

LEVERAGING DATA MINING AND MARKET SEGMENTATION
TO GAIN CONSERVATION OPPORTUNITY INTELLIGENCE

by

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ABSTRACT

Rural landowners are an important audience for conservation messages about natural resource management. On-going collaborations between scientists, academics, and practitioners are producing actionable intelligence related to reaching, engaging and influencing rural landowner messaging and program marketing. One goal of such collaborations is to improve conservation program enrollment. Recently, market research and market segmentation approaches have generated a better understanding of the drivers for natural resource management program participation. This pilot study demonstrates a proof of concept using analytic processes which can be effective for market segmentation. A cluster analysis, using a representative two county sample and an empirically based set of variables, was instrumental in identifying seven landowner types that explain interest or willingness to be program participants. Using these clusters, I generated maps of landowners who represent opportunity for engagement. Techniques for understanding the human dimensions of conservation in a priority resource area and the groups of landowners who may be receptive to program messages are explored and explained. Based on the success of this clustering method, other landowner engagement campaigns could consider following this approach to increase their predictive abilities and improve return on investment in direct response marketing campaigns.

1. INTRODUCTION

Systematic natural resource conservation planning is a process that locates regional priority areas, identifies methods which could protect and/or better manage those areas, and narrows the focus of conservation service delivery efforts (Amundsen 2011; Pressy et al. 2007). Targeting private landowners within a prioritized area for natural resource conservation can be effective and efficient (Batie 1985) for getting conservation practices on the ground, and there are calls for more targeted approaches (Osmond et al. 2012) with private landowners. Furthermore, rural landowners who own working lands have viewed targeted conservation as an acceptable strategy to address agri-environmental problems (Arbuckle 2012).

Resource management agencies engage landowners who are willing to install conservation practices or who are interested in learning more about managing their land. Technical and financial assistance programs which increase the knowledge and capabilities of participants and use financial incentives as inducements are popular for voluntary conservation efforts, and in Texas one or more professionals are available in every county to assist landowners with these types of programs.

One researcher (Stern 1999) noted that if financial incentives are large enough to demonstrate a clear personal benefit, increasing the incentive amounts may be far less effective in producing behavior change than increasing the amount of information provided to target audiences through marketing. Marketing conservation programs has become a process as important as spatial prioritization in large-scale conservation initiatives (Knight 2007).

This research project examined landowner characteristics and land parcels in the Fayette Prairie region of Texas. The working hypothesis is that a handful (or less) of characteristics could be effective in grouping landowners when attempting to explain grassland restoration program participation. The managers of this program are looking to researchers to help them overcome the challenge of predicting interest in a grassland restoration program, and to locate individuals who can make an impact on biological objectives for grassland bird species in the southern focal area of the Oaks and Prairies Joint Venture's Grassland Restoration Incentive Program (GRIP).

Research Questions:

1. Which variables will effectively group landowners to explain program participation?
2. Which landowners should be targeted for program engagement?
3. Where are these targets located?

1.1. Conservation program participation factors

Game (2011) coined the term *informed opportunism* to refer to the process of combining systematic conservation planning with a market understanding of human opportunities and constraints. To explain conservation program enrollment, researchers study human behavior, attitudes, and beliefs. Determining what factors influence landowner uptake of a conservation program is challenging (Reimer et. al., 2012). Reimer and others (2014) suggested that studying the adoption or use of conservation practices by landowners is difficult to measure or predict for a variety of reasons. One suggestions is to widen the approach researchers take to examine participation. Other

researchers have also suggested this approach is important (Featherstone and Goodwin, 1993; Curtis et al., 2000).

Agriculturalists are often the target for conservation programs. Some landowners involved in ecological restoration activities on their land would not be considered agriculturalists. Butler (2007) describes one such landowner as a “retreat” landowner. Kluender and Walkingstick (2000) referred to another as “affluent weekenders”. These landowners are often more interested in the recreational or rural/natural amenities their properties provide and are frequently conservation program participants.

Stern (2000) examined the issue of explaining environmentally significant behavior in populations other than rural landowners who live on their property. He argues that there are basically four broad types of causal variables attributable to any individual’s actions: attitude, personal capabilities, contextual factors, and habit/routine. Having a focus on an individual’s personal circumstances especially as related to attitude and motivation seem to be the prevailing approach to explaining a landowner’s willingness to participate.

Bengston (2011) identified eight broad categories and 37 sub-categories of motives and values. Moon (2012) looked at personal circumstances as determinants of landowner participation in a biodiversity program. Personal circumstances of landholders (e.g., lifestyle and wellbeing, information and knowledge, financial security) and social characteristics (e.g., attitudes, norms, and trust) are examined in many studies to see if they are important predictors.

For this study, I was interested in being able to map landowner program prospects. Curtis and colleagues (2003) linked landowner data to maps in their assessment of conservation opportunity. And although they used primary data for their study, they linked landowner spatial units to independent variables related to land management (e.g., property size), socio-demographic characteristics (e.g., hours worked on property), economic factors (e.g., level of on-property income), environmental factors (e.g., native vegetation on their property) and knowledge of natural resource management (e.g., value of native vegetation in relation to other natural resource concerns like soil erosion), as well as dependent behavioral variables such as the planting of trees and shrubs. Similar data points, and ones that are important to this project, can be extracted from tax records (Table 1).

Lesch and Wachenheim (2014) point out that methods used to identify factors affecting conservation decisions also vary. These include: producer surveys (primary data), qualitative studies (in-depth interview and focus groups) and secondary analyses of survey data. Researchers have also presented farmers with hypothetical scenarios or conditions to model the decision-making. No study could be found that looked at landowner context issues or personal circumstances of landowners from secondary data sources other than survey data, like those collected by a tax appraisal district as this study does.

Table 1: Independent variables examined in this study

VARIABLE	JUSTIFICATION	SOURCES
Size of rural parcels owned	Compared with larger property owners, owners of smaller properties were undertaking some conservation practices over	Featherstone and Goodwin, 1993; Curtis et al., 2000

Table 1, Continued: Independent variables examined in this study

	a significantly greater proportion of their property. However, larger property owners had adopted more conservation practices and over a larger total area.	
Home ownership, home types & location of mailing address	Property owners who lived on the same land for a long period of time were found to be more conservation-oriented.	Wilson, 1996; Cai 2016; Bengston 2011
	Absentee owners have different opinions and divergent ownership objectives. Primary residence could refer to owning rural land as part of the landowner's current or future main residence. Examples include 'home sweet home', 'rural land joins the one acre my home is on' and 'possible future home'.	
	Seasonal homes include rural land as a setting for a seasonal or weekend home or cabin or a potential site for a future seasonal home. Examples include 'summer home', 'a plan for building a cabin', 'cabin site' and 'vacation property'.	
	Retirement refers to a current—or more often future—place to retire and live. Examples include 'future retirement', 'to retire in the country' and 'to live my retired life in the country'	
Wildlife land-uses and tax exemption status	The higher the level of off-farm income, the higher the level of conservation behavior. A landowner group that is predominantly financially motivated, a group that is predominantly amenity motivated, and a group that has a mix of financial and amenity motivations, and a group that has neither.	Camboni and Napier, 1993; Cary et al., 2001; Reimer, Thompson and Prokopy, 2012; Kabii 2006
	For landowners less-economically dependent on their	

Table 1, Continued: Independent variables examined in this study

	land, they may be more interested in the non-utility benefits of restoration.
Land use	If there was agricultural activity (e.g., a cropping system or an orchard) this is accounted for by taxing agents
Land type	If there was improved pastures with non-native grass that is beneficial to cattle grazing is of interest. Native pasture or prairie, especially which is accounted for as wildlife habitat areas, are present on the rural acreage tax rolls and is of interest.

1.2. Context for this study

For this study, I examined independent variables such as landownership characteristics across the dependent variable of landowner groupings. I am interested in a workable classification system for landowners that would be both an analytical construct and as Kittredge (2004) suggests, also a market segmentation tool. The types of “market segments” for rural private landowners interested in conservation programs are varied. Most of the research referenced for this study limited typologies at 3 to 5 groups, and based them in large part on attitude or motivation.

For example, Reimer, Thompson and Prokopy (2012) looked at attitudes specifically in the adoption of conservation practices by rural landowners and argued that there are basically three types of rural landowners participating in conservation programs: 1) those motivated by their farm or ranch as a business, 2) those motivated by stewardship, and 3) those motivated by off-farm environmental benefits. Morris (1995) identified attitude stratifications within landowner populations and classified his

landowner groups: 1) most resistant non-adopter of conservation programs, 2) the conditional non-adopter, 3) the passive adopter, and 4) the active adopter. Butler et al. (2007) classified landowners as: 1) pursuing supplemental income, 2) working the land, 3) retreat, or 4) uninvolved. Kluender and Walkingstick (2000) named his study's groups as: 1) timber managers, 2) poor rural residents, 3) resident conservationists, and 4) affluent weekenders. The farm typology developed by Hoppe (2006) identifies five groups of small family farms: 1) limited-resource, 2) retirement, 3) residential/lifestyle, 4) farming-occupation/low-sales, and 5) farming occupation/ high-sales.

These studies and others generally categorize rural landowners into a group that is predominantly financially motivated, a group that is predominantly amenity motivated, a group that has a mix of financial and amenity motivations, and a group that has neither. These typologies are useful when attempting to segment a market. However, I was specifically looking for a way to build a landowner segmentation that could provide utility for examining landowners who may or may not be interested in grassland conservation programs.

Brown (2011) in his research on native plant restoration on private lands points out that environmental managers cannot assume regions of high conservation priority will be areas of high conservation opportunity. So if conservation success depends ultimately on conservation planners identifying and implementing a process which capitalizes upon conservation opportunities within prioritized areas, this study may partly address the need to test methods for improving sub-regional spatial resolution within project areas where landowner "opportunities" and "non-opportunities" are classified.

Precision Conservation (Aspen Institute 2013) has been described as “getting the right practices, in the right places, at the right scale, and at the right time to maximize their environmental benefits while minimizing their social and financial costs.” Bengston (et al., 2011) noted that even in recurring and comprehensive national surveys (e.g. National Woodland Owner Survey, USA), landowner types from subsequent surveys are hard to generalize due to changed sampling methodology and survey-specific questions. This study attempts to build on the precision conservation approach and partially address the challenge pointed out by Bengston by using of local-data from a data source which lends itself to a replicable and generalizable classification scheme that matches-up with the national landowner market segmentation effort by sponsors of the National Woodland Owner Survey.

2. METHODS

2.1. Study Area

The Fayette Prairie runs from DeWitt and Gonzales counties in the southwest to the northeast to Washington and Austin counties. Original vegetation of the region included tall grass prairie grasses, little bluestem, big bluestem, yellow Indian grass, side oats grama, switchgrass, eastern gamagrass, and Texas wintergrass. The Fayette Prairie's 4.2 million acres is separated from the main belt of the Texas Backland Prairie by an ecological region that extends from oak woodlands of the East Central Texas Forests as a more woody form of vegetation (Omernik 1995). The fertility of the Blackland Prairie soils made them attractive for agriculture and improved pastures, and it has long been estimated that less than 1% of the original prairie vegetation persists (Smeins and Diamond 1983).

The map in Figure 1 displays the nine-county southern focal area for the Oaks and Prairies Joint Venture, two counties chosen for Two-Step Cluster Analysis, and eco-regions associated with the nine-county area. The Fayette Prairie and the Coastal Prairie ecosystems are present in this area, as is the Post Oak Savannah.

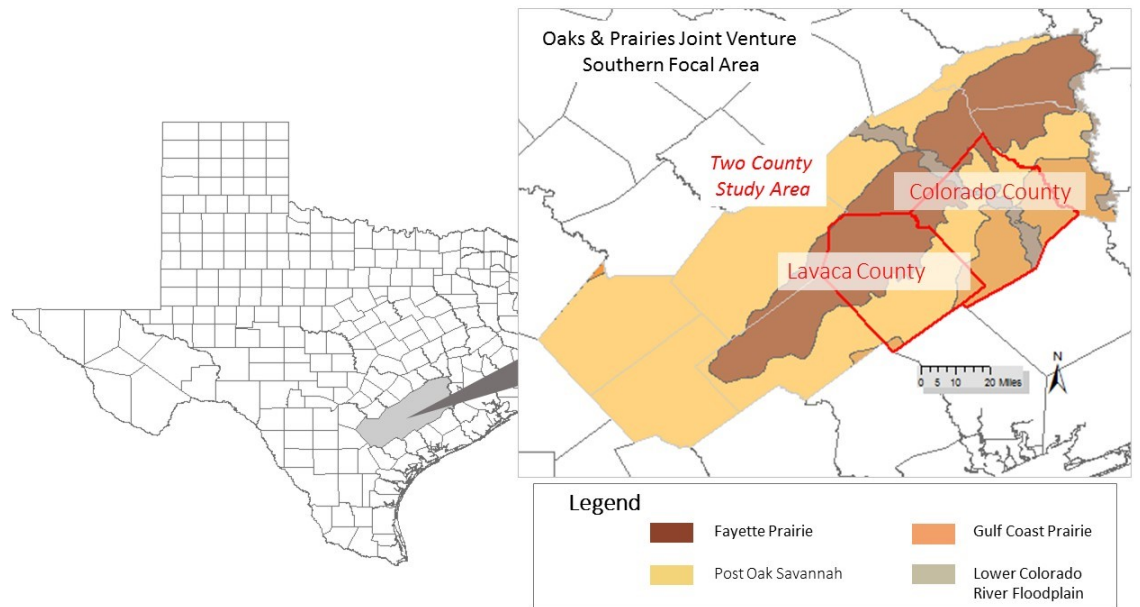


Figure 1: Study Area of the Fayette Prairie Grassland Restoration Project

2.2. Data Preparation

Special data requests were made of nine county tax assessors' offices (Table 2). Requests were designed so that very detailed land segment data which they maintain could be compared to program participation records and between landowners, and between groups of landowners in a two-county cluster analysis of landowners. Parcel boundary data was provided in Geographic Information System (GIS) shapefiles and attribute data were provided as tables in Excel spreadsheets and comma delimited text files.

Appraisal districts assess landowners annually for taxable real estate and real property. Rural real estate under an agricultural land use is valued for its production capabilities. Rural land is therefore assessed and taxed differently if it is being used for grazing purposes or a hay meadow, or if it is improved grasses that can support a higher

stocking rate of cattle than if it is native grasses. Each county keeps record by parcel of real estate values, percentages of land cover, and its relative condition.

The appraisal districts keep records on mailing addresses and physical address.

Variables like “absentee” or “residence” status can be derived from comparing zip codes.

I cross referenced zip code tables with landowner primary residence. I cross-referenced the Oaks and

Prairies Joint Venture (OPJV) data on landowner participants in GRIP with the county data for each of these landowners (Table 2).

Table 2: Program participants cross-referenced in County Appraisal District (CAD) data

COUNTY	GRIP	In CAD dB?
Colorado	8	7
DeWitt	12	7
Fayette	16	8
Washington	1	1
Karnes	1	0
Austin	6	0
Wilson	5	4
Lavaca	4	4
Gonzales	1	1
Total	54	32

Additional use of pivot tables allowed me to readily append tabular landowner data (Figure 2) with the tabular parcel land-use / land-cover information, including: the percent of vegetative type for the parcel. I also added the total number of parcels they owned in each county, the types of tax exemptions they took advantage of (i.e., wildlife tax exemption), and any residence on the parcels they owned (i.e., a house).

Preparing available tabular data in this way, enhancing the GRIP program participation records with additional attributes from public information available from the County Tax Assessor for each landowner and land parcel, allowed me to compare enrolled landowners in the program with features from the linked public data. I appended many additional data points to explore. The common fields in both data sets gave me the opportunity to merge the two to create a third data set (Table 3).

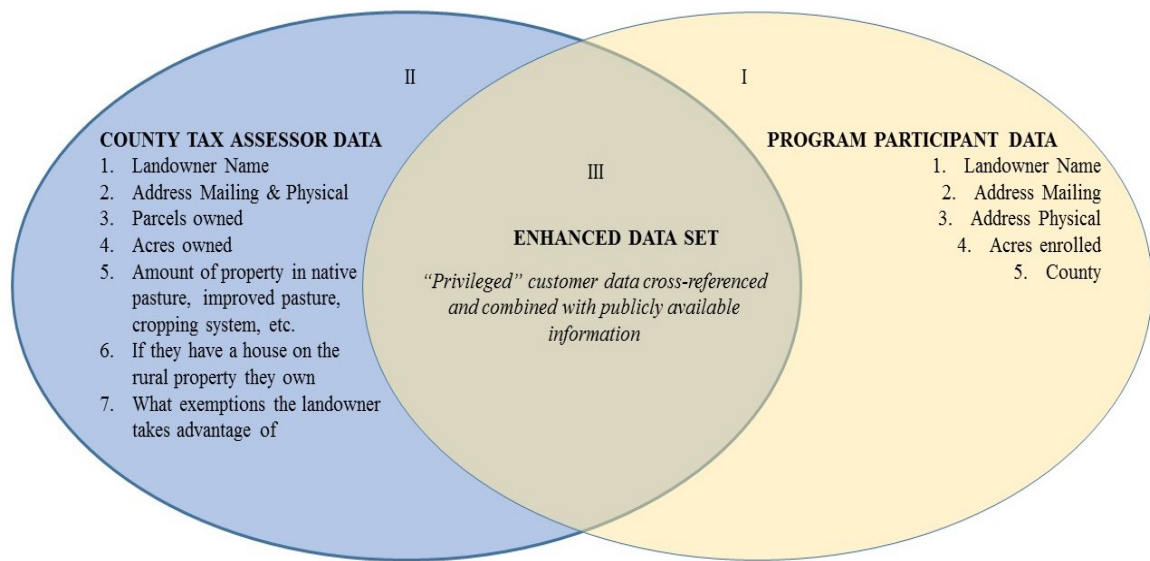


Figure 2: Diagram of two data sets combined to compose a third data set

I examined the landowner program participants from 7 counties (Karnes and Austin were not available; see Table 2) of the 9 in the southern OPJV focal area (see Table 3). I looked for variation within the participants and against the rest of the rural population (Table 4) in those counties. The idea was that these variations may be useful to explain why landowners participated or potential ways to segment the market for the program.

Each county keeps records, but not all make available these records in formats that were useful for this research project. County records differ in format from one another and where data were not available I didn't attempt to address the missing values because this examination was an exploratory phase of the research and mainly intended to inform which variables may be of interest for the Two-Step Cluster Analysis.

To prepare the data for examination (Table 3) I coded binary (Yes / No) variables for “Presence of Native Pasture or Prairie”, “Resident or Absentee”, “Presence of a Home

on rural land”, “Wildlife Tax Exemption” and “Presence of Crops or Orchard land uses”.

There are also two continuous variables: Sum of Native acres and Number of rural properties associated with each landowner instance.

All of the GRIP participants were found to have land-cover recorded by the Appraisal District as “Native Pasture or Prairie”. All also had greater than forty acres of this land cover. The latter part of this statement seemed particularly significant from a market segmentation perspective. Only 39% of the population in Lavaca County has land parcels with greater than 40 acres of native pasture or prairie. In Colorado County it was only 36%.

Table 3: GRIP participants examined in this study

Owner	County	House on Rural Property	Absentee	"Native" Prairie and Pasture tax valuation	Sum of "Native" acres	Landowner tax status is evaluated on wildlife land-use	Landowner has crop or orchard land-use associated	Multiple properties associated with this landowner	Number of rural properties associated with this landowner
1	Colorado	Yes	Yes	Yes	120.759	Yes	No	Yes	3
2	Colorado	No	No	Yes	63.162	Yes	No	Yes	2
3	Colorado	No	No	Yes	672.37	Yes	No	No	1
4	Colorado	Yes	No	Yes	66.73	Yes	No	No	1
5	Colorado	No	No	Yes	383.321	No	Yes	Yes	3
6	Colorado	No	Yes	Yes	115.656	Yes	No	No	1
7	Colorado	Yes	No	Yes	868.36	No	No	Yes	8
8	Lavaca	No	Yes	Yes	335.13	No	Yes	Yes	15
9	Lavaca	No	No	Yes	136.5	No	No	Yes	3
10	Lavaca	Yes	Yes	Yes	119.78	No	No	Yes	3
11	Lavaca	No	No	Yes	869.15	No	No	Yes	8
12	Fayette		No	Yes	225.718	Yes	No	Yes	2
13	Fayette		No	Yes	234.372	No	No	Yes	2
14	Fayette		Yes	Yes	387.4	No	No	Yes	2
15	Fayette		Yes	Yes	708.709	No	No	Yes	5
16	Fayette		Yes	Yes	613.72	Yes	No	Yes	2
17	Fayette		Yes	Yes	66.11	Yes	No	No	1
18	Fayette		Yes	Yes	72.505	Yes	No	No	1
19	Fayette		No	Yes	203.531	Yes	No	Yes	5
20	Dewitt	Yes	Yes			Yes		Yes	2
21	Dewitt	No	No			No		No	1
22	Dewitt	Yes	Yes			No		No	1

Table 3, Continued: G.R.I.P. participants examined in this study

23	Dewitt	Yes	Yes			Yes		Yes	2
24	Dewitt	Yes	No			No		No	1
25	Dewitt	Yes	Yes			No		Yes	2
26	Dewitt	Yes	Yes			No		Yes	26
27	Gonzales	No	Yes					Yes	2
28	Wilson		Yes	Yes	2244	No	No	Yes	15
29	Wilson		Yes	Yes	1518	Yes	No	No	1
30	Wilson		Yes	Yes	2264	Yes	Yes	Yes	4
31	Wilson		Yes	Yes	1708	No	Yes	Yes	4
32	Washington	Yes	Yes	Yes	41	Yes	No	No	1

I looked at other variations between GRIP participants and the populations of Lavaca and Colorado County. Participating in GRIP were landowners who were 8 to 24 times more likely to participate in the State's wildlife tax exemption than the general population (Table 4). Also noted were that in Colorado County the population of landowners are less than half as likely to have a house on their property as compared to GRIP landowners.

Clueing in on variation that may be of interest for closer examination, I also looked at variables which exhibited multicollinearity. For example, initially I was interested in the number of parcels owned by an individual landowner because greater than 2/3 of GRIP participants owned more than one parcel in the county. I looked at both how many parcels they owned as a continuous variable, as well as whether they owned more than one parcel. However, if we used both the total number of acres owned by the landowner and we also used the number of parcels owned by the landowner as an independent variable, these two variables would have a relationship to one another and the model did not perform as well. The multivariate analysis was improved by using just the total number of rural acres owned.

Table 4: Variables of interest examined in GRIP and compared to 2 pilot counties

Variables of interest	GRIP (33)	Colorado (4518)	Lavaca (7886)
Native Pasture / Prairie	100%	82%	90%
Native > 40 acres	100%	36%	39%
# rural properties >1	69%	45%	75%
Residents (opposite of absenteeism)	63%	53%	63%
Home on rural land	58%	23%	50%
Wildlife Tax Exemption	48%	6%	2%
Crop or Orchard	17%	10%	7%

Using data from these sources, I performed a Two-Step Cluster Analysis similar to Davis and Broussard (2007), which for this project is a way to group similar landowners by the characteristics they have in common. Procedures required organizing and handling the information in digital formats using Microsoft Excel 2013 and SPSS 22.0. Table 5 displays the final variables selected.

Table 5: Variables Selected for Cluster Analysis

Variable	Coding	Type
V1 – <i>Absenteeism / Resident</i>	Binary (Yes / No)	Categorical
V2 – <i>House present on rural property</i>	Binary (Yes / No)	Categorical
V3 – <i>Wildlife exemption on rural property</i>	Binary (Yes / No)	Categorical
V4 – <i>Acres of rural land owned in that county by that landowner</i>	Acres as whole numbers	Continuous

I narrowed my focus to two contiguous counties within the nine county focal area for the cluster analysis. My independent variables for the cluster analysis represent only four data points (Table 5) per landowner instance. As for which landowners were examined, I removed or excluded any rural homeowners who didn't also own rural land, as they wouldn't be able to participate. Landowners with native vegetation in their pastures or prairies that equaled less than forty acres were also excluded based on a

finding that all GRIP participants owned more than forty acres of native prairie or pastures.

2.3. Two-Step Cluster Analysis

I used the statistical software program SPSS (v22.0) to determine optimal clusters of information – in this case, landowners – based on automated assessments and calculations performed on the data. The first step (of the two-step operation) is that the program will aggregate landowner instances into their ideal pre-cluster. The second step will determine the number of clusters and delineate the pre-clusters into the optimal clustering solution. The number of clusters depends on the data and whether or not the researcher wants to manually set the number of clusters. A hierarchical algorithm built into the software operation can decide the appropriate number of clusters. I decided after trials with both, to leave groupings of landowners to the software algorithm.

The resulting eight cluster solution has maximum homogeneity within the cluster (coherence) and maximal heterogeneity between clusters (separation). Each cluster exhibits as much difference as is possible based on the variables chosen. These new units for analysis – the cluster and the cluster membership for each landowner – revealed valuable information about program participants and the prospects for future program participation which I share in the Results section.

The “measure of goodness of fit” is an overall measure for the quality of the clusters formed based on the variables chose and the importance of each variable in the model. The silhouette scale (Figure 3) is the display for the measure of goodness of fit and is depicted for Colorado County. The silhouette coefficient has two aspects to it: *cohesion* and *separation*.

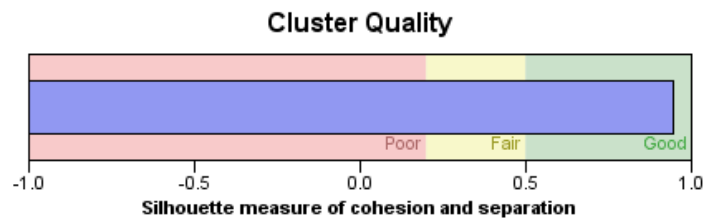


Figure 3: Measure for Cluster Quality for Colorado County

When looked at together they relay how well the clustering operations were carried out. What Figure 3 means is that each of the eight landowner clusters created exhibit a reliable level of cohesion between landowner instances and maximal separation between clusters of landowners. Both counties were identical scores.

2.4. Prime Prospect Analysis

Adapting a Prime Prospect Analysis approach (Butler et al. 2007; Dombrowski 2011; Emtage and Herbohn 2012) used in social marketing, I advanced findings from the GRIP analysis and the cluster analysis to propose additional market segmentation results derived from combining these multivariate analysis techniques. Following (Butler et al. 2007) I identified a priori in the GRIP data set, landowner characteristics which would allow us to classify landowners according to the Customer-Prospect Matrix (Table 8).

2.5. Opportunity Mapping

The study-area lies in a regional-scale prioritized conservation location essential for achieving grassland bird population recovery goals. Using a Geographic Information System (GIS) by ESRI - ArcMap 10.3.1., for this project I combined different layers of geographical and environmental data and the geo-referenced clusters of landowners in order to make an assessment of the clusters of landowners in the area. In this specific project, the overlay analysis was used as a kind of constraint mapping. In the context of this study, we identified 5 factors (Table 1) defining human and social dimensions of conservation opportunity from literature and our cluster analysis. My overlay analysis used the clusters developed in Two-Step Cluster Analysis as a vector layer of where prospective customers for a conservation program could be expected. Outputs can be described as ‘opportunity maps’ in the sense that they might help identify based on the inputs of geographical location, ecological boundaries, and cluster membership where the willingness to participate may be highest and justify some kind of targeted management or marketing campaign.

3. RESULTS

3.1. Cluster Analysis

The GRIP participants' characteristics represent a broad diversity of landowners. They are found in 6 of the 8 clusters (see Table 7 at far right hand side of table). These six clusters *plus* one more, the cluster of landowners who had crops or orchards associated with their property, makes at least 7 different GRIP landowner types who exhibit *willingness to participate* in conservation programs.

I have with the clustering solution and 4 data points, a technique that identified 7 different landowner types which represent the GRIP participant (and prospective customer) profile. Landowners that do not exhibit a high degree of shared characteristics with those in the clusters with GRIP participants – those who own property without a house on it, who reside in a different county than the property, and who do not have a wildlife tax exemption on the property – can be identified as well.

Table 6: Cluster Analysis Results

Cluster	Landowners	V1	V2	V3	V4	Acres	Mean	GRIP
1	1106 25%	0	0	0	149,584	19%	135	Yes <i>Lavaca</i>
2	734 17%	0	734	0	109,177	14%	149	Yes <i>Colorado</i>
3	1100 25%	1100	0	0	158,962	20%	145	No
4	1130 26%	1130	1130	0	167,630	21%	148	Yes <i>Lavaca</i>
5	87 2%	32	77	4	162,253	21%	1865	No
6	50 1%	0	0	50	6,698	1%	134	Yes <i>Colorado</i>
7	40 1%	0	40	40	6,804	1%	170	Yes <i>Colorado</i>
8	141 3%	73	63	141	18,852	2%	134	Yes <i>Colorado</i>

4388 Total

“Landowners” is the number of landowners in the cluster and the % of the total number of landowners in that cluster
(V1) “Local Residence” primary address of the property owner is inside the county where the property is located
(V2) “Residence” a residential house is present on the rural property
(V3) “Wildlife” the rural property has a wildlife tax valuation and not an agricultural use or market use valuation
(V4) “Acres” of rural land owned in that county by that landowner.
“Acres” is the percent of land each cluster represents in the sample
“Mean” is the acres divided by the number of landowners in the cluster
“GRIP” is “Yes” if there is at least one participant in that county and which county that GRIP participant was located

From the cluster analysis, 27% of the landowners in these two counties, those represented in Cluster 3 and Cluster 5, represent 41% of the total rural land area. These 1187 landowners share the least in common of all the clusters with the other GRIP customers in these counties.

Clusters of landowners who have not participated in the program, yet are similar to GRIP participants (those with a “yes” in the GRIP column) represent 59% of total area. Clusters that have GRIP participants represent 73% of the population. For landowners in our study, over 90% (Table 6) fall into Clusters 1, 2, 3 or 4. Clusters 1 and 2 are absentee landowners and Clusters 3 and 4 are “resident” landowners, meaning they live on their property. Cluster 1 contains 1106 landowners who are considered absentee. These landowners also do not have a house on their land. They have a rural agricultural land-use exemption on their property (and not a wildlife exemption) which means that qualifying livestock would need to be kept on this property. Livestock could either be owned by the landowners in Cluster 1 or by a grazing leasee. Most likely there is a beef cattle operation associated with the landowners in Cluster 1 in order to keep their agricultural land in “exempt” status. These same landowners are not engaged in crops, nor do they own orchards.

By extending this level of analysis to each of the clusters, program sponsors may become acquainted with the uniqueness of each cluster of landowners and by relating this information to behavior, better target them with messages that appeal to the specific unique characteristics of these landowners. For instance, the 734 landowners in Cluster 2 have a house on the property and a mailing address in a different county, and because they do not have wildlife exemption, they are also presumably running livestock. Of

those in Cluster 2 who own property in Colorado County, 110 (43%) of those in Cluster 2 from Colorado County have a mailing address in Houston, Texas.

From a social marketing perspective, the landowners in Cluster 2 may be able to be reached on the basis of enhancing the rural amenity values of their land and by hosting a workshop in an urban setting, program sponsors could specifically go after a Houston location for instance with special invites to each of these landowners. Whereas the 1130 landowners in Cluster 4 have a house on the property and also have a mailing address associated with that same county, and because they do not have wildlife exemption, are presumably running livestock. These landowners may be better reached in the rural cities nearest to the lands in the county where they reside.

The 1100 landowners in Cluster 3 are the landowners who have no house present on their rural land, but live within the county. They do not participate in the State's wildlife tax exemption program and there are no GRIP landowners associated with this cluster. Program sponsors could potentially write-off these landowners or consider them remote prospects for program participation.

Cluster 5 represents only 2% of the owners in the study, yet they own 21% of the rural land acreage. As for landowners in Cluster 5, those who participate in the wildlife tax exemption program are only 4 out of 87. Like Cluster 3, because there are no GRIP owners represented in Cluster 5, program sponsors could potentially write-off these landowners or consider them remote prospects for program participation.

3.2. Prime Prospect Analysis

When preparing the data for cluster analysis (Table 3), the majority of GRIP participants were discovered to have homes on their rural land, lived on their land or in the same county, did not have any crop land-use, and did not have wildlife tax exemption (Table 3). Wildlife exempt landowners made up 48% of the GRIP participant, whereas the population in Lavaca County has only 2% of landowners with wildlife exemptions and in Colorado County only 6% (Table 4). By combining attributes of Cluster 4 with the addition of landowners who also have a wildlife exemption (Cluster 8) we have our *Prime Prospects*.

Effective market segmentation (Table 7) into “prime” versus “marginal” or “remote” prospects can be quantified and extended in order to determine *Who are the “best” prospects for a product or service?* and *How many are there?*

Table 7: The Customer-Prospect Matrix

<i>Yes - already a Customer</i>	<i>Not a Customer</i>	Core Prospects
Core Customer <i>Beneficiary of service who demonstrates interest, attitude, and behavior that are predictive of customer</i>	Prime Prospect <i>Non-customer who has similar interests, attitudes, and behaviors as Core Customer. Additional awareness and knowledge of services available would likely convert a high percentage</i>	
Extended Customer <i>Beneficiary of service who shares some of the characteristics of core customers, but to a lesser degree</i>	Extended Prospect <i>Non-customer who shares some, but not all of the predictive characteristics of Core Customer. Additional awareness and knowledge of services available would likely convert some percentage of this group</i>	
Un-classified Customer <i>Customer despite the fact that they do not exhibit many of the core customer characteristics</i>	Remote Prospect <i>Represent limited opportunity – yet cannot be written-off by decision-makers. Campaign has low-likelihood to convert, but still the service or product has relevance to them</i>	

The conceptual underpinnings of core prospect analysis process are simple. For every product or service there is a group of customers who are loyal or high-valued customers, or who may be representative of the entire customer base. Prospective core customers would resemble these customers. Prime prospects are the most immediate opportunity.

Rural homeowners who had no land associated with their homes are ‘write-offs’; landowners who represent zero possible opportunity are omitted from consideration. This omission reduced the universe of remote prospects by 441 individuals in Lavaca County and 340 in Colorado County. Those with less than 40 acres of native pasture and prairie are also ‘write-offs’. For Colorado County, 64% of the rural landowners own less than 40 acres of native pasture or prairie. In Lavaca County that number is 61%.

Prime prospect analysis fits between the cluster analysis and the next step – opportunity mapping – see Figure 4. The important factors that explain some of the variation in a GRIP customer profile when compared to the population of that county then fed into the cluster analysis, which then fed the prime prospect analysis, which then becomes input for an opportunity map. This flow diagram in Figure 4 illustrates the starting point of combining program data with tax assessor data in order to advance some independent variables for the Two Step Cluster Analysis. It also shows the end-point of landowner opportunity maps.

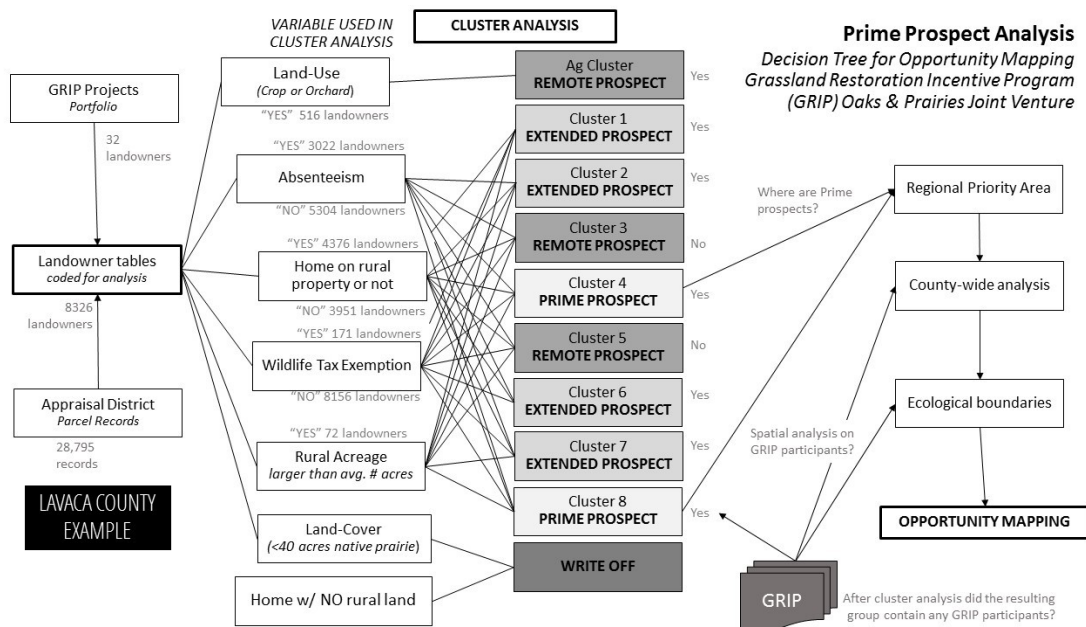


Figure 4: Decision Tree for Prime Prospect Analysis and Opportunity Mapping

3.3. Opportunity Mapping

The overlay analysis helped to locate and to quantify the landowners who are most likely to be willing to participate in OPJV Programs. In Colorado County there are 140 parcels (Table 8) that fit our prime prospect analysis. That's 2% of the land parcels in Colorado County. In Lavaca County of the 11,319 total parcels, 2,802 fit the description of "prime". This is 25% of the parcels in that county.

Table 8: Colorado and Lavaca County Prime Prospects

Cluster	Number of Parcels	Number of Acres in Native Pasture or Prairie	Number of Acres in Cluster
Colorado			
8	12	1,322	18,852
4	128	14,242	17,193
Lavaca			
8	105	4,223	13,823
4	2,697	61,550	289,227
"Primes"	2,942	81,337	321,566

Looking at Figure 5, all but two instances of GRIP landowners (probably for self-selecting reasons) can be observed to fall within the boundaries of the prairie-dominated ecosystems. With the program focus for these landowners being centered on grasslands it makes sense that the majority of participating landowners who have elected to restore prairie habitat on their parcels own property in an area that favors this type of plant community.

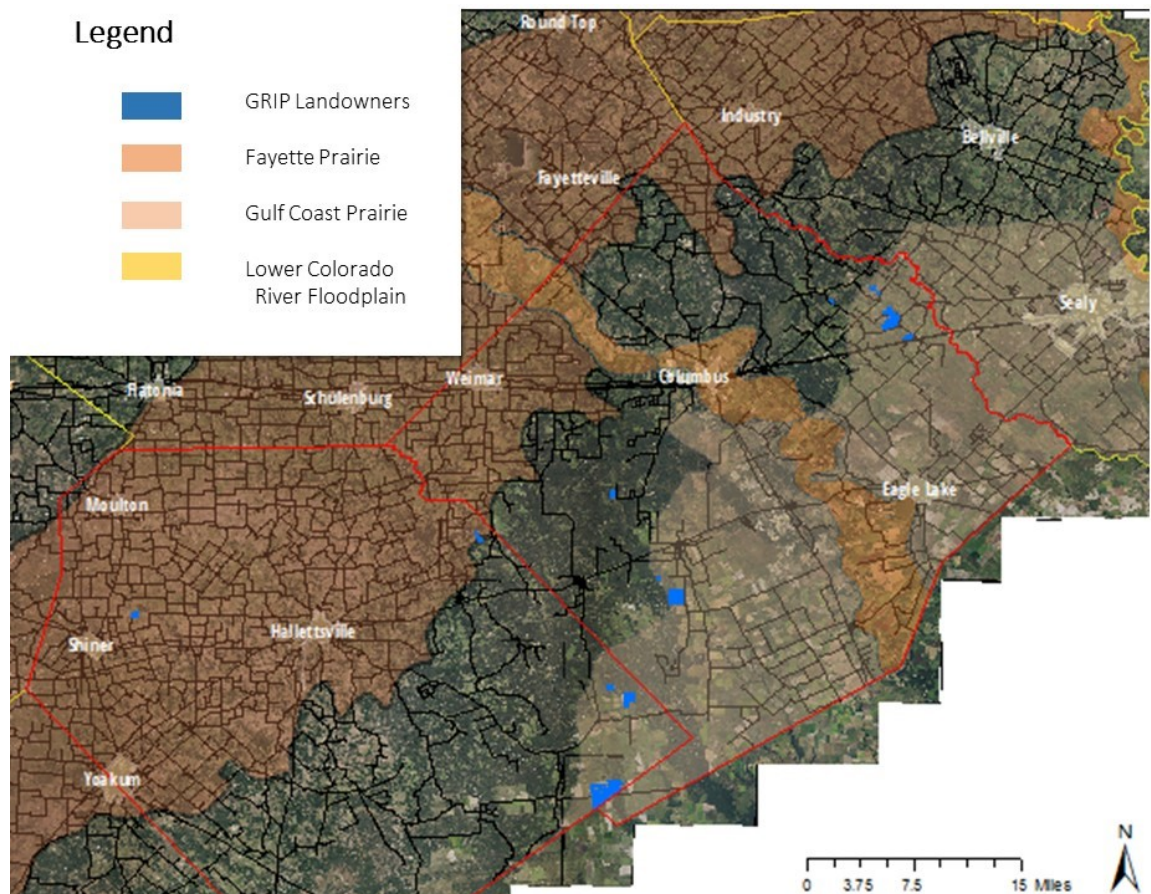


Figure 5: GRIP Landowners

The study area is part of a conservation priority area, which couples threat with conservation value in a spatial prioritization approach. However, a map of conservation priority by itself explains nothing about the human and social factors that ultimately

define OPJVs ability to stem threats and implement action effectively. If people are neither willing nor able to change their land-management choices, then conservation efforts are for naught.

Figure 6 is a map that displays just the “prime” prospect landowners from these two clusters in Lavaca and Colorado County. These are areas where action is possible, not simply desirable. From a strategic conservation point of view with the focus on biological recovery for grassland species, the conceptual and operational implications of identifying ‘opportunity’ reflects a balance between priorities based only on the persistence of biodiversity and the need to consider real-world constraints.

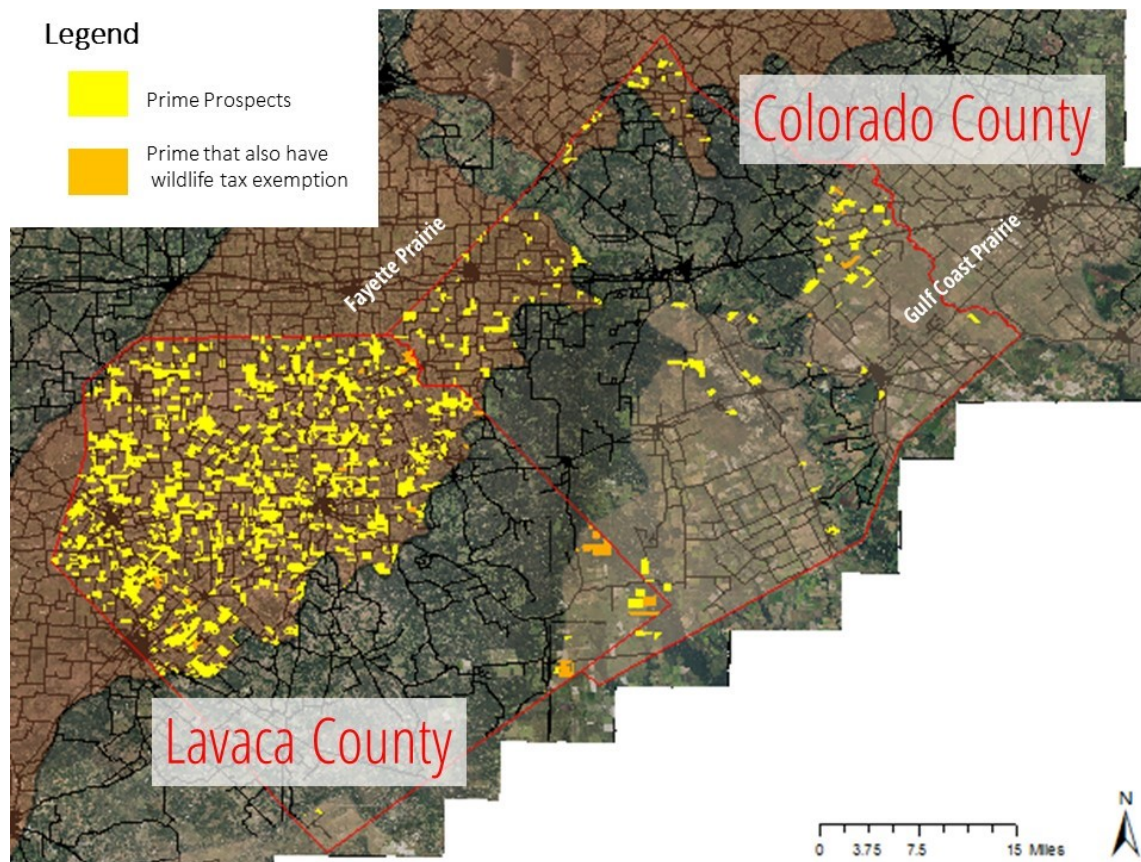


Figure 6: Colorado and Lavaca County Prime Prospects

Figure 6 is a map of where conservation could be most effectively enacted, what Knight (2011) termed as Opportunity Mapping. In simple terms, the data mining technique and two-step cluster analysis when combined with GIS, provided a pathway to represent the coinciding situation of high conservation opportunity with high conservation value.

4. DISCUSSION

Overall my findings indicate that rural landowners are a diverse group with different resources, needs, ownership arrangements, goals, motives, and beliefs about engaging in government conservation programs. Participants in the OPJV's Grassland Restoration Incentive Program (GRIP) are equally diverse. That there is not just one persona or one market segment which captures the essence of a GRIP participant's characteristic is perhaps the biggest unexpected result of this research project.

As Brown (2011) pointed out: "Environmental managers cannot assume areas of high conservation priority will be areas of high conservation opportunity." In fact just looking at two counties we can see that conservation opportunity can vary dramatically between two contiguous counties. Maps of conservation opportunity can inform intervention (e.g., management) strategies and guide future engagement of landowners in grassland habitat restoration project.

Opportunities relate to continuous variables (i.e., acreage) and categorical variables (i.e., land use, native vegetation, income earned from rural land) consistent with previous studies on the relationship between conservation behavior and these independent variables (Table 1). With these variables, an eight cluster solution (Table 9) was recommended for Colorado County and six for Lavaca County. It has to do with the model rules and representation of the clusters in my sample landowners (Table 6). Because I chose three categorical variables and coded them as binary the

Table 9: Permutations possible with three binary variables

	V1	V2	V3
1	no	no	no
2	no	yes	no
3	yes	no	no
4	yes	yes	no
5	yes	no	yes
6	no	no	yes
7	no	yes	yes
8	yes	yes	yes

expectation could be eight clusters based on presence or absence of landowners represented for that cluster in each county.

With the results of the cluster operations, no landowners are present in Cluster 5 for either Lavaca or Colorado County. This cluster if there were representation would've been composed of landowners who live in the same county as their rural property (V1), do not have a house on their rural land (V2), and also they have a wildlife exemption on their land. No such landowner exists in either of these counties. For this study, because those who would've been in this cluster are not landowners who represent high opportunity, this is not of much consequence.

However, landowners in Lavaca County did not satisfy clustering conditions for either Cluster 6 or Cluster 7. Cluster 6 are those landowners who do not have a residence in the county (V1), have no house on their property (V2) and who have a wildlife exemption on the property without the house. Cluster 7 are the landowners who have a house present (V2) on the land, have a wildlife exemption (V3), but who don't live full-time at the property and maintain a residence in another county (V1). Because 48% of the GRIP participants (Table 3) have wildlife exemptions, it is interesting to note the variation of opportunity from county to county.

If we included the two clusters not represented in Lavaca County (Cluster 6 and 7), the cluster not represented in either Lavaca or Colorado County (Cluster 5) and the additional cluster created by splitting large acreage landowners into its own cluster – the results are a 9 cluster solution for a “best fit” model to effectively segregate our landowners in these two counties. With one cluster not represented in either county we

could say that the 8 cluster solution provided by the software program for Colorado County and the 6 cluster solution for Lavaca County was in-line with expectations.

The opportunity map output (Figure 6) shows high concentrations of landowner prospects in Lavaca County and lower concentrations in Colorado County. However, Clusters 4 and 8 who represent the largest conservation opportunity are 29% of the landowners evaluated in the cluster analysis and own 23% of the acreage. This represents a substantial audience to achieve conservation targets in this region. Furthermore, willingness to participate is spatially heterogeneous concentrating in one county over another, meaning targeted engagement campaigns could be more successful when guided by the results of this or similar project.

This study was specifically designed to assess, in a simple way, the hypothesis that landowner willingness-to-participate compromises the implementation of recommendations from spatial prioritizations. However, the simplicity of the approach has its limitations and advantages. Two main advantages I see in my approach over that of Song (2014) or Brown (2011) and others, is that the data for this project was acquired very inexpensively. Time savings, accessibility, and money savings are benefits to the use of secondary data sources. The other difference is that using this type of data source and approach makes both longitudinal and comparative studies feasible. Continuous or regular data collection activities such as for government assessment of real property ownership could be especially good for such research purposes.

While data on the human and ecological factors that define implementation opportunities and constraints, like the data that have facilitated this approach, should be considered for local action. In regions where willingness-to-participate is marked as high,

and establishing on-going engagement initiatives is a goal, then these efforts may want to consider better and more expensive primary data (e.g, in-depth interviews and surveys).

5. CONCLUSIONS

In order to overcome the challenge of identifying which landowners are most likely to be willing participants in grassland habitat restoration programs, the identification of existing “core” customer characteristics and the clustering solution revealed that GRIP participants represent at least 7 unique landowner types.

By identifying these types, we can also identify landowners who categorically do not fit the profile. The implications of these findings are that an analyst following similar methods could share defensible and actionable information with project teams about the “market” or “market segments” of prospective program participants. As such, the clusters and associated profiles provide a practical way to incorporate the human dimensions of natural resource management for those interested in marketing conservation to private landowners. My work here marks a distinct and pragmatic approach to cost-effectively identify and locate opportunity within a spatially prioritized conservation initiative.

As for grouping individuals and attempting to influence their behavior at the regional or landscape scale, I and others acknowledge the need for continuing to draw the diverse strands of marketing and conservation science closer together. This approach will not replace primary data collected by social scientists. At best, the hope is to underscore the importance of existing sources of secondary data for local-scale actions by conservation professionals within a regional priority area.

Market segmentation into landowner groups and studying the membership within these groups or clusters should provide practical and tactical advantages to project teams. While the predictive validity was not measured in this study, multivariate cluster analysis is a common approach to identifying homogenous landowner groups. Future studies and

follow-on projects have a substantial basis for taking the results from this pilot study and advancing efficacy testing or scaling-up to more counties. Ultimately the ability to influence target audiences based on the insights of relationships between landowner characteristics and behavior requires more studies like this one that includes in their design the insights from social research on human dimensions of natural resource management, objective factors, replicable data sources and sampling protocol, and is rooted in strategic conservation planning efforts.

Techniques applied here are not new to human geography, however they may be new to conservation professionals. Increasing the number of landowners actively managing grassland natural resources will require more than the analysis here that identifies and locates them. However, for the Fayette Prairie in Lavaca County, there are 2,802 landowner contacts that are pre-qualified and ideally suited for the pitch of conservation program benefits. The real effort now is for tying these opportunities to the practitioners and professionals who will communicate the offer of current conservation programs and 'close the deal' with these prime prospects – the landowner participants who represent the most immediate opportunity for saying “yes”.

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