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Exploring the potential for silvopasture adoption in south-central Florida: an application of SWOT–AHP method

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Abstract

We analyzed the prospects and challenges for silvopasture adoption in south-central Florida using the strengths, weaknesses, opportunities, and threats approach in combination with analytic hierarchy process. We used preference data from opinion leaders who have had extensive knowledge about silvopasture practices in south-central Florida. Results reveal that strengths and opportunities for silvopasture adoption outweigh its weaknesses and threats. The participants perceive that land stewardship and diversification of income as major strengths of silvopasture and environmental benefits and government support for silvopasture practices as important opportunities. While long-term investment requirement and poor-quality soils are identified as weaknesses for the adoption of silvopasture, government regulation relating to land-use practices is considered as a critical threat. These results provide important insights for policy developments relating to silvopasture practices.

Keywords: Agroforestry; SWOT–AHP; Preferences; Decision factors

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1. Introduction

Silvopasture is an agroforestry technology that combines trees and pasture with cattle operations (Gold et al., 2000; Clason and Sharrow, 2000). It provides various environmental benefits including soil conservation, carbon sequestration, water quality improvement, biodiversity conservation, and aesthetics (Alavalapati and Nair, 2001; Clason and Sharrow, 2000). This system is thought to have a potential of diversifying the risk and enhancing household income (Kurtz et al., 1996). Lundgren et al. (1983) found that pine silvopasture systems in the southeast could have as much as a 4.5% positive rate of return. Clason (1995) reported that silvopasture utilizing loblolly pine (*Pinus taeda*) in Louisiana could produce greater net returns than either pure pasture systems or pure timber systems. Grado et al. (2001) found that raising beef cattle with pine plantations can be profitable in southern Mississippi. Stainback and Alavalapati (2004) found that combining longleaf pine production with cattle ranching is more profitable than conventional forestry or cattle ranching in Florida. However, silvopasture adoption among North American farmers is still very limited (Garrett et al., 2000).

The prospects for silvopasture adoption are often analyzed using financial cash-flow or benefit-cost techniques (Current et al., 1995; Kurtz, 2000). These analyses, however, incorporate only tangible and commensurable inputs and outputs information to derive decision criteria. A host of environmental, social, and institutional factors, which cannot be quantified easily, may influence landowner's adoption decisions. It is important to know how landowner's preferences to environmental services, uncertainty associated with future taxes, and future land use regulations, for example, influence their silvopasture adoption decisions.

In this study, we attempt to assess the effect of environmental, economic, and social factors relating to silvopasture adoption decisions. We use the strengths, weaknesses, opportunities, and threats (SWOT) approach in combination with analytic hierarchy process (AHP) to achieve this task. The SWOT–AHP allows us to define silvopasture adoption decision process in a hierarchical structure of factors, evaluate factors in pairs, and quantify the relative importance of each factor to the adoption decision. We utilize preference data from selected opinion leaders involved in silvopasture practices in south-central Florida. Although SWOT–AHP is an established method in strategic planning literature, to our knowledge, this is the first study to apply it to agroforestry.

2. SWOT–AHP methodology

The SWOT approach involves systematic thinking and comprehensive diagnosis of factors relating to a new product, technology, management, or planning (Weihrich, 1982). It is used extensively in strategic planning, where all factors influencing the operational environment are diagnosed with greater detail (Weihrich, 1982; Kotler, 1994; Smith, 1999; Hill and Westbrook, 1997). Specifically, it allows analysts to categorize factors into internal (strengths, weaknesses) and external (opportunities,

threats) as they relate to a decision and thus enables them to compare opportunities and threats with strengths and weaknesses. One of the main limitations of this approach, however, is that the importance of each factor in decision-making cannot be measured quantitatively. As such it is difficult to assess which factor influences the strategic decision most (Pesonen et al., 2000). If used in combination with analytic hierarchy process, however, SWOT approach can provide a quantitative measure of importance of each factor on decision-making (Kurttila et al., 2000; Saaty and Vargas, 2001; Ananda and Herath, 2003). AHP enables decision makers to assign a relative priority to each factor through pair-wise comparison. Following Kurttila et al. (2000), we elaborate the steps involved in our silvopasture SWOT–AHP methodology.

The first step involves identifying key factors that influence the decision (see Fig. 2). It is suggested to keep the number of factors within each SWOT group less than 10 so that the number of pair-wise comparisons remains at a manageable level. Pair-wise comparison of factors within each SWOT group is the second step of the SWOT–AHP method (see Fig. 3). Finding which of the two strength factors is more important and how much, is central in this step. This procedure must be repeated separately for all possible pairs of SWOT factors. From these pair-wise comparisons, the relative priority value of each factor within each SWOT group is computed using the eigenvalue method as explained in Eqs. (1)–(5).

Information derived from pair-wise comparisons can be represented as a reciprocal matrix of weights, where the assigned relative weight enters into the matrix as an element a_{ij} and reciprocal of the entry $1/a_{ji}$ goes to the opposite side of the main diagonal,

$$\mathbf{A} = (a_{ij}) = \begin{bmatrix} w_1/w_1 & w_1/w_2 & \dots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \dots & \\ \vdots & \vdots & \dots & \vdots \\ w_n/w_1 & w_n/w_2 & \dots & w_n/w_n \end{bmatrix}, \tag{1}$$

where rows indicate ratios of weights of each factor with respect to all others (Eq. (1)). In the matrix, when $i = j$, then $a_{ij} = 1$. When we multiply matrix $\mathbf{A}$ by the transpose of the vector of weights $\mathbf{w}$, we get the resulting vector in $n\mathbf{w}$,

$$\mathbf{A}\mathbf{w} = n\mathbf{w}, \tag{2}$$

where $\mathbf{w} = (w_1, w_2, \dots, w_n)^{\mathrm{T}}$ and n is the number of rows or columns. Further, Eq. (2) can be rewritten as

$$(\mathbf{A} - n\mathbf{I})\mathbf{w} = \mathbf{0}, \tag{3}$$

where n is also the largest eigenvalue, $\lambda_{\max}$, or trace of matrix $\mathbf{A}$ and $\mathbf{I}$ is the identity matrix of size n. Saaty (1977) demonstrated that $\lambda_{\max} = n$ is a necessary and sufficient condition for consistency. Inconsistency may arise when $\lambda_{\max}$ deviates from n due to inconsistent responses in pair-wise comparisons. Therefore, the matrix $\mathbf{A}$ should be tested for consistency using the formula,

$$\mathrm{CI} = (\lambda_{\max} - n)/(n - 1), \tag{4}$$

$$CR = CI/RI, \tag{5}$$

where CI is the consistency index, RI is random index (RI) generated for a random matrix of order n, and CR is the consistency ratio (Saaty, 1993; Mawapanga and Debertin, 1996). The general rule is that $CR \leqslant 0.1$ should be maintained for the matrix to be consistent. Homogeneity of factors within each group, smaller number of factors in the group, and better understanding of the decision problem would improve the consistency index (Saaty, 1993). SWOT–AHP analysis can be conducted even with a small sample of individuals or groups who are knowledgeable with the issue under investigation. As such it is different from statistical analyses, which require large samples to derive confidence intervals around the means and draw inferences for relevant population.

Estimation of overall factor priority scores is the third step. This requires the derivation of a scale parameter for each SWOT group. Then the overall priority score of each factor is computed as the product of the factor priority score (obtained in the second step) and the scale parameter. These overall priority scores can be analyzed and used in the decision-making process.

3. Description of the study area

South-central Florida has 1.67 million ha of ranchlands, approximately 68% of total ranchlands in the state (Florida Agricultural Statistics Service, 1999). Commercial forestry is very limited in this region and almost all of Florida's 5.9 million ha of forestland is in north and north-central Florida (Jacobson and Vericker, 2001). Historically the cattlemen in south-central Florida are dependent on traditional ranching and have little or no experience in silvopasture.

Spanish settlers first introduced cattle in 1521, and Florida's ranching industry remained in north and north-central Florida for more than 300 years (Akerman, 1984). After the American Civil War, central and southern Florida (Orlando south to the Everglades) experienced many changes. For example, the region was opened for settlement, timber harvest began on a large scale, and market for beef expanded. Native vegetation on the cut-over pinelands formed the forage-base for the cattle industry in this region. Soils in the region are dominated by Spodosols, which are relatively unfertile compared with Ultisols in northern Florida. These Spodosols are seasonally flooded between June and September when the region receives approximately 75% of its annual rainfall. These poor edaphic conditions (referred to as poor-quality soils) coupled with unsystematic burning and overgrazing limited forest regeneration in this region. In the 1940s, cattlemen began to clear remaining native vegetation on the cut-over pinelands, established drainage systems, and introduced plants and fertilized grasses, especially bahiagrass (*Paspalum notatum*).

Florida has 1.8 million cows and calves and ranks 10th in the nation (3rd in states east of the Mississippi River) for beef cattle. Approximately 66% of Florida's beef cattle are located in 25 counties in central and southern Florida (Florida Agricultural Statistics Service, 2002). After weaning, about 80% of Florida's calves are shipped to

feedlots in Texas, Oklahoma, and Kansas. Florida ranchers can broadly be classified into two groups. First group consists of ranches that are relatively small and are entirely dependent on cultivated grasses and legumes for grazing. Many of these ranchers often have a large portion of their income from non-farm sources. In contrast, the second group, which is about 2% of the ranchers located in central and southern Florida, owns about 75% of the pastureland and accounts for 48% of Florida cattle. These ranchers own large herds of more than 750 head of cattle each (Wade and Minton, 2002). Income for this group is largely from sale of calves, augmented by the sale of sod, hay, seed, and other ranching related commodities. Florida Division of Agriculture and the University of Florida have a mandate to support cattle ranchers through a variety of agricultural extension services. In particular, the University of Florida has been conducting research on biophysical and socioeconomic aspects of cattle ranching in the study area.

4. Implementing SWOT–AHP

The SWOT–AHP research involves several stages. They include identification of key stakeholders involved in the decision problem, classification of critical factors influencing the decision, and evaluation of the factors using SWOT–AHP framework (Kurttila et al., 2000; Ananda and Herath, 2003). A complete process of SWOT–AHP is presented in Fig. 1.

4.1. Identification of stakeholders

The adoption of a new technology, silvopasture in this case, depends on several factors including the availability of technology, information about markets for silvopasture inputs and outputs, size of the farm to successfully operate silvopasture, and access to government services such as extension services and financial incentives. This implies that it is critical to elicit information from research and extension service

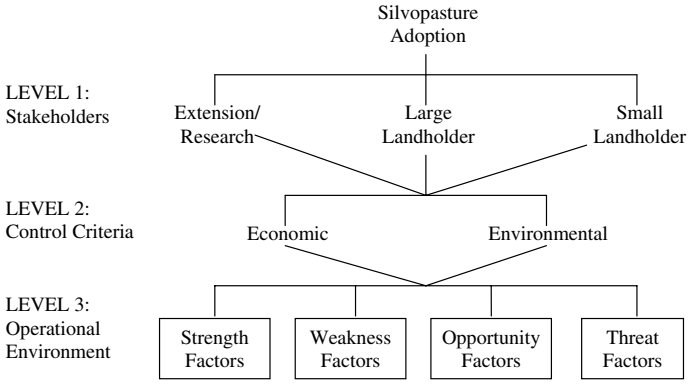

Fig. 1. A SWOT–AHP research framework.

which designs and promotes silvopasture technologies and landowners who adopt silvopasture. We identified three opinion leaders, a research/extension specialist to represent the agricultural research and extension service, and two ranchers to represent landowners. The research/extension specialist has over 28 years of experience of conducting research on silvopasture and assisting landowners with information relating to silvopasture adoption. Out of the two landowners, one is a *large landholder* (owns >750 head) engaged in silvopasture as sole occupation and the other is a *small landholder* (owns <200 head) who operates livestock mostly as a side business. Our field observations and formal/informal enquiries revealed that ranchers in the study region seek advice from these landowners on conventional ranching and silvopasture practice. Therefore, we consider these three individuals as the key opinion leaders. Theory of diffusion of innovations suggests that opinion leaders in rural agricultural communities hold centrist views and reflect the preferences of masses (Rogers et al., 1988). Following representative democracy principles (Kangas, 1994; Ananda and Herath, 2003), we hope that these individuals represent the research and extension service and the Florida Cattlemen Association well.

The two ranchers are both from Manatee County, whose ranches are on Spodosols in the flatwoods region (Myers and Ewel, 1990). The *large landholder* is the 3rd generation owner of the 3240 ha tract of land. The property was purchased in the 1930s when it was covered with south Florida slash pine (*Pinus elliottii*) and initially managed for turpentine production. About 2230 ha still remain under forestry, mostly on better soils, with income coming from sale of 30–36 cm diameter veneer logs. Native vegetation on this flatwoods forest site also provides some grazing, primarily for mature cows in winter. This owner has about 1500 cows on 1000 ha pasture. He maintains improved pasture, mostly bahiagrass with additional stargrass (*Cynodon nlemfuiensis*) and limpograss (*Hemarthria altissima*) for hay and winter pasture, respectively. An additional 121 ha are utilized as a citrus grove. The *small landholder* is the first-generation owner who purchased 259 ha of land in 1971. This respondent has retired from a previous career and does not reside on the property. The landowner owns about 125–150 cows and maintains approximately 162 ha of pasture, mostly bahiagrass. He has a 15 ha slash pine plantation, at $1.2 \times 2.4 \times 12.2$ m spacing, and intends to maintain as silvopasture by raising bahiagrass. The respondent also operates an ornamental nursery as an alternative income source.

4.2. Classification of decision factors

Identification and classification of critical decision factors was accomplished using literature review, focus group discussions, and field visits to ranches of south-central Florida. After preparing the preliminary list of decision factors, they were categorized into 12 major factors, three of which were placed in each SWOT group (Fig. 2). For instance, *diversification of income and risk reduction* includes factors such as income generation from tree crops and income from livestock. Input from the focus group discussions helped us in aggregating factors into major groups. While it is beneficial to consider as many factors as possible, it is important to keep in mind that the number of pair-wise comparisons in AHP grows exponentially with the number of factors.

Strengths S_1 *Monetary benefits*: increased income from silvopasture adoption. S_2 *Diversification of income and risk reduction*: having separate income from cattle and trees. S_3 *Stewardship and safisfaction*: having trees and natural surroundings in private lands.	**Opportunities** O_1 *Potential government support*: for pasture with tree cover. O_2 *Increase in land value*: trees preserve land productivity. O_3 *Environmental and wildlife habitat preservation*: increase recreation and agroecotourism potentials.
Weaknesses W_1 *Long-term investment*: trees requires more planning. W_2 *Poor-quality soil*: soil limits tree growth and productivity in south-central Florida. W_3 *Need more skills*: silvopasture needs training in both tree farming and cattle ranching.	**Threats** T_1 *Future tax increase*: on timber revenue by the time trees are ready to harvest. T_2 *Uncertain government regulations*: on private land. T_3 *Fire hazard*: as forest becomes prone to wildfire.

Fig. 2. Key SWOT factors influencing silvopasture adoption.

To keep pair-wise comparisons at a manageable level, we worked with three key factors in each SWOT category.

4.3. Evaluation of the factors

The SWOT factors described in Fig. 2 were used to develop a questionnaire for pair-wise comparison using SWOT–AHP methods. The questionnaire included a rating scale to weigh each factor relative to the other (Fig. 3). The respondents were asked to evaluate if both factors are equally important or one is more important than the other. During the pair-wise comparison of *monetary benefits vs. stewardship and satisfaction*, for example, the respondent would first decide which of the two factors is more important, then assign a weight ranging from one to nine indicating the relative magnitude of its importance. The data from pair-wise comparisons were used to estimate a priority value for each factor within each SWOT group. Throughout our analysis consistency ratios are maintained <0.1 as suggested in Saaty (1977, 1993).

We developed scale parameters for each SWOT group using a rating scale as detailed in Saaty and Vargas (2001). This approach requires a specification of control criteria. In this study we considered economic and environmental objectives as two equally important control criteria. Each strength, weakness, opportunity, and threat was rated based on these two control criteria and five intensity ratings (very high, high, medium, low, and very low). For example, the research/extension specialist rated strength of silvopasture 'High' in terms of economic criterion, where as it was rated 'Very High' in terms of environmental criterion (Table 1). Using this rating process, we obtained scale parameters that were used to calculate the overall priority score of each factor within each SWOT group. Thus, scale parameters also reflect the priority scores of each SWOT group. We used the computer software Expert Choice 2000 to analyze data generated from pair-wise comparisons and ratings (Expert Choice, 2001).

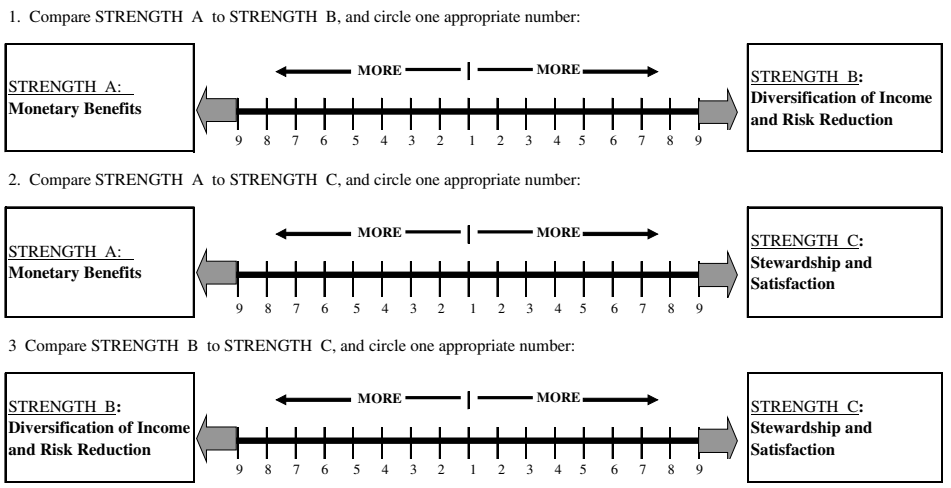

Fig. 3. Sample questionnaire for the pair-wise comparison of factors.

Table 1
Scale parameters obtained from priority ratings of the strength, weakness, opportunity, and threat [very high (0.42), high (0.26), medium (0.16), low (0.11), and very low (0.05)]

	Strength	Weakness	Opportunity	Threat
Research/extension specialist				
Economic	High	Low	Medium	Very low
Environmental	Very high	Low	High	Very low
	0.479	0.155	0.296	0.070
Large landholder				
Economic	High	Low	Very low	Medium
Environmental	Very high	Low	Low	Low
	0.511	0.165	0.120	0.203
Small landholder				
Economic	Low	Low	Very high	High
Environmental	Medium	Very low	Very high	Medium
	0.165	0.098	0.512	0.226

Note. The scale parameters are normalized for each respondent, thus the values obtained for SWOT are proportional and sum to one.

5. Results and discussion

The data obtained from three respondents were analyzed separately to derive factor priority and overall priority scores and weighted equally to estimate mean scores (Table 2). Factor priority scores demonstrate the relative importance of each factor within SWOT groups. The overall priority scores obtained by adjusting priority

Table 2
Factor priority scores and overall priority scores of SWOT–AHP analysis

SWOT groups	Factor priority			Overall priority			Mean score[a]
	Research/extension specialist	Large landholder	Small landholder	Research/extension specialist	Large landholder	Small landholder	
Strengths				**0.479**	**0.511**	**0.164**	**0.385**
S_1	0.075	0.210	0.101	0.036	0.107	0.017	0.053
S_2	0.229	0.550	0.466	0.110	0.281	0.076	0.156
S_3	0.696	0.240	0.433	0.333	0.123	0.071	0.176
Weaknesses				**0.155**	**0.165**	**0.098**	**0.139**
W_1	0.143	0.731	0.334	0.022	0.121	0.033	0.059
W_2	0.714	0.188	0.333	0.111	0.031	0.033	0.058
W_3	0.143	0.081	0.333	0.022	0.013	0.033	0.023
Opportunities				**0.296**	**0.120**	**0.512**	**0.309**
O_1	0.129	0.489	0.100	0.038	0.059	0.051	0.049
O_2	0.276	0.067	0.433	0.082	0.008	0.222	0.104
O_3	0.595	0.444	0.467	0.176	0.053	0.239	0.156
Threats				**0.070**	**0.204**	**0.226**	**0.167**
T_1	0.058	0.059	0.062	0.004	0.012	0.014	0.010
$_2$	0.578	0.470	0.212	0.040	0.096	0.048	0.061
T_3	0.364	0.471	0.726	0.025	0.096	0.164	0.095

Note. Numbers in bolds are scale parameters (values) of each SWOT group and numbers underlined are highest three factors under respondent categories.

[a] We assigned equal weight for each respondent to keep the analysis simple. However, different weighting schemes can be used to aggregate priority scores across stakeholders (Kangas, 1994; Ananda and Herath, 2002).

scores with scale parameters illustrate the relative importance of each factor across all SWOT groups. The mean scores reflect the aggregated preferences of respondents to silvopasture adoption.

5.1. Research/extension specialist

From within-group analysis of research/extension specialist's preferences it is revealed that *stewardship and satisfaction* was the most important strength of silvopasture with a priority score of 0.696 (Table 2). The second most important strength factor was the *diversification of income and risk reduction*. This indicates that from research/extension specialist's standpoint, ranchers in south-central Florida would mostly adopt silvopasture to diversify income and to ensure land stewardship. With a priority score of 0.595, *environment and wildlife habitat preservation* was shown to be the major opportunity factor. This result is expected because our field visits revealed that ranchers in south-central Florida anticipate growth in outdoor recreation due to silvopasture. For example, recreation hunting on private ranchlands has been generating up to $19.45 ha/year additional revenue for ranchers (preliminary report of agroforestry economics project, University of Florida, 2003). The most serious weakness, with a factor priority score of 0.714, was *poor-quality soil* (poor edaphic condition) to support tree growth. The unfertile Spodosols and seasonal flooding in the majority of the pasture and rangelands in south-central Florida do not support good growth of commercial tree species such as slash pine. This respondent also perceives that *uncertain government regulations* on private land may be the greatest threat for silvopasture adoption (factor priority score 0.578).

From across-group analysis of research/extension specialist's responses, it is revealed that the strength group is highly influential in silvopasture adoption decision compared with the other three SWOT groups. The priority score representing the strength group is 0.479 (Table 2), followed by opportunities (0.296), weaknesses (0.155), and threats (0.070). The overall priority score of each factor is computed using factor and group priority scores. For example, the overall priority score, 0.333, for *stewardship and satisfaction* is the product of its factor priority score (0.696) and strength group priority score (0.479). The overall priority scores are presented in graphical framework (Fig. 4). The values in each quadrant must be interpreted in absolute terms.

In Fig. 3, the cumulative score of each SWOT group indicates its relative importance compared to other groups. For this respondent, strength factors will have about a 48% influence on silvopasture adoption decisions. On the other hand, weakness factors are shown to have only about a 16% impact on the adoption decision.

5.2. Large landholder

Analysis of within-group factors for the large landholder shows that *diversification of income and risk reduction* as the most important strength in adopting silvopasture, a factor priority score of 0.550 (Table 1). The most important opportunity factor as perceived by this landholder is the *potential government support* for silvo-

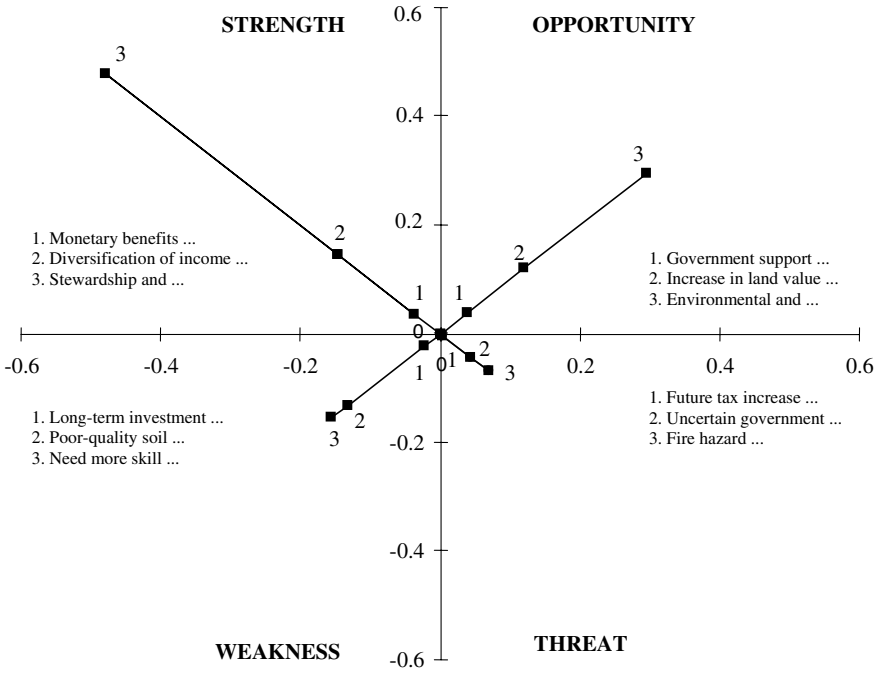

Fig. 4. Research/extension specialist's preferences towards silvopasture.

pasture practices, which has a priority score of 0.489. The most influential weakness factor as perceived by this rancher is *long-term investment* requirement with a priority score of 0.731. Finally, the two critical threats of nearly equal magnitude are *fire hazard* and *uncertainty in government regulations* with factor priority scores 0.471 and 0.470, respectively. The across-group analysis of the large landholder's preferences shows predominant influence of strength factors with a group priority score of 0.511 followed by threats, weaknesses and opportunities with the priority scores of 0.204, 0.165, and 0.120, respectively (Table 2 and Fig. 5).

Although the analysis suggests that the strengths of silvopasture are significant, this landowner perceives that cattlemen are wary about more government regulations. Furthermore, the respondent's concern for *fire hazard* reflects the personal experience of working with 2230 ha of natural forest, which is often susceptible to wildfires. However, fire would be less of a problem in silvopasture since the land will be simultaneously managed for pasture. It is also evident from the analysis that *long-term investment requirement* for silvopasture adoption will be a major limitation.

5.3. Small landholder

The analysis of small landholder's perceptions also indicates that *diversification of income and risk reduction* is the most important strength of silvopasture adoption with a factor priority score of 0.466. This landholder perceives all weakness factors

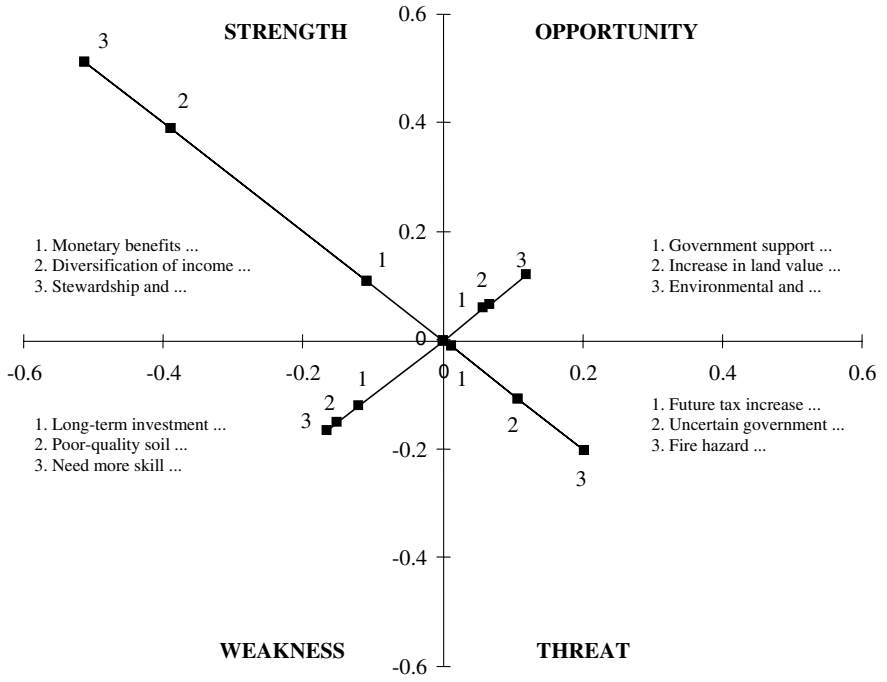

Fig. 5. Large landholder's preferences towards silvopasture.

with equal importance, but identifies *fire hazard* as the most important threat. Fire susceptibility of silvopasture may be of greater concern to this respondent due to frequent incidence of catastrophic forest fires in Florida. *Environmental protection and wildlife habitat preservation* was considered to be the most important opportunity factor for silvopasture adoption. The across-group analysis of factors for this landholder demonstrated that opportunity factors are highly influential with group priority score of 0.512 followed by threats (0.226), strengths (0.164), and weaknesses (0.098) (Table 2 and Fig. 6).

When the priority scores are averaged across the respondents using equal weights, strength and opportunity groups stood out with the highest scores. The *stewardship and satisfaction* (strength) turned out to be the most important factor in silvopasture. The *diversification of income and risk reduction* (strength) and *environmental and wildlife habitat preservation* (opportunity) are shown to be equally important. Finally, an *increase in land value* (opportunity) found to be the third most important factor in silvopasture adoption.

In sum, both research/extension specialist and small landowner perceive that the influence of positive factors would outweigh the negative factors associated with silvopasture. The large landowner, however, recognizes the positive and negative factors of silvopasture almost equally. As cattle ranching is the major source of income for this landowner, this respondent gave more weight, relative to other respondents, to weaknesses and threats associated with silvopasture. With greater understanding

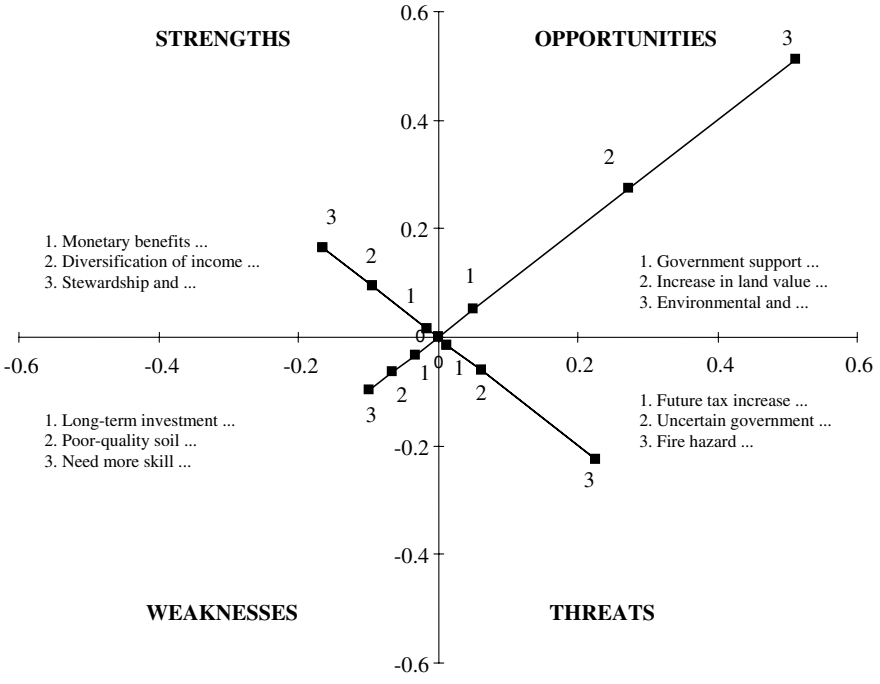

Fig. 6. Small landholder's preferences towards silvopasture.

about the ecological economic benefits of silvopasture, the researcher/extension specialist perceives that silvopasture has a potential to improve ranchers' income and the environment in south-central Florida.

6. Conclusions

This study illustrates the application of SWOT–AHP approach to assess the importance of problems and prospects relating to silvopasture adoption. The agricultural research and extension service branch, which develops and disseminates silvopasture technologies, and ranchers, who are the potential adopters of silvopasture are considered as the key stakeholders of this process. Drawing on the concept of opinion leader and representative democracy principle, we selected three individuals who had experience and knowledgeable about silvopasture to represent the research/extension agency and cattle ranchers. Results suggest that land stewardship, diversification of income, environmental benefits, and government support programs are the main prospects for silvopasture adoption. Long-term investment and uncertainty associated with future government regulations are found to pose challenges to silvopasture adoption.

It is important to recognize that the environmental services produced through silvopature practices are not exclusive to landowners. As such they may not consider

them in their adoption decisions. If environmental services are internalized through incentive programs, the profitability of silvopasture relative to conventional ranching would improve and ranchers may adopt silvopasture more. One window of opportunity to make it happen is to consider silvopasture practices to be eligible for government support programs such as the Conservation Reserve Program (CRP) payments. Furthermore, ranchers have to deal with long-term investments if they switch to sivlopasture. If they perceive that the profits of silvopasture would be uncertain because of future regulations or policies related to the environment, endangered species or taxes, they are less likely to come forward to invest in silvopasture. A stable policy environment would further sivlopasture adoption.

As the results derived in this study are from a small sample, a caution should be taken in using these findings in a broader context. A large sample is highly desirable to capture greater heterogeneity in preferences and to make generalizations. A mail survey approach can be followed to gather information from a large sample. Alternatively, respondents can be invited to convenient locations and ask them to deliberate the factors and come to a consensus on pair-wise comparison. One of the problems of this approach is that some people may dominate the deliberations and influence the choice. It would be interesting to compare the results of individual responses with those from group consensus.

Acknowledgements

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References

Akerman Jr., J.A., 1984. Florida Cowman, A history of Florida Cattle Raising. The Florida Cattlemen's Association, Kissimmee, FL.

Alavalapati, J.R.R., Nair, P.K.R., 2001. Socioeconomic and institutional perspectives of Agroforestry. In: Palo, M., Uusivuori, J. (Eds.), World Forests, Society and Environment – Markets and Policies. Kluwer Academic Publishers, Dordrecht, pp. 52–62.

Ananda, J., Herath, G., 2003. The use of Analytic Hierarchy Process to incorporate stakeholder preferences into regional forest planning. Forest Policy and Economics 5, 13–26.

Clason, T.R., 1995. Economic implications of silvipastures on southern pine plantations. Agroforestry Systems 29, 227–238.

Clason, T.R., Sharrow, S.H., 2000. Silvopasture practices. In: Garrett, H.E., Rietveld, W.J., Fisher, R.F. (Eds.), North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy, Madison, WI, pp. 119–147.

Current, D., Lutz, E., Scherr, S., 1995. Costs, benefits, and farmer adoption of agroforestry: project experience in central America and the Caribbean. World Bank Environment Paper Number 14, Washington, DC.

Expert Choice, 2001. Expert Choice. Expert Choice, Inc. (verified 13 October 2002). Available from http://www.expertchoice.com/.

Florida Agricultural Statistics Service, 1999. Florida farmland: Florida farms and acreage. In: Florida Agricultural Facts (verified 13 October 2002). Available from http://www.fl-ag.com/agfacts/farmland.htm..

Florida Agricultural Statistics Service, 2002. Beef cattle and calf inventory by county. In: Livestock, Dairy, and Poultry Summary, p. 23 (verified 13 October 2002). Available from http://www.nass.usda.gov/fl/lvstk/ldpsum00/00ldp23.htm.

Garrett, H.E., Rietveld, W.J., Fisher, R.F., 2000. North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy, Madison, WI.

Gold, M.A., Rietveld, W.J., Garrett, H.E., Fisher, R.F., 2000. Agoforestry nomenclature, concepts, and practices for the USA. In: Garrett, H.E., Rietveld, W.J., Fisher, R.F. (Eds.), North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy, Madison, WI, pp. 63–78.

Grado, S.C., Hovermale, C.H., Louis, D.J.S., 2001. A financial analysis of a silvopasture system in southern Mississippi. Agroforestry Systems 53 (3), 313–322.

Hill, T., Westbrook, R., 1997. SWOT analysis: it's time for a product recall. Long Range Planning 30 (1), 46–52.

Jacobson, M., Vericker, J., 2001. Forestry in Florida's counties (verified 24 September 2001). Available from http://www.sfrc.ufl.edu/Extension/county/county.htm.

Kangas, J., 1994. An approach to public participation in strategic forest management planning. Forest Ecology and Management 70, 75–88.

Kotler, P., 1994. Marketing Management: Analysis, Planning, Implementation and Control, eighth ed. Printice-Hall, Englewood Cliffs, NJ.

Kurttila, M., Pesonen, M., Kangas, J., Kajanus, M., 2000. Utilizing the analytic hierarchy process AHP in SWOT analysis – a hybrid method and its application to a forest-certification case. Forest Policy and Economics 1, 41–52.

Kurtz, W.B., 2000. Economics and policy of agroforestry. In: Garrett, H.E., Rietveld, W.J., Fisher, R.F. (Eds.), North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy, Madison, WI, pp. 321–360.

Kurtz, W.B., Garrett, H.E., Slusher, J.P., 1996. Economics of agroforestry. Agriculture MU Guide. University Extension, University of Missouri, Columbia, MS.

Lundgren, G.K., Conner, J.R., Pearson, H.A., 1983. An economic analysis of forest grazing on four timber management situation. Southern Journal of Applied Forestry 7, 119–124.

Mawapanga, M.N., Debertin, D.L., 1996. Choosing between alternative farming systems: an application of the analytic hierarchy process. Review of Agricultural Economics 18, 385–401.

Myers, R.L., Ewel, J.J., 1990. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Pesonen, M., Kurttila, M., Kangas, J., Kajanus, M., Heinonen, P., 2000. Assessing the priorities using A'WOT among resource management strategies at the Finish Forest and Park Service. Forest Science 47 (4), 534–541.

Rogers, E.M., Burdge, R.J., Korsching, P.F., Donnermeyer, J.F., 1988. Social Change in Rural Societies: An Introduction to Rural Sociology, third ed. Prentice-Hall, Englewood Cliffs, NJ.

Saaty, T.L., 1977. A scaling method for priorities in hierarchical structure. Journal of Mathematical Psychology 15, 234–281.

Saaty, T.L., 1993. The analytic hierarchy process: a 1993 overview. Central European Journal of Operation Research and Economics 2 (2), 119–137.

Saaty, T.L., Vargas, L.G., 2001. Models, Methods, Concepts and Applications of the Analytic Hierarchy Process. Kluwer Academic Publishers, Boston, MA.

Smith, J.A., 1999. The behavior and performance of young micro firms: evidence from businesses in Scotland. Small Business Economics 13, 185–200.

Stainback, G.A., Alavalapati, J.R.R., 2004. An economic analysis restoring longleaf pine on Ranchlands. Forest Policy and Economics (in press).

Wade, M.A., Minton, T., 2002. Forage management practices in Florida beef cattle production by size of operation. Soil Crop Science Society of Florida Proceedings 61, 36–40.

Weihrich, H., 1982. The TOWS matrix – a tool for situation analysis. Long Range Planning 15 (2), 54–66.