the same time, however, there was near-universal dislike of the most costly option, Alternative 4.

In terms of our second research objective, which focused on the effectiveness of the SDM approach in a developing community context, we observed several clear benefits. During our discussions with respondents during the elicitation procedure,

people agreed that the SDM framework helped them to take what many in our study area viewed as an intractable problem and organize it into a series of interrelated, yet cognitively manageable, steps; e.g., thinking about objectives, connecting these objectives to sensible attributes, reviewing the available management alternatives in a user-friendly format, and confronting tradeoffs across the full range of their concerns. At the same time, people were pleased that they were given the opportunity to offer their own opinions, in a constructive fashion, about the management of an important issue in their communities. In the past, people had been asked for their opinions through interviews and surveys for example. However, many respondents reported that our research was the first time that they had the opportunity to reflect on their preferences in a more in-depth and constructive manner.

Our follow-up survey results (Table 16) seem to bear this out. For example, respondents felt strongly that the SDM approach helped them to confront tradeoffs by balancing the pros and cons associated with all of the alternatives (Question 6; $\bar{x}$ = 4.5, sd = 0.5) and, therefore, make choices that reflected what mattered most to them (Question 3; $\bar{x}$ = 4.3, sd = 0.5). It is our view that, in large part, respondents' high level of satisfaction with their decisions (Question 1; $\bar{x}$ = 4.2, sd = 0.8) can be attributed to this aspect of the SDM method.

However, it is worth noting that the SDM method did not necessarily make the decision *easier* for respondents (Question 2; $\bar{x}$ = 3.4, sd = 0.9). A common misconception about SDM is that it simplifies complex decisions. In fact, there is nothing simple about a complex problem that requires people to confront challenging tradeoffs. What SDM does is provide people with a systematic method for clarifying the

multiple, related aspects of a decision and then balancing the pros and cons of alternatives through a deliberative and iterative process. We acknowledge that this process still can be challenging for decision makers. The benefit, however, is in helping to ensure that the resulting decision is internally consistent.

It is also worth noting that other, seemingly more straightforward and easy, approaches for eliciting these kinds of preferences exist. Stated choice methods (Adamowicz et al. 1998; Boxall et al. 1996) such as conjoint analysis, for example, have been widely used in Costa Rica (e.g., see Alpizar & Carlsson 2003). These methods use survey instruments to present respondents (local community members, other stakeholders) with a series of alternatives, characterized as multidimensional composites or scenarios, that present integrated (i.e., conjoined) combinations of different attributes (e.g., different levels of air quality, water quality, and local employment). Combinations generally reflect actual or projected variations in the attributes (e.g., different levels of air and water quality and local employment opportunities). In the more sophisticated conjoint surveys, often termed “choice experiments”, the represented attributes are specified by an experimental design that estimates the separate and interacting effects of component attributes (Louviere 1988).

Multiple regression or similar analyses of decision makers’ choices among the presented options are used to estimate the relative contributions of individual attributes to their expressed preferences for the conjoint alternatives. In other words, the choices made by people in response to survey questions are used to reveal the tradeoffs that they are willing to make when comparing multiattribute alternatives. Stated choice methods/choice experiments are being used with greater frequency in developing

countries to inform the design of PES programs. Specifically, conjoint surveys and choice experiments are used to identify the environment-development tradeoffs that people seem willing to make so that appropriate payment vehicles and amounts can be designed and built into PES contracts.

However, as decision scientists, were believe that there are significant challenges associated with stated choice approaches stemming from how judgments requiring tradeoffs across benefits and costs are constructed. A wealth of research in psychology and behavioral economics demonstrates that people are not the ideally rational maximizers of multiattribute utility that many policy makers assume they are (Ariely 2008; Kahneman et al. 1982; Tversky & Kahneman 1974). Instead, people construct their judgments in response to contextual and experiential cues that are available to them during the decision making process (Arvai et al. 2006; Payne et al. 1992; Slovic 1995; Slovic & Lichtenstein 2006). As a result, information about implied tradeoffs may be misleading because the judgmental processes that led to them were prone to judgmental inconsistencies. This problem is likely to be more significant when the choice context is unfamiliar, which has shown to be true for many environmental policy options (Gregory et al. 1993).

With stated choice approaches, for example, questions may be raised about the extent to which survey respondents are actually confronting tradeoffs across *all* of the attributes and levels that are being presented to them in choice experiments. This problem, which has been termed “process validity” in the literature on choice experiments (Carson et al. 1994; Mitchell & Carson 1995), may bedevil even the most carefully designed process. For example, conjoint surveys assume that respondents

are considering the full set of described attributes when choosing among options; the expectations are that some of these attributes will be more important than others and choices between the presented options will provide important insights about the tradeoffs that people are willing to make (Adamowicz et al. 1998; Green & Srinivasan 1978; Louviere 1988).

One problem here is that a given attribute weight of zero, or near zero, may not mean that a given attribute is not important (as the zero value implies). Instead, such an attribute may be quite important to a decision maker but may nevertheless largely be ignored during the construction of preference. A common reason for this, which has been studied in other contexts (Arvai & Gregory 2003; Arvai et al. 2006; Arvai et al. 2007; Gregory 2003; Gregory et al. 2001; Lichtenstein et al. 2007), is tradeoff avoidance associated with constitutive incommensurability (Baron & Spranca 1997; Tetlock 2000; Tetlock et al. 2000). When confronted with tradeoffs that make decision makers feel as though they must subvert some morally significant values in favor of others, many people respond by anchoring on a single important attribute while blocking out the others. This occurs not because the blocked attributes are not important—quite the opposite. These attributes *are* important but they are discounted because they are difficult or uncomfortable to balance against other attributes.

The swing weighting procedure in a SDM approach counters this problem by making the need to evaluate alternatives on an attribute-by-attribute basis explicit. Swing weighting has a built-in advantage over other approaches—like stated choice methods—in that it is very sensitive to the range of values that an attribute takes on. In other words, respondents are required to consider the range of possible outcomes

across all of the attributes and then make a determination about which of these ranges—and by extension, the associated attribute—is most in need of attention; respondents then repeat this procedure for each attribute in the set (see Table 9). As a result, the risk that respondents will make decisions based solely on a single attribute—which we believe to be a significant shortcoming of stated choice approaches—is reduced considerably (Clemen 1996; von Winterfeldt & Edwards 1986). At the same time, SDM does not oversimplify the decision by unrealistically dissecting a complex problem into its component parts (which tends to falsely portray them as unrelated). Rather, after helping decision makers evaluate each attribute and their levels, SDM's holistic approach and explicit focus on deliberative tradeoff analysis helps decision makers weigh the pros and cons of the consequences of different combinations of attribute levels.

To conclude, decisions focused on managing environmental systems present some of the most imposing challenges to policy makers, scientists, and stakeholders alike. Adding to these challenges, decisions about the environment are not simply decisions about the environment; they affect individuals, communities, as well as business and commercial interests. As a result, these decisions must contend with multiple, conflicting, and often poorly understood values that, in turn, are linked to social, cultural, spiritual, economic, as well as other objectives and concerns. Complicating matters further is the fact that these decisions must often be made under severe time pressure, either because of impending environmental damage or because of political constraints faced by decision makers. These challenges are made all the more pressing and significant in developing communities, where most decisions about

the environment directly influence the livelihood of one or more stakeholder groups. Due to the precarious socio-economic status of people in these areas, these direct—and even indirect—influences can have devastating effects on the ability of resource-dependent individuals and communities to sustain themselves (Kellon & Arvai 2011). Together, these challenges motivated our research. In the end, we believe our findings speak volumes about the value of applying SDM approaches in an international development context.

APPENDICES

APPENDICES

Table 8. Alternatives developed for evaluation by stakeholders. *Alternative 1 reflects the status quo.

Objective	Attribute	*Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Human & Env. Health	Allowed number of leachable agrochemical applications/year	4	1	1	0	2
Env. Health	Maximum plantation size	>250 ha	50-250 ha	<50 ha	<50 ha	>250 ha
Human Health	Requirement that external buffer zones be established	No	Yes	No	No	Yes
Long-Term Cultivability	Requirement that soil conservation techniques be used	No	Yes	Yes	No	No
Enforcement	Number of random compliance checks/year	0	1	1	>3	>3
Infra-structure & Enforcement	Monthly household fee on *Grupo ICE* bill	₡0	₡463	₡1,837	₡2,452	₡105

Table 9. Worst and best ranges, derived from the options presented in Table 8, used in the swing weighting procedure. Italicized figures depict the ranks and weights elicited from a single respondent.

Objective	Attribute	Worst	Best	Rank	Weight
Human & Env. Health	Allowed number of leachable agrochemical applications/year	4	0	*1*	*100*
Env. Health	Maximum plantation size	>250 ha	<50 ha	*5*	*65*
Human Health	Requirement that external buffer zones be established	No	Yes	*2*	*90*
Long-Term Cultivability	Requirement that soil conservation techniques be used	No	Yes	*3*	*78*
Enforcement	Number of random compliance checks/year	0	>3	*6*	*60*
Infrastructure & Enforcement	Monthly household fee on *Grupo ICE* bill	₡2,452	₡0	*4*	*70*

Table 10. Mean weights (wt.) and standard error (se) elicited for each attribute by region. For the Tukey's post-test, all significant differences are at the $p < 0.05$ level where: 1 corresponds with Pococí ≠ Guácimo; 2 corresponds with Guácimo ≠ Siquirres; and 3 corresponds with Pococí ≠ Siquirres.

Attribute	Pococí		Guácimo		Siquirres		pANOVA	Post-Test
	wt.	se	wt.	se	wt.	se		
Allowed number of leachable agrochemical applications/year	92.3	8.1	92.3	13.3	95.5	5.2	0.203	*NA*
Maximum plantation size	69.0	23.3	76.5	19.4	80.70	19.7	0.172	*NA*
Requirement that external buffer zones be established	89.5	7.1	81.5	17.8	84.30	10.9	0.004	*1,3*
Requirement that soil conservation techniques be used	93.1	5.3	87.4	14.8	87.6	13.3	0.057	*NA*
Number of random compliance checks per year	94.8	8.4	85.6	10.9	80.2	17.3	0.001	*1,3*
Monthly household fee on *Grupo ICE* bill	92.5	10.5	77.7	23.6	86.1	19.0	0.011	*1*
	n=31		n=31		n=33			

Table 11. Mean weights (wt.) and standard error (se) elicited for each attribute by age. For the Tukey's post-test, all significant differences are at the $p < 0.05$ level where: 1 corresponds with 18-40 Years ≠ 41-60 Years; 2 corresponds with 41-60 Years ≠ >60 Years; and 3 corresponds with 18-40 Years ≠ >60 Years.

Attribute	18-40		41-60		>60 Years		pANOVA	Post-Test
	wt.	se	wt.	se	wt.	se		
Allowed number of leachable agrochemical applications/year	94.0	7.7	95.1	7.0	87.8	15.4	0.345	*NA*
Maximum plantation size	74.3	20.6	81.4	18.9	66.3	25.0	0.111	*NA*
Requirement that external buffer zones be established	82.1	14.6	86.3	9.3	90.9	13.0	0.067	*NA*
Requirement that soil conservation techniques be used	92.9	10.1	86.4	12.5	85.6	14.1	0.045	*NA*
Number of random compliance checks per year	88.7	10.2	84.0	16.2	86.9	18.4	0.263	*NA*
Monthly household fee on *Grupo ICE* bill	83.6	20.9	85.6	18.6	90.0	16.3	0.686	*NA*
	n=45		n=34		n=16			

Table 12. Mean weights (wt.) and standard error (se) elicited for each attribute as a function of education level (characterized by the number of years of formal education). For the Tukey's post-test, all significant differences are at the $p < 0.05$ level where: 1 corresponds with 0-6 Years ≠ 7-11 Years; 2 corresponds with 7-11 Years ≠ >11 Years; and 3 corresponds with 0-6 Years ≠ >11 Years.

Attribute	0-6 Years		7-11		>11 Years		pANOVA	Post-Test
	wt.	se	wt.	Se	wt.	se		
Allowed number of leachable agrochemical applications/year	92.1	10.8	96.8	5.1	91.0	8.8	0.065	*NA*
Maximum plantation size	73.1	21.7	81.6	18.2	72.0	24.4	0.351	*NA*
Requirement that external buffer zones be established	87.9	9.6	84.8	11.7	70.0	21.6	0.001	*2,3*
Requirement that soil conservation techniques be used	86.5	14.0	92.4	7.1	96.9	4.2	0.010	*3*
Number of random compliance checks per year	86.5	15.8	87.5	10.9	86.0	12.7	0.824	*NA*
Monthly household fee on *Grupo ICE* bill	89.9	16.6	81.8	20.0	70.0	23.1	0.008	*3*
	n=57		n=28		n=10			

Table 13. Mean weights (wt.) and standard error (se) elicited for each attribute as a function of gender.

Attribute	Women		Men		p
	wt.	se	wt.	se	
Allowed number of leachable agrochemical applications/year	95.6	6.0	89.7	12.5	0.027
Maximum plantation size	80.2	20.7	67.8	19.9	0.011
Requirement that external buffer zones be established	83.7	13.7	87.4	11.4	0.244
Requirement that soil conservation techniques be used	90.2	12.4	88.0	11.6	0.324
Number of random compliance checks per year	84.1	12.4	91.0	15.8	0.096
Monthly household fee on *Grupo ICE* bill	80.8	20.7	93.1	13.9	0.001
	N=59		N=36		

Table 14. Mean weights (wt.) and standard error (se) by attribute relative to the poverty line (PL) of ₡218,433 per month.

Attribute	< Poverty		> Poverty		P
	wt.	se	wt.	se	
Allowed number of leachable agrochemical applications/year	94.5	6.6	91.9	12.0	0.038
Maximum plantation size	69.7	20.9	82.6	21.4	0.019
Requirement that external buffer zones be established	81.2	15.7	88.9	7.5	0.006
Requirement that soil conservation techniques be used	88.0	11.9	90.7	12.4	0.226
Number of random compliance checks per year	83.3	16.3	90.9	10.1	0.006
Monthly household fee on *Grupo ICE* bill	82.9	20.2	89.7	16.6	0.149
	n=49		n=43		

Table 15. Mean weights (wt.) and standard error (se) by attribute relative to respondents' relationship with the pineapple industry. Respondents reporting "yes" either worked in—or had a close relative or family member working in—the pineapple industry.

Attribute	Family: No		Family: Yes		P
	wt.	se	wt.	se	
Allowed number of leachable agrochemical applications/year	97.0	4.8	88.5	11.7	0.001
Maximum plantation size	77.1	20.6	73.4	22.0	0.283
Requirement that external buffer zones be established	87.7	9.0	81.5	16.3	0.026
Requirement that soil conservation techniques be used	85.2	12.7	94.9	8.7	0.001
Number of random compliance checks per year	86.5	14.8	87.0	13.3	0.864
Monthly household fee on *Grupo ICE* bill	81.3	19.6	90.9	17.7	0.039
	n=54		n=41		

Table 16. Follow-Up survey results.

Follow-Up Survey Questions	$\overline{x}$	sd
1. Satisfaction with choices	4.2	0.8
2. Difficulty with decision-making process	3.4	0.9
3. Choices reflect what matters	4.3	0.5
4. Choices seemed realistic	4.3	0.7
5. Information seemed unbiased	4.9	0.2
6. Ability to balance pros and cons	4.5	0.5

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CONCLUSION

The objective of this research was to better understand, and gauge the effectiveness of, two approaches for confronting difficult environment-development tradeoffs. A comparison of the findings from the stated choice and SDM treatments reveals strengths and weaknesses of both approaches with respect to their practical implications, as well as the appropriateness of the methods in similar decision-making contexts.

The conjoint method is, on one hand, an extremely efficient data collection method that lends itself to powerful statistical analysis. On the other hand, the method assumes rational, utility maximizing actors; the options generated by orthogonal design are not entirely realistic; respondents are asked to compare sets of conjoined attributes without first evaluating each of the attributes and their associated levels, thereby increasing the risk of anchoring on highly affective attributes; and respondents cannot see the consequences of their true weights, which means they cannot make informed tradeoffs.

By contrast, the swing weighting method acknowledges the constructed nature of respondents' preferences; presents respondents with realistic options (actual production scenarios); gives respondents the opportunity to deliberate about their choices, consider tradeoffs, and change their decisions; and allows respondents to evaluate both individual attributes and the consequences of combining different levels of attributes, which helps to inform tradeoffs. The weakness of this method is that interviewers require more training since it is not a simple survey, therefore making it a potentially

less efficient data collection method. Efficiency could be further compromised if respondents are not familiar with assigning weights, as the interviews would tend to take longer to conduct.

Results from respondents' own evaluations revealed that the people who went through the swing weighting process reported a higher degree (statistically significant) of satisfaction with their decision-making process than those who responded using the conjoint protocol. Specifically, the swing weighting respondents were generally more satisfied with their choices; the choices they made better reflected what matters most to them; the options they chose seemed more realistic; the information they considered when making their choices seemed unbiased; and it was easier for them to balance the pros and cons of each of the options. Interestingly, there was no difference between treatment groups regarding the perceived difficulty of making choices.

These findings show that confronting difficult tradeoffs is, by nature, difficult—regardless of the method used. That said, SDM appeared to help respondents improve their decision-making process by better understanding their own preferences and preference orders; making more informed and deliberated tradeoffs; enjoying the process more (by not being annoyed by options that seemed biased or unrealistic and by not being confused since they understood their own decision criteria); and being more satisfied with their choices.

The practical implications of findings from both treatments show that while both methods produced useful findings, the SDM approach revealed what appears to be a more holistic—and therefore, more policy relevant—understanding of residents' preferences regarding the pineapple production practices they were asked to consider.

Essentially, respondents from the conjoint treatment appear to be less willing to make tradeoffs across the different attributes and levels than those from the SDM treatment, and importantly, it is not clear *why* conjoint respondents were willing (or unwilling) to make tradeoffs. Conversely, the SDM results reveal a greater willingness on behalf of respondents to make tradeoffs across attributes and levels, and due to the way respondents worked through the swing weighting method (ranking and weighting attributes first, evaluating the production alternative their weights produced, and repeating the process until they were satisfied with their choice), they were able to understand and express their tradeoff analysis process. The SDM treatment's more nuanced findings regarding community members' main concerns and their willingness to make tradeoffs when addressing these concerns (and their reasons for doing so) will be critically important to the stakeholders working to improve the environmental sustainability of pineapple production in the Atlantic Region of Costa Rica.

In the end, both methods produced valuable results, and it is clear that for certain kinds of decision processes, a stated choice approach would be entirely appropriate. Basically, decisions that are not complex or highly affective and for which respondents' preferences and preferences orders already exist typically do not require much deliberation and a stated choice method would be very useful. However, this research suggests that for decisions similar in nature or complexity to the one presented here, a stated choice approach would tend to oversimplify the decision problem. It would also generalize the inherent tradeoffs by not giving respondents the opportunity to adequately construct their preferences, consider the impact of these preferences, and further evaluate their willingness to make tradeoffs before making their final choice. For

these reasons, this research indicates that a SDM approach such as swing weighting has great potential for helping stakeholders address difficult environment-development decision problems. To be sure, more research is needed in order to evaluate the performance of swing weighting and other SDM methods in similar decision contexts, as well as to improve these methods by finding more efficient and context-appropriate ways to use them as part of data collection in the field.