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Decision Modeling: Why farmers Do or Do Not Convert to Organic Farming

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Abstract

This study examines why farmers in Northern New South Wales, Australia do or do not convert to organic farming from conventional farming practices. Organic agriculture provides a production alternative that may be environmentally and nutritionally beneficial. Because the structural settings of economy and society influence decision-making on an individual basis at the farm level, discussions of policy must consider why farmers do, or do not, convert to organic farming. Ultimately, the successfulness of a policy depends on the effectiveness of motivating individual action.

A hierarchical decision tree was created using ethnographic decision tree modeling. Elimination criteria, motivational criteria, and constraints to conversion were identified from ethnographic interviews with organic and conventional farmers. These criteria were arranged into a decision tree. A survey consisting of these criteria was administered to a different sample of conventional and organic farmers, and the results were used to evaluate the predictive validity of the decision tree. The decision tree classified 95 participants with 88.42% accuracy; this is above the 80% accuracy threshold for satisfactory models.

The greatest benefit of the ethnographic decision modeling method is a rejection of structural determinism. The tree shows that structural factors in and of themselves don't determine farmer behavior; it's the constructs of each individual, his or her values and priorities, that shape the decision. Structural factors are mediated by the actor's perception, and are considered only if perceived to be decisive.

This is an optimistic and exciting finding for proponents of organic farming. Many structural factors are impossible to change, but personal constructs are open to revision; the organic farming movement must not move mountains, only minds.

ISP topic codes: Cognitive psychology 903, Agriculture 602, Communication and the Arts: General 101.
Keywords: Ethnography; decision modeling; personal construct psychology; organic farming

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Introduction

From birth until death, a human must eat. This need is one of our most pressing and has existed since the beginning of our species. When our need for food could no longer be met by hunting and gathering, agriculture was invented. This has had the greatest impact on humanity, and on the Earth, of any invention, ever (Diamond, 1997).

Modern agriculture

Agriculture is the most common occupation, with 41.18% of the world's population growing food in 2003 (Food and Agriculture Organization of the United Nations, 2006). Of the world's land, 13.31% of it is arable, and 4.71% of it was used in 2005 for permanent crops (Central Intelligence Agency, 2006).

Modern, high-yield agriculture has been wildly successful. In the past four decades the world's population has doubled, yet agriculture has been able to meet most of the world's food needs. This success is tempered, however, by environmental consequences:

> contamination of groundwaters, release of greenhouse gases, loss of crop genetic diversity and eutrophication of rivers, streams, lakes and coastal marine ecosystems (contamination by organic and inorganic nutrients that cause oxygen depletion, spread of toxic species and changes in the structure of aquatic food webs) (Tilman, 1998).

Most importantly, high-yield agriculture causes erosion and a loss of soil fertility. This has been countered by farming practices, such as alternating crops that increase soil fertility and abandoning fields to be overgrown with natural vegetation, and artificial inputs, such as pesticides or fertilizers containing nitrogen.

Organic agriculture

It was dealing with the issue of soil fertility that created the organic movement. Ironically reactionary, an organic philosophy was developed in 1940s Britain; its pioneers, Rudolf Steiner and Lady Eve Balfour, founded the Soil Association and a number of methods to retain soil health without synthetic chemicals (Macilwain, 2004; Trewavas, 2001).

Today, organic methods of production are becoming mainstream (*Nature*, 2004). Markets for organic food are growing; in 2000, sales of organic products totaled eight million dollars, or 1.5% of total food sales, in the United States of America (International Trade Center, 2001).

Organic agriculture provides a production alternative that may be environmentally and nutritionally beneficial. Because the structural settings of economy and society influence decision-making on an individual basis at the farm level, discussions of policy must consider why farmers do, or do not, convert to organic farming. Ultimately, the successfulness of a policy depends on the effectiveness of motivating individual action (Morris and Potter, 1995; Wilson, 1997; Beedell and Rehman, 2000; McGregor et al., 2001).

Australia is second only to China in land area devoted to agriculture. Australia produces a substantial amount of food; in 2003, Australia produced 1.7% of the world's fiber crops and 1.6% of the world's cereal crops[1] (FAO, 2006). There is no research, however, examining why Australian farmers do, or do not, convert to organic farming.

Modeling decisions

Modeling decisions is not a new science; there are many different approaches, qualitative and quantitative. Past studies have examined the factors influencing farmers'

motivations for participating in agricultural policies in general or converting to organic farming. Most of the studies used normalizing methodologies such as formal questionnaires or surveys, allowing farmers to select motivations and constraints for action from a predefined list (Häfliger & Maurer, 1996; Freyer, 1998; Burton et al., 1999; Kirner & Schneeberger, 2000; Rämisch, 2001; Schneeberger and Kirner, 2001; Schneeberger et al., 2002). Because of their strictly quantitative nature, these studies allow a large number of participants to be included and statistical models to be built, identifying the relative importance of barriers to conversion. However, this method impairs the development of a robust model as there are usually many interrelated factors involved in making a decision; analysis of these factors as individuals is misleading (Wilson, 1997).

A qualitative methodology can solve this problem, as many studies have found (Buck et al., 1997; Lockeretz, 1997, 1999; Duram, 1999, 2000; Fairweather, 1999; Kaltoft, 1999; Lund et al., 2002). This methodology allows for a wide variety of decision criteria and structural factors to emerge from the farmers' themselves; the actors can speak for themselves, rather than be boxed in by the constructs of the researcher. This approach assumes that the farmers are experts who have different objectives and exercise different farming practices based on their own criteria, experiences, and theoretical perspectives. This doesn't mean that structural factors are ignored. Rather, the complex interactions of internal and external factors are recognized (Falconer, 2000).

A problem with existing literature on motivations for organic farming, whether qualitative or quantitative, is its general exclusion of conventional farmers. Studies like Conacher and Conacher (1982), Lockeretz and Madden (1987), Milder et al. (1991), Willer and Gillmour (1992), Kvist (1994), and Dubgaard and Sorensen (1998) only sample from populations of biodynamic or organic farmers.

There are a small number of studies that include samples of both organic and conventional farmers. These studies identify a variety of motivations for organic farming. Buttel and Gillespie (1988) found that differences in production practices between organic and conventional farmers in New York, USA were far less than differences in theoretical perspectives. Beharrell and Crocket (1992) support this finding, studying 117 English farmers to determine that organic and conventional farmers share a common negative outlook on organic farming but retain different theoretical perspectives. Padel (1994) offers a summation on the diversity of motivations, concluding that reasons for conversion to organic are either farm-related or personal. This research does not examine decision making itself, however; only factors related to decision making are considered. To truly examine the act of making the decision, a different methodology is required: ethnographic decision modeling.

Ethnographic decision modeling

Ethnographic decision modeling was pioneered by Gladwin (1976) in her examination of farmers' decisions regarding Plan Puebla, a project recommending practices to increase yields of maize in Puebla, Mexico. This method was expanded upon in Gladwin (1989), and used to study decision making regarding the adoption of improved maize varieties in Kenya (Franzel, 1984), tree plantings (Fairweather, 1992), on farm or off-farm work (Fairweather, 1995), new sheep breeds (Jangu, Fairweather & Martin, 1995) and the adoption of improved feed crops in Ethiopia (Darnhofer, Gretzmacher & Schneeberger, 1997). It elicits decision criteria from the decision makers themselves using ethnographic techniques; in this way, it follows in the tradition of qualitative research. The criteria are then arranged sequentially and read like a flowchart.

Using a tree model has many advantages to other methods of modeling. It is easy to understand, requiring little explanation or expertise. It uses a white box model, meaning that the conditions are easily explained using Boolean logic.[2] It's possible to validate a tree model using statistical tests.[3] And most importantly, decision tree models are predictive and accurate; when compared with other decision models like expected utility, regression modeling, classification and regression modeling (CART), and linear-additive econometric models, the decision tree model was found to be the most descriptive and accurate (Murray-Prior & Wright, 1994; Darnhofer et al., 1997; Darnhofer, Schneeberger & Freyer, 2005).

Gladwin (1976) explains how to model decisions in four steps: interview and observe a sample of the population, place the decision criteria into a flowchart using the participants' language, test the flowchart's predictive validity by using the same sample, test the flowchart's predictive validity by using a different, random sample from the same population.

Choice

Gladwin used a hierarchical theory of choice to explain how everyday people make choices over a large number of objects. The theory assumes that when one makes a choice, they do so by considering alternative sets of discrete characteristics after eliminating most of the objects. Gladwin uses the example of a used car. A person may pick up a newspaper with hundreds of classified ads for used cars. After a few minutes of elimination, the person will only be considering a small number of cars. The theory states that the decision-maker eliminates all objects that have an aspect that the decision-maker doesn't want. This process often occurs rapidly and unconsciously; in this case, the person may have eliminated all trucks, vans, convertibles, two-door sedans, and manual-drive cars. The decision-maker is

left with a manageable pool of objects to examine in more detail. In the next stage, the decision-maker considers all the characteristics of the objects and eliminates the characteristics that are equal or irrelevant. In the example, if two cars both satisfy a certain requirement, such as the cost being under $5,000, then that criterion is no longer used in the decision process. When the characteristics are narrowed down to a manageable amount, then the decision-maker chooses one to order the objects, such as ordering the cars by the mileage per gallon. In the final stage, the decision-maker formulates constraints from the remaining characteristics and passes the ordered objects through the constraints. In the example, the person may eliminate any cars that do not have passenger-side airbags, considering the cars in their order of mileage per gallon. If no alternative passes all the constraints, another strategy is employed. This theory of decision-making is often referred to as "maximization subject to constraints" in microeconomics. Because there is an ordering of alternatives rather than consideration on a continuous aspect, the process may be represented algebraically or graphically (Gladwin, 1976).

Hierarchical theory of choice alone is not enough to explain decisions. Murray-Prior (1993) argues that personal construct psychology is necessary to fully model decisions. Personal construct psychology views people as scientists, making sense of the world by creating hypotheses, or constructs, about how the world behaves. A person creates a construct from experience, discerning patterns or establishing order to complex behaviors or events. A person continually tests his or her constructs against what he is she feel has occurred. When dissonance occurs between construct and reality, either the construct is amended or reality is interpreted to fit the construct.

Personal construct psychology is useful because it emphases individual interpretation. The satisfaction we gain from our actions is dependant on how what we perceive as happening matches with what we expected to happen. Thus, decisions about farming

behaviors are motivated by the farmer's construction of future events. Coupled with the hierarchical theory of choice, this creates a useful conceptual framework to investigate why farmers in Northern New South Wales do or do not convert to organic farming. An outline of the decision making process is represented in Table 1.

Table 1: Outline of the decision making process

Stage 1: Pre-attentive or unconscious processing

1. Rapid elimination of a large number of objects that fail to pass a series of aspects (or fit into constructs)

Stage 2: Maximization subject to constraints

1. Listing of objects remaining after Step 1.
2. Disregarding criteria that are equivalent or irrelevant
3. Selection of an ordering characteristic
4. Ordering of objects
5. Framing of characteristics as minimum requirements to be met (constraints); if continuous, a threshold is selected
6. Passing of objects through constraints
7. Alternative strategy is adopted, if no object survives constraints

Methodology

This study was conducted in Northeastern New South Wales in Australia. This region was chosen because of its large population of farmers and the familiarity All interviewees live within 100 kilometers of Lismore. Surveying was conducted at the Rural Buying Service, a farming supplies store, and at the Rainbow Region Organic Market in Lismore.

This study involved three stages: interviewing, constructing the decision tree, and surveying. Table 2 contains the schedule of methodology.

WWOOFing

WWOOF stands for Willing Workers on Organic Farms, a network of organic farmers willing to provide free food and lodging in exchange for work. The Bruin family grows small crops on an organic farm slightly north of Tyalgum, on the border of New South Wales and Queensland. I worked on their farm for a week while constructing my interview guide. This allowed me to cluster sample using the Bruins' social network, and utilize the Bruins' experience while constructing the interview guide.

Most importantly, I was able to experience organic farming firsthand. This proved to be beneficial, as familiarity with the data is crucial in decision modeling; "a feel for the data [is necessary] in order to reach a comprehensive assessment of the variables under consideration" (Darnhofer et al., 1997, p.279).

Interviewing

13 farmers were interviewed, five conventional and eight organic; a list of these farmers can be found in Appendix A. These farmers were identified through cluster sampling and recruited over the phone or by email. Six farmers were interviewed in person; these interviews were tape recorded and handwritten notes were taken. The visit often included a farm tour.

Seven farmers were interviewed over the phone, and handwritten notes were taken during the interview. All farmers were advised of their rights as participants.

An interview guide was created to standardize the interviews; this guide is located in Appendix B. Each interview began with the farmer providing demographics about the farm, such as type, size, and time owned. Then the farmer was asked to explain how he or she came to farming, his or her approach to farming, and why. Special care was taken to allow the decision criteria to emerge from the farmer and not be influenced by the research. Thus, questions were always very general and open ended, and probes were used only after the farmer had provided a full and detailed explanation of his or her story. Farmers enjoyed explaining their methods and reasons for farming, so it was not difficult to be "hands off" during most of the interview.

Farmers were considered to be experts who had reasons for their actions based on experience or knowledge. Because this study was examining the structure, not the validity, of the decision process, farmers' beliefs were accepted at face value, even if the belief might be considered to be incorrect or not well founded by others.

Often the interview would include a discussion about structural factors relevant to their particular situation or an evaluation about farming in general. While these topics were generally not relevant to this study, they provided an opportunity to develop a greater familiarity with the farming industry.

Mild deception was used when presenting the topic to the farmers. The study was described as an examination of farming practices, and the organic component was never mentioned because of the potential for the farmers to tailor their responses or be less than candor; the word "organic" has the ability to provoke a number of different associations and feelings. At the conclusion of the interview, a full description of the study was provided to the farmer.

Data analysis

The interview recordings, when available, and handwritten notes were analyzed for motivations for and constraints against farming organically. Because conventional farming is considered the standard method for farming and organic the alternative, the data was analyzed in terms of converting to organic farming. This conceptualization is supported by data; of the farmers interviewed, no conventional farmer had ever farmed organically, and many of the organic farmers had originally farmed conventionally. The motivations and constraints were converted into questions with yes/no responses. These criteria were then combined into a decision tree.

The decision tree must allow each farmer to move downward through the tree to an endpoint reflecting his or her method of production. Also, the tree must combine the criteria in a logical way, explaining each farmer's outcome in a meaningful way (Fairweather, 1999).

This produced a decision tree, located in Appendix E. In order to test the predictive validity of the decision tree, a survey containing the criteria was administered.

Survey

The survey contained a question about whether the participant farmed conventionally or organically, what he or she grew, and the decision criteria elicited from the interviews. Participants were restricted to answering “yes” or “no” to each question. A copy of this survey is located in Appendix C.

After two days of surveying, three changes were made to the survey in order to clarify three of the decision criteria. These changes are marked in bold in Appendix D. The schedule of methodology (table 2) notes which survey was used on which day.

The surveys were administered at the Rural Buying Service in Lismore, a store that sells farming supplies from chemicals to tools to clothing, and at the Rainbow Region Organic Market in Lismore, a market where only organic farmers may sell their produce. 87 farmers completed the survey at the Rural Buying Service while eight farmers completed the survey at the Rainbow Region Organic Market, making a total of 95 farmers surveyed. Of these 95, 21 were organic farmers.

Rural buying service method

Participants were recruited by convenience sampling. When a customer approached the counter, he or she was asked, “Are you a farmer?” If the customer answered in the affirmative, he or she was then asked if they would be willing to complete a survey about farming practices. Not every customer who approached the counter was asked; the Rural Buying Service has four counters, and during busy periods there wasn’t enough time to cover all four. Of the 87 farmers surveyed at the Rural Buying Service, 13 were organic farmers.

Table 2: Schedule of methodology from 18 April 2006 to 16 May 2006

[insert schedule of methodology.pdf]

Rainbow region organic market method

Participants were recruited by convenience sampling. Every farmer who had a stall at the market was administered a survey. All eight farmers were organic farmers.

Data analysis

Each survey traced a path through the decision tree based upon the responses. These paths were plotted onto the decision tree, noting the number passing through each choice. Each path has an ending, and the number of conventional and organic farmers arriving at each ending was recorded. The accuracy of the model was then calculated by dividing the number of correctly sorted participants by the total number of participants.

Results

Decision criteria

The decision criteria identified from the interviews fit into three different categories: elimination criteria, motivational criteria, and constraints. The criteria are listed in table 3.

Table 3: Elimination criteria, motivational criteria, and constraints for farming organically

Elimination criteria

1. Setting up and getting organically certified would take too long
2. Growing organic produces lower yields
3. Weed control, nut bora, etc.
4. Organic isn't practical / it can't be done
5. There's no advantage to farming organically
6. Climate conditions eliminate lots of yield
7. Won't make money farming organically

Motivational criteria

1. Make more money per product than growing conventionally
2. Health reasons, generally
3. Suffered ill health from chemicals
4. Better for the environment
5. Conventional isn't sustainable, environmentally
6. Conventional isn't sustainable, economically
7. Export guidelines prohibit use of certain chemicals
8. Chemicals are expensive
9. Conventional farming is over-regulated
10. Eats organic, wants personal health benefits

Constraints

1. Topography
2. Fruit fly exclusion zones require mandatory spraying
3. Organic regulations too restrictive
4. Paying for extra labor would be too expensive
5. Can't afford to lose income growing organically
6. Monoculture risk too high

These criteria were formed into questions. Several criteria were combined. These were elimination criteria 2 and 6, elimination criteria 3 and 4, motivational criteria 2 and 8, and motivational criteria 7 and 9.

Elimination criterion 2 was combined with criterion 6, as both dealt with the problem of lower yields.

Elimination criterion 3 is one aspect of criterion 4, organic growing being impractical or impossible. There were a myriad of biological factors such as weeds, nut bora, fungi, etc. that were cited as being elimination factors. Rather than include every factor, the question was phrased in such a way as to include any biological factor affected by sprays.

Motivational criterion 2 was combined with criteria 8 because they both dealt with chemicals; each aspect of the rejection of chemicals was included in the question.

Motivational criterion 7 was combined with criterion 9 under restrictive regulations.

Motivational criterion 5 was split into two different questions. Motivational criterion 5 was split into a question stating that organic farming is sustainable and a question stating that conventional farming isn't sustainable; in interviews, farmers would cite that conventional farming isn't sustainable while they believe that organic farming is sustainable. No one believed that both conventional and organic farming were not sustainable and still converted to organic farming.

The questions, and which criteria each one covers, are located in Table 4.

Table 4: Questions formed from elimination criteria, motivational criteria, and constraints

[insert table 4.pdf]

Decision tree construction

The questions were then arranged as nodes on a decision tree, located at figure 1. A close analysis of the interviews provided the structure of the tree, which resembles other trees found in research literature (Fairweather, 1999; Darnhofer, 2005).

Three different types of criteria were identified from the interview data: elimination, motivational, and constraints. Elimination criteria must be passed before organic farming is considered; they are part of the pre-attentive stage of decision making, and often weren't considered as part of the actual decision making process. All of the elimination criteria must be passed before considering motivational criteria.

Figure 1: Decision tree

[insert DT2.pdf]

Only one motivational criterion must be accessed to consider organic farming. Once this has happened, all constraints must be passed in order to commit to farming organically. While elimination criteria and constraints see alike, their place in the decision process is what differentiates them. They can be better conceptualized by thinking of elimination criteria as "I can't, because…" while thinking of constraints as "I would, but…."

The decision tree begins with questions 9 and 10, asking if the participant believes that organic farming is more environmentally friendly than conventional farming and if the participant believes that organic farming is sustainable. These beliefs predicate all other elimination criteria because they were mentioned the most often and strongest during interviews. Many farmers believed that organic farming is now no more environmentally friendly than conventional farming, especially since many farmers use lower quantities of chemicals that are less environmentally destructive than in the past. Some farmers noted that organic farming still requires inputs, thus it cannot be sustainable. A negative answer to either question results in being removed from the tree and classified as philosophically opposed. 34 conventional farmers and 1 organic farmer were classified as philosophically opposed.

If participants survived questions 9 and 10, they moved onto questions 4 and 3, asking if the participant thinks it's possible to farm successfully without the use of synthetic fertilizers and sprays, or if it's possible to produce an equal amount of yield if the participant grew organically. These address the issue of practicality; many farmers believed that they would not be able to be successful if they grew organically. Many cited specific structural factors that would prohibit them from growing organically, such as macadamia nut bora, fruit flies, or climate conditions inducing extra weed growth. If the participant answered no to question 3, he or she was removed from the tree and classified as practically opposed. If the

participant answered no to question 5, the participant was asked if he or she thought that he or she could make more money growing organically in question 6. This is because of the difficulty in separating yield and price per product, especially in dealing with niche markets. For example, one converted organic farmer believed that his conventional coffee crop produced more yield, but the price per unit for the organic coffee generated more money than the lost conventional yield. This effect is less apparent in markets such as beef or bananas. If the participant answered no to question 6, he or she was removed from the tree and classified as practically opposed. If the participant answered yes to question 6, he or she was classified as potentially organic. This node feeds into both classifications, and thus acts as both an elimination and motivational criterion because it was cited as both during interviews. 28 conventional farmers and 4 organic farmers were classified as practically opposed.

Participants who survived the elimination criteria moved onto the motivational criteria: questions 8, 7, 11, 13, and 12. These asked about suffering ill health from the use of farming chemicals, wishing not to use chemicals because of their toxicity or cost, believing that conventional farming is not sustainable environmentally, and believing that conventional farming is not sustainable economically. These issues were usually cited in a personal context; personally suffering from chemicals, for example, or realizing the damage to the environment their or a neighbor's farm was doing to the environment. One interviewee had a particularly strong moment of motivational revelation; "As a small, part-time [farm], why do I need to pump more shit into the world when the guy across the valley is dumping chemicals from his [crop dusting] plane?" If a participant answered yes to any of the criteria except for the reversed 12, he or she was moved to the potentially organic classification. A classification was created for someone who didn't answer yes to any motivation, unmotivated conventional, but no participant was classified in this manner; all participants who survived the elimination criteria answered yes to a motivational criterion.

At this point, the participant must survive constraints against action. These are questions 15, 16, 17, 20, and 5. These questions asked about the topography of the land, shipping a product into a fruit fly exclusion zone, organic regulations, total crop failure, and whether it would be advantageous to farm organically. The first four questions were all cited as constraints during interviews. Often they are very specific, such as the law that requires fruit shipped into a fruit fly exclusion zone be sprayed with a synthetic pesticide. The risk of a total crop failure because of a monoculture – a single crop being produced, often in large amounts – was often cited as being too great in organic farming. The constraints ended with question 8 because of an anomaly that occurred in an interview: although not eliminating organic farming and being properly motivated to do so, the interviewee just didn't think farming organically would be a better situation than farming conventionally. This question acts as a final catch-all; if the participant just doesn't think organic farming is a good idea, then he or she won't farm organically. Answering yes to any of the constraints except for the reversed 5 removed the participant from the tree and earned him or her a classification of pragmatic conventional. 11 conventional farmers and 5 organic farmers were classified as pragmatic conventional.

If a participant survived the entire tree he or she was classified as organic. 1 conventional farmer and 11 organic farmers were classified as organic.

Survey construction

The questions were then compiled into a survey, located in Appendix C, and administered on 8-May and 9-May at the Rural Buying Service. The results from 8-May and 9-May were used to evaluate a preliminary decision tree, located in Appendix E. Some revisions were made that produce the tree in figure 1 and Appendix F. Revisions were made to two survey

questions at this time also; these changes are noted in bold in table 4 and in Appendix D. The revised survey was administered on 11-May and 12-May at the Rural Buying Service and on 16-May at the Rainbow Region Organic Market in Lismore.

The results from the surveys were plotted onto the decision tree in figure 1. The number in parenthesis next to each yes or no indicates how many participants passed through each path.

Accuracy

The accuracy of the tree is computed as a percentage of correctly classified participants (Gladwin, 1976). Other studies regard 80% as the threshold of acceptance (Gladwin, 1976; McGregor et al., 2001); this decision tree classified 95 participants with 88.42% accuracy.

Discussion

The decision tree constructed in this study accurately classified 88.42% participants as conventional or organic farmers; because of this, it is considered an accurate and acceptable decision model.

The decision tree was able to combine elimination criteria, motivational criteria, and constraints in a logical and succinct manner while allowing farmers to be classified as philosophically opposed, practically opposed, pragmatic conventional, or organic. This supports previous literature on modeling farmers' decisions, such as Fairweather (1999) and Darnhofer (2005).

Limitations

However, there are limitations to this study. Cluster sampling participants for the interviewing component was time-effective and easy, but it wasn't random. There's a risk that the sample was not representative of farmers in the Northern New South Wales region, or of conventional or organic farmers. The data was constantly being evaluated for its internal and external validity, but because some interviews were conducted over the phone it was impossible to verify that the practices the farmer was talking about was actually happening on his or her farm. Although results reached saturation by the end of the interview process, there's always a danger that one more interview would have resulted in new, useful information.

The sample that participated in the survey was also not chosen at random. However, there were several factors at play determining who was handed a survey: the person had to enter the Rural Buying Service one of the days I was there, either arriving during a non-busy

period or approach the counter where I was stationed while it was busy, self-identify as a farmer, and then agree to fill out a survey. Again, there's a risk that this sample was not representative of farmers in the Northern New South Wales region, or of conventional or organic farmers. Also, assuming that the sample was representative, there's no guarantee that farmers who shop at the Rural Buying Service are representative of farmers in the Northern New South Wales region, or of conventional or organic farmers. The same is true of the Rainbow Region Organic Market in Lismore.

There are also limitations in the method of ethnographic decision modeling. The interviewer must be sure to elicit decision criteria delicately and without altering the reality of the farmer; the observer effect certainly applies here. Also, care must be taken not to expose the nature of the study to conventional farmers until the end of the interview – the word "organic" has a powerful influence on how a farmer will respond.[4] The conversion of criteria into questions can also be problematic. As explained below, there were several questions that just weren't adequately converted and thus had to be removed from consideration. The difficulty exists in preserving the language of the farmers' who described the criteria while writing an answerable survey question.

Many survey participants had difficulty with the binary nature of the survey questions. Survey participants sometimes asked if they could circle both yes and no as a response, and often participants would include qualifying comments written underneath the question. The theoretical implication of this is problematic, because all decision making obviously isn't made in the framework of opposing duality. This behavior emphasizes the fact that the decision tree is a decision model; just like a map must distort proportional size to depict relative position, the decision model must distort some aspects of decision making in order to be successful.

Construction decisions explained

When constructing the decision tree, several decisions were made during this study that warrant explaining. Several decision criteria were not represented on the final decision tree: questions 2, 12, 14, 18 and 19.

Question 2 was originally represented on the preliminary decision tree (Appendix E). However, it was removed due to its ambiguous nature as a question; because it was written poorly, exactly how time was a factor wasn't clear. Its removal didn't impact the accuracy rating of the model.

Questions 12 and 14 because they were never accessed by participants on the tree. Because the answer to each survey question determines whether other survey answers are counted, a motivational criterion can never be accessed if all participants answer yes to a motivational criterion located earlier in the tree. The order of criteria within each subset (elimination, motivational, constraint) isn't that important, since all the elimination criteria and constraints must be passed and only one motivational criterion must be answered correctly to be classified as potentially organic. The motivational criteria are ordered to allow the most number of criteria to be accessed while preserving the relative importance of each criterion as they were expressed in interviews; the reasons that seemed the most important go first, followed by ones that interviewees regarded as less primary. This is an acceptable way to order criteria (Fairweather, 1999).

Although participants did answer yes to questions 12 and 14 in the surveys, each one also answered yes to a criterion located before 12 or 14 in line. Since those questions didn't receive any participants on the decision tree, they're considered to not model the decision and are discarded. I have kept them in the table of criteria (Table 4) because they are still reasons cited, and could very well have been accessed if the order was different.

Questions 18 and 19 were removed because they didn't clearly reflect the complex issue of money and extra labor. The question of paying for extra labor to grow organically raises complicated issues regarding finding, hiring and training new labor, if no more family labor is available. Because this question asked solely about paying for more labor, and there was no other coverage of hiring or training, a task many farmers expressed extreme reluctance towards and difficulty with, this question was removed. Question 19 was also removed because it was unclear exactly why income was being lost, although its intention was to refer to labor. Luckily, the issue of money was adequately covered by questions 3 and 6.

On the preliminary decision tree, the first question asked is the participant had ever considered farming organically. This question was used on the survey to prime the participant to answer the questions that followed in the frame of considering farming practices. Its inclusion on the decision tree was not supported by theory, and also created a confounding category. Thus, it was removed from the decision tree in the revision.

A minor error was made when creating the path that feeds into the question, do you think you could make more money growing organically. Because that acts as a motivation, it should also have reappeared further down the line for participants who answer no to producing equal yield.

This caused no errors in this study, however, because no participants were unmotivated, and thus there were no farmers who would have been motivated but for the exclusion of the money question. In further tables, the aspect of money should be more closely examined so a more elegant modeling solution may be found.

Classifications

Although these limitations existed, the model's predictive validity was demonstrated to be satisfactory. There are advantages to using a decision tree, and one of the greatest is providing a visual assessment of the different types of conventional farmers. The model identified three different types of conventional farmers: philosophically opposed, practically opposed, and pragmatic conventional. The philosophically opposed reject the most basic presuppositions of organic farming, that it's environmentally friendly and sustainable. These arguments can be found in articles about organic production (Kirchmann & Thorvaldsson, 2000; Edward-Jones & Howells, 2001; Trewavas, 2001). These farmers accept the modern paradigm of farming and focus on external inputs and technology.

The practically opposed do not reject the basic tenets of organic farming, but end their consideration of a production switch by believing that they would be unable to make more money, either by increasing yield or price per unit of product. Making more money is both an elimination and motivational factor; this is the cause of the unique tree construction that feeds into this category. These farmers still accept the modern paradigm of farming. They regard organic as a better alternative for the environment, but not a practical alternative in terms of yield or economy.

The pragmatic conventional have passed through elimination criteria and are motivated to change their farming production. Thus, many have rejected the modern paradigm of farming but cannot grow organically because of constraints. These are regarded as structural factors that cannot be overcome, such as biological or topographical impediments to organic farming.

Advantages of decision modeling

The greatest benefit of the ethnographic decision modeling method is a rejection of structural determinism. The tree shows that structural factors in and of themselves don't determine farmer behavior; it's the constructs of each individual, his or her values and priorities, that shape the decision. Structural factors are mediated by the actor's perception, and are considered only if perceived to be decisive.

This is an optimistic and exciting finding for proponents of organic farming. Many structural factors are impossible to change, but personal constructs are open to revision. This opens up innumerable topics for future study, especially for scholars of psychology, marketing, or public relations.

The organic movement doesn't have to move mountains; it only has to change a farmer's perception of them.

Conclusion

Ethnographic decision modeling was used successfully to create a model of why farmers in Northern New South Wales, Australia do or do not convert to conventional farming. Both conventional and organic farmers were included in the interviewing sample and the surveying sample. A problem with existing literature on motivations for organic farming, whether qualitative or quantitative, is its general exclusion of conventional farmers. Studies like Conacher and Conacher (1982), Lockeretz and Madden (1987), Milder et al. (1991), Willer and Gillmour (1992), Kvist (1994), and Dubgaard and Sorensen (1998) only sample from populations of biodynamic or organic farmers.

Using the framework of personal construct psychology, the decision tree reveals that constructs, not structural factors, are the determinate factors in decision making. Personal construct psychology is useful because it emphases individual interpretation, and decision trees model individuals, not groups.

The model identified three different types of conventional farmers: philosophically opposed, practically opposed, and pragmatic conventional. This is valuable for future research because each type has a distinct value system and path through the decision tree.

The greatest benefit of the ethnographic decision modeling method is a rejection of structural determinism. The tree shows that structural factors in and of themselves don't determine farmer behavior; it's the constructs of each individual, his or her values and priorities, that shape the decision. Structural factors are mediated by the actor's perception, and are considered only if perceived to be decisive. Many structural factors are impossible to change, but personal constructs are open to revision. This opens up innumerable topics for future study, especially for scholars of psychology, marketing, or public relations.

Endnotes

1: In 2003, China devoted 554,851,000 hectares to agriculture area, followed by Australia, 439,500,000 Ha, the United States of America, 409,300,000 Ha, and Brazil, 263,600,000 Ha. One hectare equals 2.471 acres. Also in 2003, 1.7% of the world's fiber crops equal 488,000 metric tons, and 1.6% of the world's cereal crops equal 35,005,500 Mt; one metric ton equals 1.102 United States' ton.

2: Boolean logic, also known as symbolic logic or propositional logic, operates by using binary variables expressing true or false. This means that each node in the decision tree can only be answered yes or no; this is opposed to a black box model such as an artificial neural network, which would be complex to the point of nearly incomprehensible and practically impossible to model by hand.

3: It's possible to test the validity of the table by using a t-test or ANOVA to determine statistical significance for each path. Gladwin (1976) explains this in a footnote: "The problem of the statistical significance of each path on a tree can be thought of as a quality-control problem: the farmers are passing through quality criteria designed to weed out the noninnovators. Then, on each path, one can use the t-statistic to see if the number of errors on the path is significantly different from zero. Therefore, one should interpret the t-statistic on a path in terms of the number of observations on that path." Unfortunately, in both Gladwin's study and this one, the sample is too small to adequately test for the significance of each path.

4: After glancing over a survey at the Rural Buying Service, one farmer encouraged me to"… go spend a month on a fucking organic farm and see how well it works."

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Appendices

A – List of interview participants
B – Interview guide
C – Survey without revisions
D – Survey with revisions
E – Decision tree before revisions
F – Decision tree after revisions

Appendix A

List of interview participants

Cath Ford, organic macadamia and coffee

Dave Wilkinson, organic small crops

Gordon Schultz, conventional banana, custard apple and stonefruit

John Cameron, conventional macadamia and custard apple

Mike Yarrow, organic passionfruit, custard apple and asian mango

Monica Christenson, organic coffee

Rob Hood, conventional stonefruit

Robert Gibbs, organic small crops

Robin Wolf, conventional mango, stonefruit and cattle

Rod Bruin, organic small crops

Ron Bartley, organic avocado, banana, passionfruit, mango

Tony Lattanzi, organic banana and small crops

Trevor Black, conventional banana

Appendix B

Interview guide

Farm demographics
- Type
- Size
- Time owned

How did you come to farming?
How did you come to this farm?

Farming practices
- What
- How
- Why

Farming influences
- Parents?
- Community?
- Books?

If converted, why?
- When considered?

Appendix C

Survey without revisions

I am a: (circle one) CONVENTIONAL / ORGANIC farmer.

I grow: _____

YES / NO 1. Do you think that organic farming is more environmentally friendly than conventional farming?

YES / NO 2. Do you think that organic farming is sustainable?

YES / NO 3. Do you think that it's possible to farm successfully without the use of synthetic fertilizers and sprays?

YES / NO 4. Have you considered farming organically?

YES / NO 5. Do you think that it's possible to produce an equal amount of yield on your farm if you grew organically?

YES / NO 6. Is farming organically so important to you that you are willing to forgo some of your income?

YES / NO 7. Are you willing to pay extra labour costs to grow organically?

YES / NO 8. Do you believe it would be advantageous for you to grow organically?

YES / NO 9. Would you be willing to take the time to obtain an organic certification in order to farm organically?

YES / NO 10. Do you think you could make more money growing organically?

YES / NO 11. Have you, or a member of your family or staff, suffered ill health from the use of farming chemicals?

YES / NO 12. Do you use chemicals but would prefer not to use them because they're too expensive or not good for you?

YES / NO 13. Do you believe conventional farming is not environmentally sustainable?

YES / NO 14. Do you believe conventional farming is over-regulated?

YES / NO 15. Do you eat organic foods?

YES / NO 16. Do you believe that your conventional farm is economically sustainable for future generations of your family?

YES / NO 17. Is the topography of your land a problem?

YES / NO 18. Does shipping your product into a fruit fly exclusion zone cause you to use mandatory sprays?

YES / NO 19. Are the organic regulations too restrictive?

YES / NO 20. Is the risk of a total crop failure of your monoculture too high for you to grow organically?

Appendix D

Survey with revisions

I am a: (circle one) CONVENTIONAL / ORGANIC farmer.

I grow: _____

YES / NO 1. Do you think that organic farming is more environmentally friendly than conventional farming?

YES / NO 2. Do you think that organic farming is sustainable?

YES / NO 3. Do you think that it's possible to farm successfully without the use of synthetic fertilizers and sprays?

YES / NO 4. Have you **ever** considered farming organically?

YES / NO 5. Do you think that it's possible to produce an equal amount of yield on your farm if you grew organically?

YES / NO 6. Is farming organically so important to you that you are willing to forgo some of your income?

YES / NO 7. Are you willing to pay extra labour costs to grow organically?

YES / NO 8. Do you believe it would be advantageous for you to grow organically?

YES / NO 9. Would you be willing to take the time to obtain an organic certification in order to farm organically?

YES / NO 10. Do you think you could make more money growing organically?

YES / NO 11. Have you, or a member of your family or staff, suffered ill health from the use of farming chemicals?

YES / NO 12. Do you use chemicals but would prefer not to use them because they're too expensive or not good for you?

YES / NO 13. Do you believe conventional farming is not environmentally sustainable?

YES / NO 14. Do you believe conventional farming is over-regulated?

YES / NO 15. Do you eat organic foods?

YES / NO 16. Do you believe that your conventional farm is economically sustainable for future generations of your family?

YES / NO 17. Is the topography of your land **too much** of a problem **for you to grow organically**?

YES / NO 18. Does shipping your product into a fruit fly exclusion zone cause you to use mandatory sprays?

YES / NO 19. Are the organic regulations too restrictive **for you to grow organically**?

YES / NO 20. Is the risk of a total crop failure of your monoculture too high for you to grow organically?

Appendix E

Decision tree before revisions

[insert DT1.pdf]

Appendix F

Decision tree after revisions

[insert DT2.pdf]