Planning for Natural Resources : Overcoming Environmental Crisis Through an Adaptive Management System in a Texas Urban Forest Region

건강하고 지속가능한 자연자원을 위한 환경 적응관리 시스템 적용
- 미국 텍사스의 Sam Houston Forest Region을 대상으로

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국문초록

대도시 휴스턴과 인접해 있는 Sam Houston forest region은 해당 지역과 주변 지역의 도시개발로 인해 중요한 생태환경 또는 자연자원 (natural resources)으로서의 역할을 상실해 가고 있다. 이러한 환경위기를 극복하기 위해서 그 생태 환경을 활용하면서 지속가능한 개발을 위한 환경계획으로 적응 관리 시스템 (adaptive management system)의 적용이 요구된다. 이 시스템은 해당 자연자원을 포함하는 지역에 있는 다양한 의사결정자들 (decision-makers and stakeholders)과 참여자들 (participants)간의 공통된 목적 달성을 필요로 한다. 더구나 이를 위해 정보 교류 (sharing information)와 협력, 지속적인 생태환경 보존을 위한 주민들의 감시 (monitoring), 인접지역 주민과의 의사소통을 통한 공감대 형성 등이 중요시 된다. 이 시스템을 바탕으로 Sam Houston forest region을 건강하고 지속가능한 생태환경으로 유지하고, 주변 지역개발을 위해서는 적절한 도시성장 개발 규제 (urban growth boundary)와 토지이용 규제 (transfer of development rights) 등의 환경계획 방법이 필요하다.

키 워 드 ■ 환경계획, 적응관리 시스템, 자연자원, 도시성장 개발규제, 토지이용 규제, 의견 합의
Keywords ■ Environmental planning, Adaptive management system, Natural resources, Urban growth boundary, Transfer of development rights, Censensus building

Ⅰ. Introduction

Urban areas are having an ever- increasing influence on local, regional, and global environments. Particularly, in the United States, these areas continue to extend outward, altering or displacing forests, agricultural fields, and other valued open spaces (Nowak et al., 2005). This process of urban expansion or urbanization can not only result in direct transformation or loss of forestland but also influence forests and their management in many ways. Current threats to forests (e.g., fire at the wildland-urban interface, exotic pest infestations, unmanaged

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outdoor recreation, forest fragmentation) are strongly associated with expanding urbanization (Nowak et al., 2005).

As urban communities and their associated developments expand into forests, management and policy decisions with regard to fire protection, recreational uses, scenic views, wildlife, and other issues become more complex, with more stakeholders and more at stake than ever before (Bradley, 1984). In this regard, these challenges are more likely to become increasingly significant and complicated as urban land continues to increase and expand outward, likely at higher rates than in the past.

To accomplish this need, we developed an approach based on an adaptive management system as the principal compartments of the urban ecosystem. To demonstrate our approach we examined changing ecological, political, and built environment landscape of a urban ecosystem. Thus, the approach can be applied over a wide range of important issues for urban environmental planning. We will explain our approach in this paper and present a case study to demonstrate its application for urban ecosystem and environmental planning.

Ⅱ. Current status of natural resources and adaptive management system

1. Current status of Sam Houston national forest

The Sam Houston National Forest (SHNF), one of four national forests in is located 50miles north of and is off Interstate Highway 45 and U.S. Highway 59 (see Figure 1) in Montgomery County (47,606 acres), San Jacinto County (59,746 acres), and Walker County (54,153 acres). The forest including Lake Conroe also has three parks with campgrounds: Double Lake, Kelley Pond, and Stubblefield Lake.

In 1960, the Multiple Use-Sustained Yield Act put into law what had been practiced on the National Forests in Texas for almost 30 years. This act emphasized that resources on would be managed so that they are used in the combination (i.e., recreation, fish and wildlife, timber, grazing, soil and water, and minerals) that will best meet the needs of the people. However, even the most carefully planned system of management cannot foresee environmental or natural factors (e.g.,fire, storms, insects and disease) which can cause drastic changes.

At this point, SHNF very much needs an innovative ecological management system. Given the fact that environmental management decisions have been made at the forest district or headquarters level, the forest region has been managed by a traditional management system (i.e., top-down, hierarchical model). Existing traditional management may no longer be

suitable for the changing ecological, political, and built environmental landscape of the SHNF region (see Figure 1). Without using another management system, in particular, the change in the built environment (e.g., increasing suburban and second home development combined with a growing interest in game

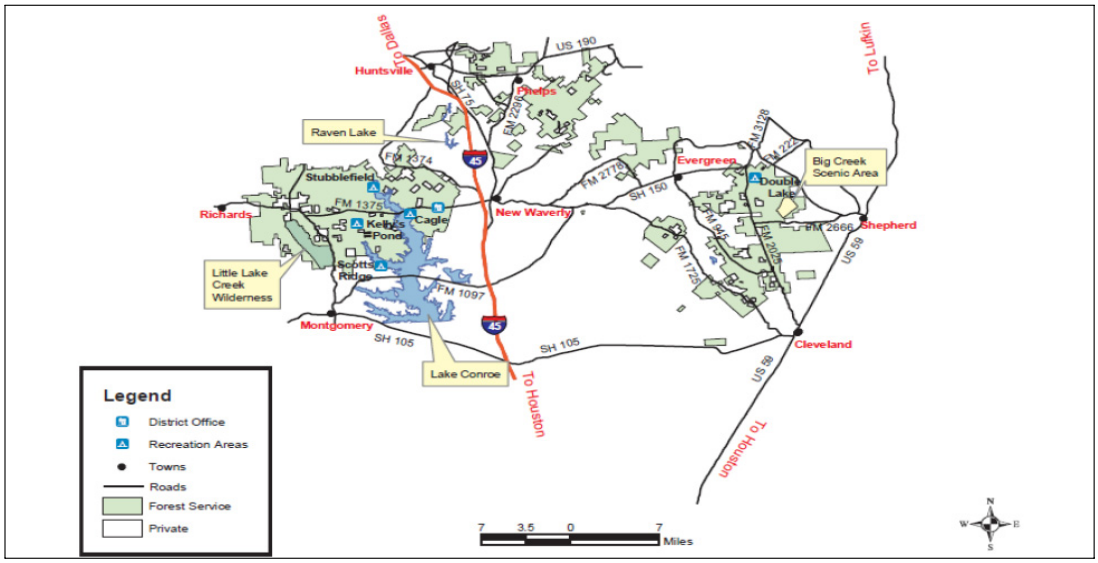

Figure 1. Sam Houston Forest Region and Surrounding Areas

hunting and off-road vehicle use) will have a negative effect on the forest areas, ultimately compromising the function and integrity of the ecosystem.

In a rapidly changing environment such as this, there is no one way to halt destruction

of diverse environmental resources, however an alternative management would serve to minimize the harm imposed on the fragile ecosystem in and around the region. Maintaining the traditional form of land management will continue to weaken the

ecosystem. Therefore, an adaptive management system is suggested as an innovative ecological approach.

2. Adaptive management system

As described in Figure 2, adaptive management in an ecosystem is a learning process which makes many changes in an ecological system. Through management, people have developed at least three diverse

ways of learning: 1) through tradition (e.g., myth, lessons of elders, parental guidance, and classroom education); 2) by trial and error; and 3) from scientific experiment (Gray et al., 2002; Klooster, 2002). These three methods have some advantages and disadvantages for implementing ecosystem management. Using tradition to prepare for

future ecosystem management can create difficult problems in try to adapt such means to new situations.

Since trial and error allows individuals to make some mistakes and improve their performance, this method is helpful in establishing sound ecosystem management practices. However, the learning is often not readily transferable to other places and people.

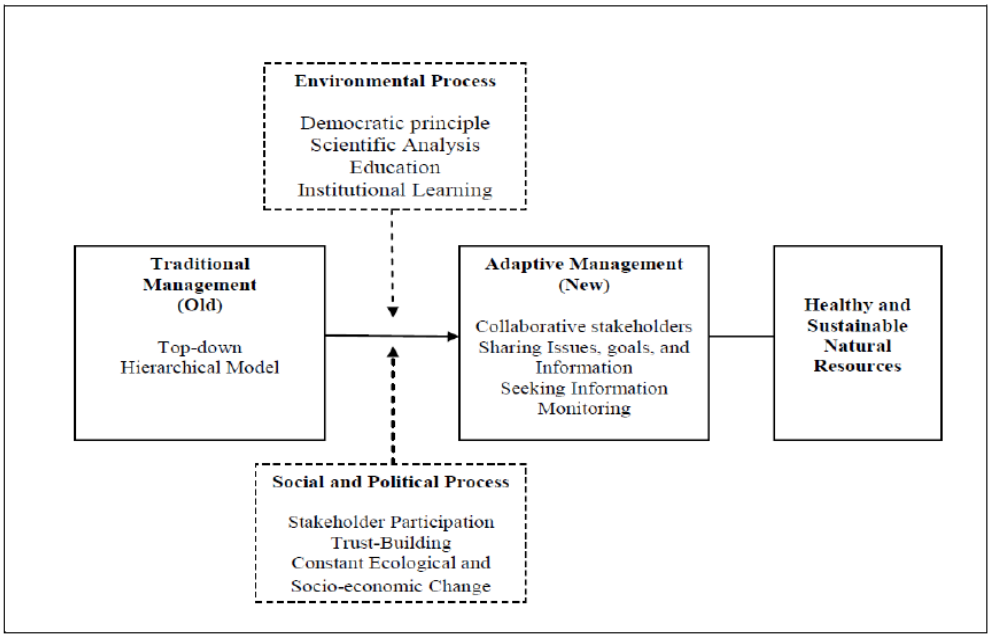

Figure 2. Process for Healthy and Sustainable Natural Resources

Note: ▶ : Time flow, ▶ : Moderator, —— : Linkage

Scientific experiments can help us develop precise and universal answers to simple questions. However, this method is not ideal in addressing complicated questions surrounding ecosystems given the fact that they involve multiple stakeholders and traverse political boundaries (Kim et al., 2011).

As pointed out by Wondolleck and Yaffee (2000), based on linking the advantages of trial and error and scientific experiments, the adaptive management system is the only way to progress by undertaking experiments,

projects, and evaluations, and by providing a process in response to the knowledge gained

from the experiments. In other words, the system is an evolving concept where policies are designed as hypotheses and management implemented as experiments to test such hypotheses (Holling, 1978). Furthermore, adaptive management is a process that combines democratic principles, scientific analysis, education, and institutional learning to manage environmental resources sustainably in uncertain situations (e.g., ecological system) (Agee and Johnson, 1988; Butler and Koontz, 2005; Holling, 1978; Kohm and Franklin, 1997; Stankey et al., 2005).

Peck (1998) mentioned that adaptive management can acknowledge the uncertainty and develop a range of viable actions, each of which is designed to investigate the diverse aspects of the management system. Such a framework also enables managers of an ecological system not only to learn about the

previous system, but also to keep up with current changes (Peck, 1998). As a consequence, managers can react to constantly changing ecological systems, sudden shifts in interest, and a continuous barrage of new and often ambiguous information (Brody, 2008).

In addition to the environmental process, adaptive management also involves social and political processes in decision-making (Butler and Koontz, 2005; Dwyer et al., 2003). Since the control over ecological or environment resources (e.g., landscapes) may be fragmented, a relationship or interaction among stakeholders is necessary. Such stakeholders oftentimes include planners, managers, monitors, researchers, local residents, and citizen groups In order to achieve successful participation, trust-building among participants is very important. Therefore, participants from diverse fields accept the risks when a project fails (Kim et al., 2011).

Once trust is created among participants, the participants can focus on negotiating an acceptable implementation or decision. Furthermore, in adaptive management, science makes crucial contributions through normal scientific research, education, and analysis of experiments at the level of management (Dwyer et al., 2003; Holling, 1978). For this reason, in the current situation of SHNF, which is undergoing rapid ecological and socio-economic changes, an adaptive management system will be very helpful in implementing current ecological policy. Furthermore, an adaptive management system is very appropriate in response to concerns over diminishing public support (i.e., only decision-making in district or headquarters level), declining biodiversity (i.e., at present no longer home of the endangered bald eagle, red-cockaded woodpecker, and other critical habitat), and long-term ecosystem health that would ultimately determine natural resource sustainability.

Ⅲ. Adaptive management in environmental planning and management : theory into practice

1. Not easy, but together with collaborative stakeholders

As mentioned above, based on the definition and characteristics of adaptive management, various stakeholders should become involved in the decision-making process for management planning. Stakeholders in ecosystem management have an interest in the project and hope to solve regional problems through decision-making (Brody, 2008; Butler and Koontz, 2005). The participation of stakeholders is one of the major components influencing the quality of a plan in an ecological system (Brody, 2008). Since ecosystem management encompasses various organizations, agencies, and lines of ownership, the decision-making process in planning needs to meet diverse and competing interests (Brody, 2008). Without stakeholder participation in a framework of collaboration and joint problem-solving, it is difficult to reach any conclusions with

ecosystem management initiatives (Wondolleck and Yaffee, 2000).

In terms of the degree of participation, it is important that all interested stakeholders, or their chosen representatives (e.g., elected officials, designated spokespersons, non-governmental organization (NGO) officers), take part in the decision-making process of ecosystem management (Gray et al., 2002). Specifically, stakeholder participation from the beginning of a project increases trust, understanding, and support for regional solutions based on ecosystem management. In addition, major parties in the consensus building form of decision-making help to instill a sense of ownership for a project and ensure that all interests are reflected in the final management plan (Innes, 1996). In addition to the broad degree of stakeholder participation in decision-making, active participation of specific stakeholders increases trust, understanding, and support for policies, especially those protecting natural systems (Duram and Brown, 1999; Wondolleck and Yaffee, 2000).

Furthermore, the degree to which stakeholders can be involved is often determined by available resources (Randolph, 2004). Schedules, budgets, and staffing may place limits on the types of interactions and number of stakeholders in the process. Even with unlimited time and resources, there are still trade-offs between the number of stakeholders that can be involved in decision-making and the degree to which they actually become part of the process.

As mentioned earlier, stakeholder participation plays an important role in collaborative decision-making (Randolph and Bauer, 1999). While some studies on stakeholder participation strongly support representation and participation of specific stakeholders in the planning process, others suggest that a participatory process may not always lead to better quality of a plan. In the negative view of stakeholder participation, high levels of participation may increase conflict through disputes at the negotiation table and frustrate planners by slowing down the decision-making process (Alterman et al., 1984; Butler and Koontz, 2005; Dwyer et al., 2003). More importantly, competing interests may dilute the strength of the final agreement.

At this point, it is necessary to address the degree of stakeholder participation. Participation should occur when a wide spectrum is displayed with various stages for different projects and with different levels of success (Stringer, 2006). Using the notion of stakeholder orbits theory, Gray et al. (2002) noted stakeholder involvement as self-selection; stakeholders can choose their own levels of involvement in accordance with their interests and comfort. As a result, stakeholder participation is appropriate at all stages of the environmental planning process. Important milestones in the project or program represent decision points when participation or collaboration is most critical for decision-making (Randolph, 2004; Kim et al., 2011).

With regard to ecological management of SHNF and the Lake Conroe region, stakeholders

are hunting coalitions, real-estate development councils, timber-harvesting interests, tourism development councils, and several community action groups. Through previous studies, it was established that stakeholders should be included when implementing a project, step by step. Consideration should be given to which stakeholder group is proper at which step. In addition, in an attempt to increase the effectiveness of stakeholder participation, participation needs to be started early in the process due to the requirement for openness and learning by participants.

2. Collaboration with participants: sharing issues, goals and information

A shared sense of purpose is equally motivating. Many successful initiatives have sought common ground by focusing on shared problems. When faced with common problems (e.g., economic downturn, degradation of a public resource) people often pull together (Wondolleck and Yaffee, 2000). Furthermore, when stakeholders realize that they share interests or goals, collaboration is easier. Above all, in order to share the problems, the content and importance of a project should be explained to stakeholders through various means (e.g., public meetings, campaigns, and forums).

As a crucial practice in collaboration within the decision-making process, sharing goal and information regarding issues facilitates collaboration and promotes an understanding among participants. In doing so, the information has been used to protect ecological systems over the long term (Brody, 2008; Dwyer et al., 2003). Without any definite charge or role in ecosystem management, participants could be persuaded or inspired by others. For this reason, since it takes time and energy to come to a common decision, sharing of information as a sharing of power is needed. In the end, participants implementing ecosystem management will collaborate with others when they understand each other and recognize overarching goals (Brody, 2008). On the other hand, with regard to inter-organizational collaboration, considerable review of its dynamics has established a number of characteristics that give rise to successful collaboration among organizations (Gray, 1989; Randolph and Bauer, 1999).

As pointed out by Gray et al. (2002), there are six important factors that comprise a successful collaboration. First, successful collaboration depends on the willingness of participants to understand the situation from all perspectives (i.e., seeking to understand others). Second, in order to understand how others see the situation, participants must be empathetic listeners. Effective collaborators do not expect their messages to be heard the first time using just one technique, but by using many methods for communication.

In addition, stakeholders should be engaged in the place and focus on the real target of their concerns. Fifth, once stakeholders begin to develop as a team, collaboration can move to

the stage of developing workable solutions to ecosystem issues (i.e., focusing on interests rather than positions). Sixth, when stakeholders begin to concentrate on their interests rather than their position, this can develop the most powerful stimulant to collaboration--recognition of common interests (i.e., seeking what is held in common).

Since community-based conservation efforts move only slightly faster than glaciers, successful collaboration depends not on having the best idea, but on having vision, courage, patience, and perseverance (Gray et al., 2002; Klooster, 2002). For this reason, within an adaptive management system, to facilitate collaboration with other agencies, landowners, industries, and NGOs in the SHNF region and the State of Texas alike, it is necessary to constantly share issue, goals, and information. Furthermore, since the forest is now broken up into four major stands across three counties, collaboration for forest conservation and development of recreation areas is urgently needed among three counties.

3. Seeking information: Get it from multiple sources

As mentioned above, information, as a sharing of power, should not be controlled and is not shown in a linear fashion as some people would like to think. Instead, information flows in a circular and decentralized pattern to bring people together in different ways (Brody, 2008). As a result, people find new solutions to existing problems.

In traditional management systems (e.g., a top-down, hierarchical model), a linear flow of information from a central clearing house is applied. The flow is passed down from headquarter offices to local ranger stations where the decision-making would be implemented. The linear information is power and the way it is collected, stored, and disseminated is an important part of conducting effective approaches to ecosystem management. In addition, information is not simply a neutral commodity passed back and forth in a rational system in the decision-making process (Brody, 2008; Dwyer et al., 2003; Gunderson et al., 1995).

On the other hand, the circular flow of information (e.g., data negotiation, communication, networks) is helpful in understanding ecosystem issues and making a decision that includes all participants (Wondolleck and Yaffee, 2000). Therefore, multiple information sources from various participants and organizations (e.g., citizen, stakeholders, organization workers, forest service staff) should be used. In addition, the most important factor in developing and using information is to build solid relationships among managers, scientists, NGOs, and the general public.

This informal relationship ensures a steady, horizontal flow of information across various organizations and individuals. Through this process, it is possible to collect abundant and accurate information to develop effective policies for ecological systems or natural resources. For this reason, sharing or seeking

multiple source-based information from informal relationships between organization and the public will be helpful to implement an adaptive management system as a new system in SHNF region.

4. Constant ecological and social and economic changes: monitoring

Monitoring is an essential activity for a learning organization and is also a central component of a high quality plan. There must be built-in mechanisms to assess how well not one, but several organizations, are managing ecological systems. Ongoing monitoring and assessment of an ecological management system provides feedback to management participants (Brody, 2008; Dwyer et al., 2003; Moir and Block, 2001). In the end, the participants can manage adaptively over time. Furthermore, monitoring can instill accountability, particularly if the monitoring party is a participant in an ecosystem management initiative (Brody, 2008; Klooster, 2002; Moir and Block, 2001).

Through this process, ecological managers can respond to constantly changing ecological systems, sudden shifts in interests, and a continuous barrage of new and ambiguous information. As pointed out by Brody (2008), a strong local monitoring program can provide a powerful informational lever for identifying negative influences on biodiversity before damage becomes irreversible. More importantly, in ecological system management, monitoring should be designed to investigate whether or not management action is developing to desired conditions for the future. As mentioned earlier, as a learning system in ecological management, adaptive management also emphasizes the importance of a monitoring program (Klooster, 2002; Moir and Block, 2001). Along with the objectives of improving management, the ongoing processes of action-based planning, monitoring, researching, and adjusting the management system is very important (Brody, 2008; Dwyer et al., 2003; Holling, 1995).

In particular, in an attempt to get an effective result, community-based monitoring is needed. This monitoring is a process in which various participants (e.g., citizens, government agencies, industry, academia, community groups, and local institutions) collaborate in order to monitor, track, and respond to the issues of common community concerns. Therefore, this community-based monitoring provides potential gains (e.g., working together, delivering information, adapting to change) not only to isolated communities but also networking communities (Berkes et al., 1998; Dwyer et al., 2003; Gray et al., 2002; Gunderson et al., 1995).

As a result, communities can obtain diverse information and share resources. Furthermore, community involvement in monitoring ecological systems leads to communication with other broader communities. The monitoring information derived from these communication activities is helpful, can be acted on easily, and used to make good and effective decisions (Fernandez-Gimemez et al., 2008; Moir and Block, 2001). For this reason, in an attempt to prevent rapid development

based on sprawl from Houston and the amenities offered by Lake Conroe, community-based monitoring is needed to integrate isolated communities with networking communities regarding common community issues.

5. New resource policies and implication: Overcoming current status

First, the managers of the SHNF region should perform Urban Growth Boundaries (UGB) as a type of land use regulation for growth management and environmental protection. This area has many new suburban and tourist or amenity developments. This unplanned rapid growth and development will have a negative effect on the existing national forest. To solve the problem, UGB regulation is needed. This regulation is a method of containing development within a set boundary separating urban and rural land uses (Randolph, 2004). Since UGBs were first used in Oregon, they have become an important tool in achieving Smart Growth's objective to emphasize development in areas with existing infrastructure and de-emphasize development in greenfields. UGBs are usually intended to accommodate growth for a specified period of time (e.g., 15 to 20 years).

With the present situation in the SHNF and at Lake Conroe (see Figure 1), it is necessary to divide the region into two areas: available areas for development (Areas I and II) and preservation lands (Area III). Area I is an area within New Waverly that has adequate urban facilities and services and is expected to continue to accommodate urban development. Area II is the reserve area, now under county jurisdiction, where annexation to Area I can be considered consistent with available area for development and a buffer zone for Area III. Area III is the remaining area in the SHNF. The area is divided into the Area III-Little Lake Creek, wilderness and lake (Conroe and Raven) watershed ecosystem, where the county intends to preserve existing critical habitat and biodiversity, and the Area III-Big Creek Scenic Area, where the county intends to restore fragmented area and promote recreation activities. Along with this UGB as an innovative regulatory tool to integrate smart growth management and environmental protection, it is necessary to partner with surrounding counties and neighboring jurisdictions (Randolph, 2004).

Second, the managers of the SHNF region should perform Transfer of Development Rights (TDR) as a type of land use regulation for growth management and environmental protection. This area has many conflicts between stakeholders and rangers regarding preservation and development and problems regarding ownership between public land (i.e., the SHNF) and private land (i.e., the non-forest area). To solve the conflicts, TDR is needed. This regulation transfers rights from areas the community wishes to protect to areas that are more appropriate for development (Randolph, 2004). A TDR program can be designed to protect working landscapes, open space, resource lands, and historic districts.

Furthermore, one advantage of TDR to the community is that the costs of development

rights purchases are borne by private landowners in the receiving area, not the local government. For this reason, the conflicts or problems between stakeholders and rangers or between public land owners and private land owners are lessened. In the end, for preservation and development to coexist, TDR should be applied in the SHNF and Lake Conroe region. For healthy and sustainable ecological lands! For coexisting in preservation and development situations!

IV. Conclusions

The Sam Houston National Forest has experienced rapid environmental changes due to increasing suburban and home development combined with a growing interest in game hunting and off-road vehicle use. Its urban environmental deterioration has reached an alarming level and thus has led to negative effects in the forest areas. To solve these environmental problems and promote healthy and sustainable lands for the future, the forest needs an adaptive management approach rather than the existing approach of traditional environmental management.

The adaptive management system comprising diverse democratic principles, scientific analysis, education, and institutional learning to manage environmental resources sustainably can be implemented through decision-making with collaborative stakeholders, collaboration with participants sharing issues, goals, and information from multiple sources, and monitoring of constant ecological and socioeconomic changes. Particularly, in integrating environmental planning, (in order to alleviate these negative effects on the urbanized forest environmental or ecological conditions), strategies including urban growth boundaries and transfer of development rights are necessary.

The key lesson to be learned here is that with crucial practice in collaborating within the decision-making process, sharing goals and information regarding environmental issues can facilitate collaboration and promote an understanding among participants. Therefore, it is necessary that participants implementing ecosystem management collaborate with others and recognize overarching goals. In addition, when it comes to inter-organizational collaboration, considerable review of the dynamics that have established a number of characteristics that give rise to successful collaboration among organizations is necessary.

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