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MANAGEMENT OF FARM WOODLOTS AND WINDBREAKS: SOME PSYCHOLOGICAL AND LANDSCAPE PATTERNS*

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ABSTRACT

This article reports on the relationship between measures of farmers' conservation attitudes and motivations on the one hand, and their self-reported and observed management of windbreaks and woodlots on the other. The study was conducted on historic farms where tenureship is, on average, over four generations. A survey instrument assessed farmers' attitudes about farming, the benefits of using trees on farms, the aesthetics of the rural landscape, motivation and their self-reported conservation practices. An analysis of landscape patterns on respondents' farms was conducted by analysis of aerial photography. Findings suggest that a conventional, externally motivated approach to farming results in reduced use of farm woodlots and windbreaks. In contrast, an approach based upon aesthetic and intrinsic forces is predictive of increased use and maintenance of woodlots and windbreaks. It is suggested that the promotion of conservation practices on farms may benefit from subtle, non-economic interventions as well as from financial and regulatory approaches.

The link between farmers' soil and water conservation attitudes and motives, and actual change in the farm landscape is not well known. In the face of strong development pressures, increasing agricultural scales, and fluctuating farm economies, some farmers have continued to actively maintain woodlots,

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windbreaks, and other configurations of woody plants on their farms. These landscape elements in the rural landscape have been shown to have important conservation benefits [1, 2] and the tangible economic benefits of tree management practices (e.g., erosion control, timber sales, reduced flood losses, livestock shelter) may help to explain their continued use. However, research has also suggested the importance of non-economic factors in explaining farmers' conservation behavior [3].

A long term project has been undertaken to examine the relationship between factors in the local landscape and the psychological characteristics of the farmer that are associated with woodlot and windbreak management. The specific hypothesis is that the management of trees and windbreaks in the rural landscape is influenced not only by economic factors, but also by rural landscape aesthetic preferences, pro-conservation attitudes, intrinsic satisfactions, perceived benefits of woodlots and windbreaks, and overall landscape patterns beyond farm boundaries. The initial study, reported on here, focuses on the physical configurations of farm trees and the relationship to farmer attitudes, preferences, and motivations. The analysis includes measurement of subtle, intangible factors such as sensitivity to large-scale landscape patterns (those larger than the farm itself), aesthetic forces unique to the rural landscape, and intrinsic satisfactions gained from active engagement in conservation behavior and farm management.

BACKGROUND

Landscape Patterns

The benefits of trees in agricultural systems have been explored in several disciplines. Woodlots have long provided an important role in the American farm landscape. Although woodlot and windbreak management is an important aspect of conservation in the agricultural countryside, it is a relatively neglected topic in recent ecological agriculture literature. Specific contributions of trees to rural systems include protection of soil resources, increase in crop diversity, and enhanced quality of life [2]. However, few studies have specifically addressed farmers' attitudes toward planting, management and preservation of woody plant materials, although much has been written on attitudes and perceptions toward other conservation measures (e.g., conservation tillage, waterway revegetation) [4-6].

Increasingly, ecologists, planners and designers are studying and shaping agricultural landscape patterns. Landscape ecology is used as one theoretical and practical basis for this work, based on structure, function and change at the inter-farm and intra-farm scale [7]. The literature in landscape ecology has suggested that heterogeneity in agricultural ecosystems is critical for both agricultural productivity and biological health [8]. An assumption of this study is that woody plants contribute to this farmland heterogeneity significantly and that woodlot and

windbreak patterns are particularly strong structural elements in heterogeneous landscapes. While the study reported here is concerned with on-farm landscape elements and their configurations, ongoing work in this area is being done to study the connectivity of woodlots and windbreaks across farm boundaries and to understand farmer attitudes and motives regarding this larger scale. This study reports on measures that are being developed for testing at this larger scale.

CONSERVATION MOTIVES

The role of non-economic motives in explaining and promoting behavior has been explored in the areas of landscape aesthetics and conservation behavior. The economic realities that bear on farm woodlot management have been examined by a number of writers [9, 10]. Yet, it has also been suggested that financial and regulatory forces, and subsidy programs may not fully explain farmers' conservation motives. Research has recently expanded to an investigation of the variety of motivational forces at work in farmers' decision making [11-13].

While there is agreement that conservation behavior is motivated by a multitude of independent factors [14], current promotion techniques are based on a unidimensional model of human nature. This model relies extensively on extrinsic motivation [15]. While this model is readily accepted as an oversimplified explanation of human behavior it has nonetheless been the major, if not only, means of promoting farm-based conservation practice. Examples include conservation easement provisions that provide economic assistance to landholders, and the state and federal tax credits for planting or maintaining forests for shelterbelts, windbreaks and woodlots.

Using a model of human behavior that is so oversimplified can only be justified in terms of its unequivocal effectiveness at promoting conservation behavior. Unfortunately, virtually all attempts to sustain conservation behavior under an incentive-based program have been characterized by an abrupt termination of the behavior once the external justifications for the behavior is withdrawn. At best, in the absence of other motives, monetary rewards have proven to have a limited and transient effect [16-18].

So long as the incentives can be kept in place, such limitations are of little practical concern. However, as the country faces up to economic reality, assistance to farmers could become scarce. Under such conditions these limitations would turn out to be more serious—perhaps serious enough to make alternatives worth exploring.

There are several strategies being explored to overcome this troublesome weakness of strong, external incentives. They involve attention to motives less dramatic and more intangible than the strong economic motives commonly used to explain behavior (see [19]). This study investigates whether any of these subtle motives are at work in farmers' management of trees and windbreaks.

METHODS

Study Area and Sample

A sample of 151 farmers in Washtenaw County, Michigan were asked to complete a written survey instrument during the spring of 1991. The sample consisted of all Washtenaw County participants in Michigan's Centennial Farms Program. Centennial Farms are those distinguished by having been owned and operated in the same family for 100 years or more. In addition, farms in the proposed South Lima Township Rural Historic District, also in Washtenaw County, were surveyed. Both sets of farmers were selected because of their longevity on one farm. Because the study explored the long-term use and preservation of woodlots and windbreaks, it was important that the participants have a lengthy history on their particular piece of land. Forty-one farmers responded producing a low (27%) but adequate return rate for this preliminary study. Respondents' farms were then inventoried to measure existing configurations of trees.

Approximately 72 percent of the respondents are men. Twenty-two percent are under fifty years old, about 25 percent are in their fifties and just over 50 percent are sixty years or older. The respondents are long-time farmers and all are owner/operators of the land they work. Over 77 percent are from families who have always been involved in farming. About one-third of the farms have been in the same family for five or more generations, about two-thirds have lived there for four or more generations and over 87 percent have been in the same family for at least three generations. The average farm size is 88 ha (217 acres) with a range from 4 to 424.7 ha (10 to 1000 acres). On average, the respondents receive 39 percent of their income from farming, with 11 percent of the respondents receiving no income from farming and 15 percent receiving all of their income from farming.

Survey Instrument

The survey instrument included a six-page questionnaire and a postage-paid return envelope. A short cover letter was included and respondents were provided with a phone number to call if they had any questions. All items other than a series of self-reported behavior and background questions used a five-point rating scale.[1]

The questionnaire contained groups of items that measured conservation attitudes, the perceived benefits of trees and woodlots, aesthetic preference, conservation motives and intrinsic satisfactions, and woodlot and windbreak management practices. Nineteen items were included that measured *attitudes*

[1] A copy of the survey instrument is available from the second author at School of Natural Resources and Environment, The University of Michigan, 430 East University, Ann Arbor, Michigan 48109-1115.

about such things as family farming, environmental quality, use of trees on farmlands, and soil erosion. The questionnaire also included nine items that dealt with *motivation*. Items measured both intrinsic and extrinsic motivation. Included were items from a previous study of Michigan farmers [3]. The sixteen *benefit* items covered the many potential advantages trees provide farmers—from soil conservation to enhancing the rural landscape. *Aesthetic preferences* were measured by asking respondent to rate thirty-five items describing different farmland views. Twenty-five items were included that measured *intrinsic satisfaction* gained from such activities as avoiding waste, directly participating in activities that can help society, and helping to maintain the rural landscape. Many of these items were derived from previous research on conservation behavior [16]. Finally, respondents were asked to indicate which of a series of *conservation practices* (e.g., woodlots, tree windbreaks) they use to improve soil fertility and maintain the sustainability of their farming. Finally, they were asked whether they actively preserved or restored windbreaks or woodlots.

These data were analyzed in two separate steps. First, the distinct sets of questionnaire items were subjected to a non-metric factor analysis and stable categories of items were identified. These categories were then tested for their degree of coherence using Cronbach's coefficient alpha—a measure of internal consistency [20]. In the second step, relationships between these categories and the self-reported conservation behaviors and landscape inventory data were investigated using analysis of variance. In preparation for performing these analyses, scores for each category were divided into three distinct levels (i.e., high, medium, and low scores on that measure).

Landscape Inventory

In the landscape inventory methodology, aerial photographs were used to understand overall farm layout and to measure selected elements on respondents' farms. Color slides were acquired from the USDA Agricultural Stabilization and Conservation Service—each representing one section (260 ha; 640 acres) of land. Farm measurements included 1) woodlot acreage as a percent of farm size, 2) lengths of full (uninterrupted) windbreaks, 3) lengths of sparse or interrupted windbreaks, and 4) numbers of "tree islands" (individual trees of clusters of trees) within crop fields. Figure 1 illustrates these factors on two sample farms of approximately the same size.

RESULTS

The factor analysis identified a number of separate and stable categories of questionnaire items. These categories are organized into five groups: attitudes, perceived benefits of trees, aesthetic sensitivity (shown in Table 1) and motivations and intrinsic satisfactions (shown in Table 2). The relationship between each

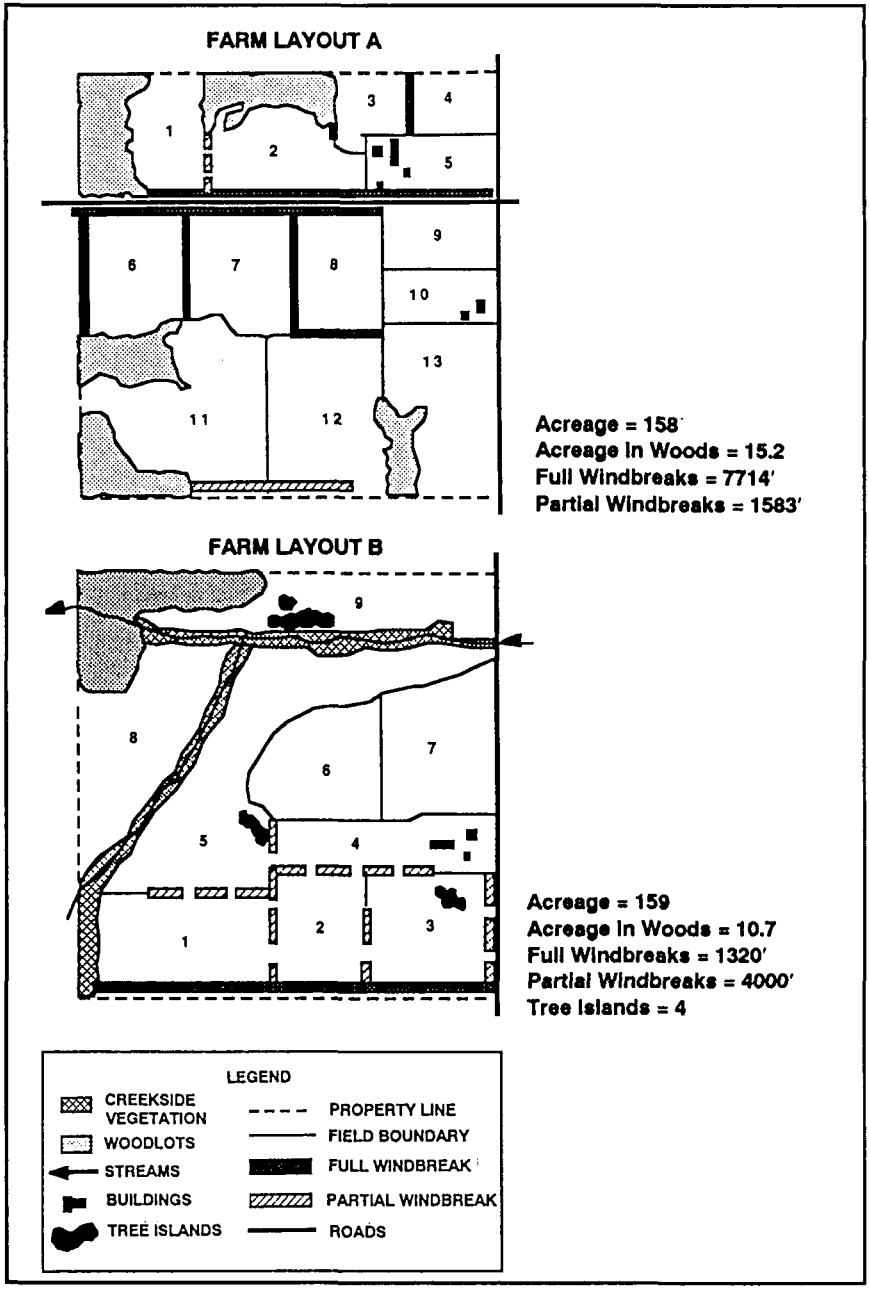

Figure 1. Landscape inventory of two sample farms of approximately the same size.

Table 1. Categories of Attitudes, Benefits, and Aesthetic Preferences[a]

Category Name and Items Included	Mean[b]	Std. Dev.	Alpha
1. *ATTITUDES*			
ATTITUDE ABOUT FARMING	3.07	.81	.77
The current focus on environmental quality in farming is overdone			
Farmers should *not* plant more trees and shrubs			
Pollution from the use of agricultural chemicals is *not* a serious problem			
Food prices should *not* be kept low . . . if it hurts family farms			
Farming is a much more satisfying occupation than others			
POSITIVE SOIL CONSERVATION ATTITUDE	3.79	.63	.69
More farms should practice soil conservation			
Farmers must take personal responsibility for agricultural conservation			
Farmers should spend more money to control soil erosion			
The loss of soil through erosion is a very serious problem			
2. *BENEFITS FROM TREES*			
ECOLOGICAL BENEFITS FROM TREES	3.78	.95	.91
Protecting native plants			
Attracting wildlife			
Attracting insect-eating birds			
Enhancing the rural landscape			
Beauty			
ECONOMIC BENEFITS FROM TREES	2.67	.96	.83
Providing additional farm income			
Production of firewood			
Production of harvestable timber			
Producing posts and poles			
Shelter for livestock			
SOIL BENEFITS FROM TREES	3.18	.98	.86
Soil conservation			
Improving water quality			
Identifying field boundaries			
3. *AESTHEIC PREFERENCES*			
PREFERENCE FOR PASTORAL SCENES	3.63_a	.88	.82
Road or farm lane			
Old barn			
Livestock			
Woodlot			
Large tree windbreak			

Table 1. (Cont'd.)

Category Name and Items Included	Mean[b]	Std. Dev.	Alpha
PREFERENCE FOR NATURAL SCENES	3.72_a	.88	.80
Dense forest			
Open airy forest			
Wildlife			
Insect-eating birds			
PREFERENCE FOR SEASONAL SCENES	4.36	.78	.77
Large shade tree			
Large trees changing color in the fall			
Vegetable or flower garden			
PREFERENCE FOR HISTORICAL SCENES	3.74_a	.92	.76
More attention would be paid to the beauty of the rural landscape			
People would be more appreciative of historical land use practices			
Buildings would be built to fit into the landscape better			

[a]Means are based on five-point Likert scales. Higher values denote higher endorsement for the category.
[b]Within groups of categories (i.e., attitudes, benefits, preferences), differences between means are significant at $p < .05$ except for means sharing a subscript.

group of categories and the use and preservation of windbreaks, woodlots and "tree islands" (individual trees or clusters of trees in crop fields) is reported below. Given the preliminary nature of this study, both statistically significant relationships ($p < .05$) and trends or tendencies ($p < .10$) will be reported. Unless stated in the text, the result discussed are significant at $p < .10$.

The factor analysis derived two categories from the attitudinal items: an *attitude about farming* and a *positive soil conservation attitude.* The attitude about farming has a utilitarian focus. This category is clearly supportive of the idea that farmers need *not* concern themselves with the ecological implications of their practices. Respondents scoring higher on this first attitude have fewer windbreaks ($F = 3.61$, $df = 2$, $p < .04$), fewer "tree islands" ($F = 3.34$, $df = 2$, $p < .05$) and a tendency to have fewer woodlots. They also report a lesser tendency toward actively preserving or restoring such landscape features. In contrast, the second attitude category reflected the notion that farmers are responsible for the ecological effects of their farming practice particularly as it applies to soil conservation. Respondents reported a positive trend between holding an attitude supportive of soil conservation initiatives and the use, maintenance and restoration of windbreaks and woodlots. In a pairwise comparison of the mean scores of these two attitude categories the respondents reported a significantly higher endorsement for the positive soil conservation attitude ($p < .05$).

Table 2. Categories of Motivations and Intrinsic Satisfactions

Category Name and Items Included	Mean[a]	Std. Dev.	Alpha
4. *MOTIVATIONS*			
INTRINSIC MOTIVATION	3.72	.74	.78
I get a great deal of enjoyment from conservation activities			
I find conservation to be personally rewarding			
Economics is *not* the main driving force behind most of my decisions			
ECONOMIC MOTIVATION	2.72_a	.93	.81
I'd need a quick pay-back before I'd adopt any conservation plan			
I'd only adopt additional conservation measures that are very cost effective			
NON-ECONOMIC MOTIVATION	2.89_a	.94	.51
There are so many good things about farming that a person should be willing to get along on a lower income to keep these advantages			
It is better to make a smaller profit each year than to attempt something where there is a chance of financial loss			
5. *INTRINSIC SATISFACTIONS*			
VISUAL PATTERN SATISFACTION	3.88_a	.78	.92
Creating a visual pattern that carries across all my fields			
Helping to maintain the beauty of the entire rural landscape			
Planning the farm so that it fits together visually			
Maintaining farm buildings in their original form			
Finding ways to make fields pleasing to look at			
Having a family tradition about how to manage a piece of land			
Creating a more beautiful environment to live in			
SATISFACTION FROM FRUGALITY	4.14	.67	.90
Finding ways to avoid waste			
Keeping equipment running long past its normal life			
Finding ways to use things over and over			
Repairing rather than throwing things away			
Saving things I may need someday			
Finding ways of doing things which don't rely on others			
SATISFACTION FROM PARTICIPATION	3.79_a	.94	.87
Doing things that will help bring order to this crazy world			
Taking actions which can help change the world			
Helping to make sense out of the world			
Finding ways to keep a farm in the family			

[a]Within groups of categories (i.e., motivations, intrinsic satisfactions), differences between means are significant at $p < .05$ except for means sharing a subscript.

Three categories emerged from the factor analysis of the items measuring the perceived benefits of trees: *ecological benefits, economic benefits*, and *soil benefits*. The more farmers perceive ecological and/or economic benefits, the more they report a tendency to plant, restore and maintain woody vegetation. In addition, the landscape inventory did indeed find more vegetation on these farms. What is fascinating, however, is the relationship of perceived soil benefits with ecologically appropriate management (Figure 2). Farmers who have a higher score on the soil-related benefits category also are observed to have 1) the most full and dense windbreaks ($F = 3.75$, $df = 2$, $p < .04$) and 2) the fewest partial or sparse windbreaks ($F = 3.65$, $df = 2$, $p < .04$). They also report a tendency to actively preserve and restore windbreaks and woodlots. This suggests that farmers who have a strong perception of the soil conserving properties of trees are actually managing windbreaks effectively and are less apt to tolerate marginal ones. Those who do not perceive soil-related benefits are more apt to have fragmentary or haphazard windbreaks. In a pairwise comparison of the category means, the respondents reported higher endorsement from the ecological benefits category and lower endorsement for the economic benefits category with all three pairwise comparisons significant at $p < .05$.

The factor analysis identified four categories of aesthetic sensitivity: a preference for the *pastoral, natural, seasonal*, and *historic*. Farmers reporting a higher preference for pastoral scenes also report being active in preserving and restoring woodlots and windbreaks ($F = 4.21$, $df = 2$, $p < .03$) and are observed to have a tendency to use more windbreaks. A preference for natural scenes is also associated with self-reported semi-permanent conservation practices ($F = 4.83$, $df = 2$, $p < .02$) and an observed tendency to use and maintain more windbreaks. Respondents with a seasonal preference also reported a tendency to preserve and restore woodlots and windbreaks. They are also observed to have a significantly greater amount of windbreaks ($F = 7.62$, $df = 2$, $p < .005$) and a tendency to have a higher percentage of farmland in woodlots and have a greater number of "tree islands" in fields.

These findings are particularly interesting in that they may say something about farmers' perceptions and preferences regarding larger off-farm landscape patterns. For instance, farmers with greater interests in historic patterns on rural land are observed to preserve more "tree islands" in fields ($F = 3.21$, $df = 2$, $p < .05$) and have a tendency to use more windbreaks (Figure 3). They also report a greater use of semi-permanent conservation practices ($F = 4.51$, $df = 2$, $p < .02$) and preservation of woodlots ($F = 5.45$, $df = 2$, $p < .01$). In a series of pairwise comparisons, the respondents reported significantly higher preference for seasonal scenes than for pastoral, natural or historical scenes ($p < .05$).

The final categories of measures that predicted actual behavior involved motivation: *intrinsic motivation, economic motivation*, and *non-economic motivation*. Also included are three categories of intrinsic satisfactions: *frugality, participation* and *visual*. Intrinsic motivation measures include enjoyment from

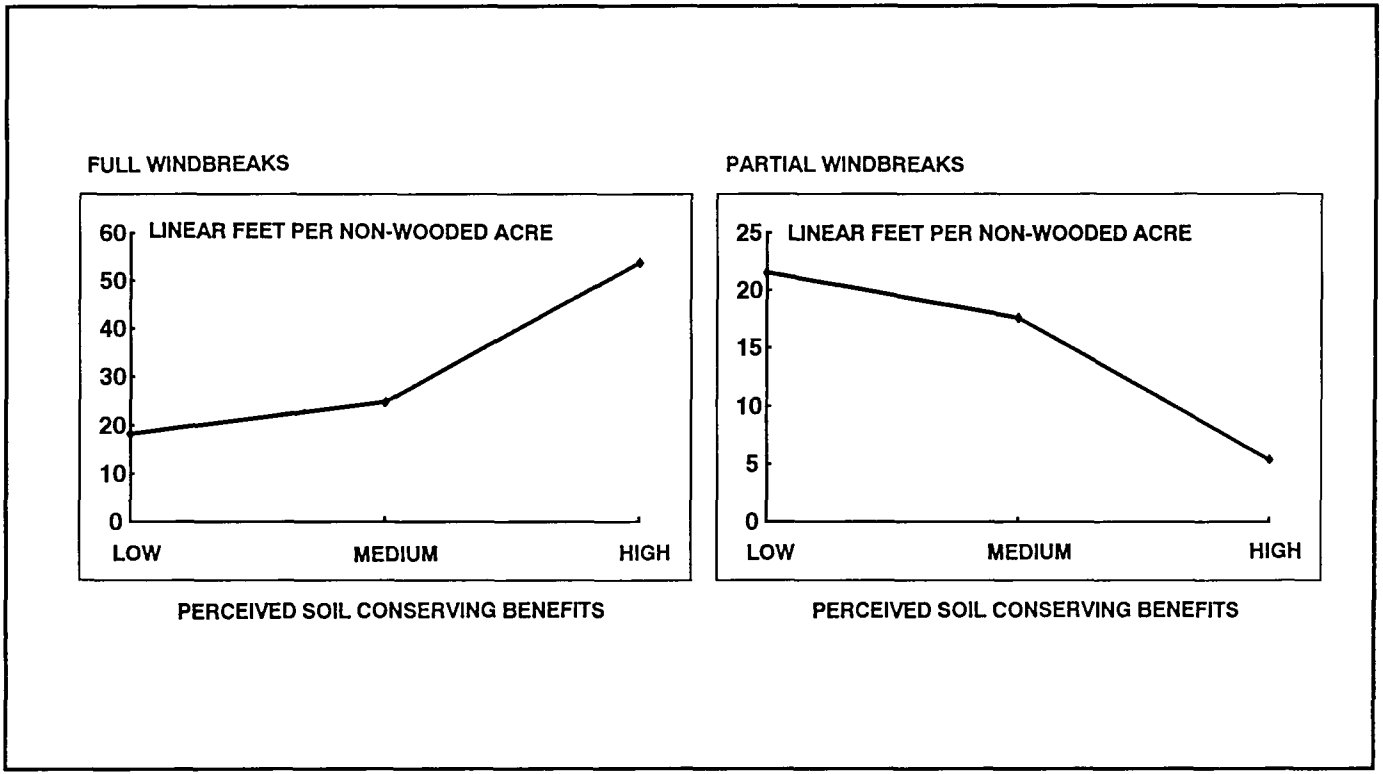

Figure 2. The relationship between perceived soil-conserving benefits of trees and type of windbreak actually used by respondents.

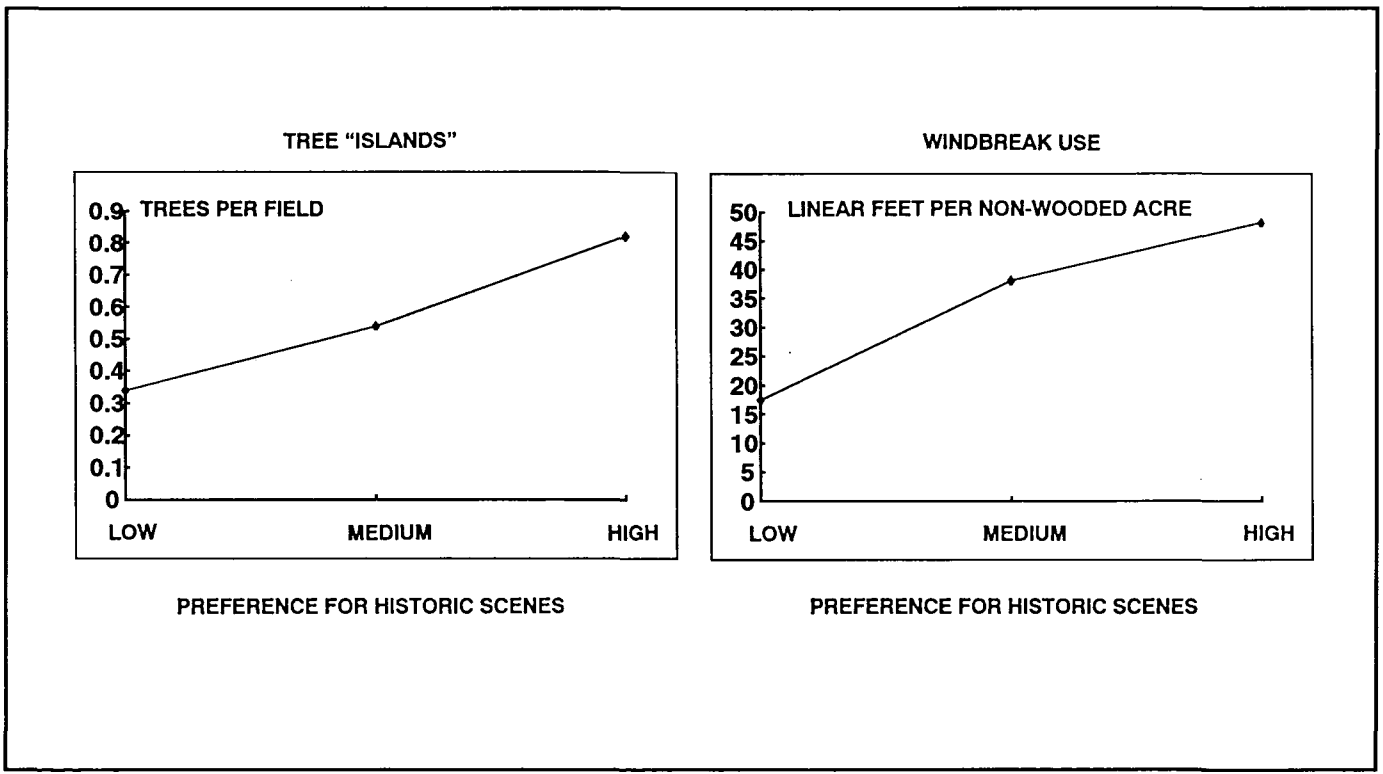

Figure 3. The relationship between the preference for historic scenes and the actual number of "tree islands" and windbreaks used by respondents.

conservation activities, personal reward, and non-economic decision-making criteria. The extrinsic motivation measures primarily concern cost-effectiveness while the non-economic category captures a sense that farming involves more than just attention to financial rewards. Intrinsic satisfactions are considered an alternate measure of intrinsic motivation. Respondents who report higher scores on the intrinsic motivation category are observed to have a tendency to manage a greater percentage of their farmland as woodlots and to make greater use of windbreaks. They also tend to report greater use, preservation and restoration of woodlots and windbreaks. In contrast, respondents with higher scores on extrinsic motivation report significantly less use of semi-permanent conservation practices ($F = 4.24$, $df = 2, p < .03$). They also tend to have less land in woodlots, fewer "tree islands" in fields, and fewer windbreaks, and to self-report being less active in the preservation and restoration of woodlots and windbreaks. In a series of three pairwise comparisons, respondents reported a significantly higher endorsement for the intrinsic motivation category than for the economic or non-economic motivation categories ($p < .05$).

The intrinsic satisfaction categories are not associated with the management of woody materials on farms with a few exceptions. Respondents reporting higher scores on the visual satisfaction category tended to report being more active in the preservation and restoration of woodlots and windbreaks. And respondents reporting higher scores on the satisfaction from frugality category tended to have *fewer* windbreaks and have significantly *less* woody plant dividers between fields ($F = 5.21$, $df = 2, p < .02$). This last relationship seems in contrast to the findings of other studies that have investigated intrinsic satisfactions and reported a positive relationship between the frugality category and conservation behavior [16]. Without further research one can only speculate that the respondents may view windbreaks as an inefficient use of land and see it as contrary to the avoidance of waste concept captured in the frugality category. In a pairwise comparison of the three intrinsic satisfaction means, the respondents reported significantly higher endorsement for the satisfaction from frugality category ($p < .05$).

DISCUSSION

The preliminary study reported here suggests that farmers' management of windbreaks and woodlots is influenced by a diverse set of antecedents. On the one hand, having a positive, utilitarian attitude about farming does not seem to lead to active management of trees and other configurations of woody plants. On the other hand, having a positive attitude about soil conservation does seem to foster more diversity on farms, as measured by the increased presence and management of windbreaks, woodlots and other woody plant materials. Furthermore, an awareness of the benefits derived from trees and an aesthetic and intrinsic orientation toward the land is associated with more attention to woodlot and windbreak management, while an extrinsic (e.g., economic) orientation toward farming is

predictive of less attention to these practices. It would seem, then, that a multidimensional and often subtle set of forces are helping to shape the rural landscape. These forces, while not economic in nature, are coherent. When they are better understood, these forces may prove useful in promoting increased levels of sustainable farm management.

It is important to better understand the forces encouraging conservation behaviors for both theoretical and practical reasons. While we know that people practice stewardship, we know little about the diversity of forces encouraging such behavior. As a practical matter, we know little about how to promote conservation among those not currently practicing it. A secondary importance of this work may be in helping people understand how much they really value certain aspects of the rural landscape. With more research we may begin to understand the full scope of what prompts people to take actions which may not benefit them in their lifetime or for which the individual costs far outweigh the personal benefits.

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