Identifying Nonindustrial Private Forest Landowners Obstacles to Manage Forests for Carbon Sequestration in the Southern U.S.

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Introduction

Forested lands in the southern United States sequester substantial amounts of carbon and play an important role in climate change mitigation. Their management is considered to be the most cost effective strategy to sequester about 400 million tons of CO_2 equivalent per year in the southern United States (Galik et al., 2013). Some major strategies prescribed to increase carbon storage of stands include altering rotation length, reducing disturbance and harvest removal, and increasing productivity.

Non-industrial private landowners (NIPF) are the largest timberland ownership group in the southern United States, owning 79% of the total private timberland acreage. Their participation is important to capitalize on the carbon sequestration potential of this region. However, few studies have analyzed the major reasons for NIPF landowners not to manage their forest for carbon sequestration. The objective of this study is to identify various underlying obstacles for NIPF landowners to manage their forests for carbon sequestration in the southern U.S.

Methods

Data

We surveyed NIPF landowners in the southern United Stated to identify their barriers to manage for carbon sequestration. A regional mail survey was sent out in the Fall 2013 to 5,110 randomly-selected NIPF landowners in the 11 southern states excluding Tennessee. A total of 734 responses were received, for an adjusted response rate of 15.02 percent, providing sufficient data for our analyses.

Data analysis

Factor analysis was used to identify unobservable, hypothetical variables (factors) that contribute to the variance of observed variables. Responses to the survey questions regarding respondents' obstacles for managing carbon sequestration were analyzed using maximum likelihood method and rotated using the VARIMAX rotation. The rotation provided a matrix of correlations between rating variables and factors. Five factors were retained for analysis and they accounted 72% of the variation in respondents ratings of their obstacles to manage forest for carbon sequestration.

The factor loading coefficients were used to categorize respondents according to their obstacles, by performing cluster analysis on a set of factor scores computed for each respondent using factor loading coefficients. We used K-means clustering method to identify separate groups of respondents based on their obstacles ratings. Finally, the summary statistics of landowners within each cluster was determined.

Results

Table 1: VARIMAX rotation of factor pattern of NIPF obstacles to manage forests for carbon sequestration. Variables that are correlated with the five rotated factor axes and their correlations

Reasons for no carbon sequestration	Factor1	Factor2	Factor3	Factor4	Factor5
It might decrease my revenue	**0.80206**	0.14199	0.10539	0.12436	0.08244
I might decrease my property value	**0.70941**	0.17233	0.16626	0.11339	0.22526
It could be in conflict with my management goals	**0.6793**	0.16445	0.25074	0.02712	0.10288
My forest type not suitable	0.14263	**0.77639**	0.18076	0.0972	0.06522
Not enough forest land	0.16973	**0.5889**	0.17764	0.33639	0.04174
Other contract obligations restrict	0.27302	**0.47934**	0.10842	-0.08457	0.06903
Don't spend much time to manage	0.05144	**0.47903**	0.15352	0.41891	0.09303
I am too old to plan this	0.20961	0.23195	**0.64046**	0.20865	0.13435
I don't want to change my current management	0.20234	0.12992	**0.60845**	0.07248	0.11497
I think there is too much weather risk	0.41113	0.24722	**0.41598**	0.0323	0.17704
I am not willing to spend for this	0.14318	0.15735	**0.40797**	0.31029	0.07657
Not sure where to get advice	0.12011	-0.00304	-0.01519	**0.63699**	0.03478
I know very little	0.02614	0.18987	0.14728	**0.60156**	0.08701
I never thought about it	-0.013	0.03834	0.32224	**0.4757**	0.08998
None of my neighboring landowners interested in it	0.1609	0.17531	0.26185	0.04704	**0.93413**
None of my neighboring landowners doing it	0.18012	0.01947	0.06652	0.1533	**0.64641**

Table 2: NIPF respondent groups and their associated average factor scores (N=458)

Respondent groups	n	Mean factor scores: Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1	192	0.48	0.3	0.08	-0.26	0.02
2	155	-0.1	-0.05	-0.09	0.47	-0.69
3	111	-0.68	-0.23	-0.04	-0.22	0.8

Table 3: Respondent groups and mean value of their characteristics (N=458)

Respondent groups	Age	Income	Acres	Parcels	Length
1	66.78	102827.48	288.07	1.88	29.05
2	60.8	126595.89	252.6	2.04	21.05
3	63.98	117452.93	283.93	2.04	26.14

Obstacle Types

In Table 1, NIPF obstacles to forest carbon sequestration could be described in terms of following five underlying factors:

- Factor1 (Goal compatibility)
- Factor2 (Land suitability)
- Factor3 (Management requirements)
- Factor4 (Understanding)
- Factor5 (Other landowner concern)

The highest factor loading value was used to decide association of a variable to given factor. Factor1 (Goal compatibility) has highest positive loadings for variables related to forest income, property value, and management goals. Similarly, other highest factor loadings have been highlighted for each associated factor (Table 1).

Landowner Clusters by Obstacles

In Table 2, respondents has been grouped into three clusters based on the obstacles they consider most important. Group 1 included 42% (111) of the respondents that consider Factor1 and Factor2 as their major barriers to manage for carbon sequestration. Similarly, Group 2 and 3 included 155 (34%) and 111(24%) of the respondents.

Cluster Characteristics

In Table 3, respondents in Group 1 are relatively older with more acres and longer ownership length. While respondents in Group 2 has relatively less acres and shorter ownership length than Group 1. The Group 3 cluster characteristics are between Group 1 and Group 2 landowners.

Conclusion

To design a viable carbon sequestration policy that encourages NIPF landowners, it would be crucial to consider their heterogeneity in terms of obstacles and the importance they place on such obstacles.

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