

Ecosystem Approach for Sustainable Natural Resources Management: A Review

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Abstract

This paper is aimed to analyse the priority targets, scales and stakeholders' involvement in an ecosystem approach on natural resources management. It is an obvious that absolute anthropocentric and eco-centric views on human-nature relationship have been degraded natural resources. Because, the former perspective argues that nature exists exclusively to serve humanity; and they have ignored the natural limits to societal use of nature. On the contrary, the latter perspective treats humanity as 'just another species' with no higher value attached to their needs; and they heavily excluded human beings from nature. However, without the existence of one aspect in an ecosystem it is meaningless to the other aspects, because every elements of an ecosystem are highly interlinked to form a functional unit. In addition, an ever increasing of population growth, land use change, lack of tenure security, poverty, climate change, human settlement and others anthropogenic activities are also adversely impacts on natural resources and altering the functioning of an ecosystem. So that, ecosystem approach was emerged early as a central strategy for the Integrated Natural Resources Management that promotes conservation and sustainable use through equitable sharing of benefits. At the global level, Convention on Biological Diversity has been provided the operational guidelines and principles which can and should be applied to any decision-making processes. The author also recommended it to change this typical approach into the practical paradigms.

Keywords: natural resources management, ecosystem approach, principles, priority targets, scales, stakeholder involvement.

1. INTRODUCTION

Historically, the absolute anthropocentric and eco-centric views on human-nature relationships have been degraded natural resources. The *anthropocentric view (humanity perspective)* argues that nature exists exclusively to serve humanity which ignores the natural limits to societal use of nature. On the contrary, the *eco-centric view (naturalist perspective)* treats humanity as 'just another species' with no higher value attached to its needs and priorities. Moreover; it heavily excludes human beings from nature (Glaser, 2006). Neither view is necessarily right or wrong but they are fundamentally different views (Lackey, 1998). Usually, human needs are unlimited whilst natural resources are limited but human beings have been used as the dominant power over natural resources. In addition, ever increasing population growth, poverty, climate change, wrong policy, lack of tenure security, land use change, human settlement and other anthropogenic activities have been used paradoxically in the expenses of natural resources. It is fact that human welfare and economic stability are strongly linked to natural resources wellbeing (Brussard *et al.*, 1998). Without the existence of the one aspect, it is meaningless to the other, so it must be in a notion of '*use them, but don't lose them*' (Pirot *et al.*, 2000). As past efforts using top-down, government-mandated, sectoral and expert-driven approaches were failed or met with public resistance and resentment (Meffe *et al.*, 2002). This was because, the previous approaches were undermined the local community's power, and they decided on large natural systems rather than focusing on the appropriate levels.

However, in the present past, ecosystem approach was emerged early as a central strategy for the Integrated Natural Resources Management that promotes conservation and sustainable use of natural resources through equitable sharing of benefits (CBD, 2004). EAM is not only provides our best opportunity to describe, understand, and fit in with nature but also it is the base to restorative action that promises a healthy future for the entire biotic enterprise (Grumbine, 1994).

Therefore, this paper is aimed to analyse the priority targets, scales, and stakeholders involvement of Ecosystem Approach Management (EAM) in Natural Resources; specifically it emphasized on three of the Ecosystem Approach Principles: namely, Principle 5, 7 & 12. The main body of this paper was classified in to four topics: (1st) An Overview of EAM, (2nd) Priority Targets of EAM, (3rd) Spatial and Temporal Scales of EAM, and (4th) Stakeholders Involvement in EAM.

2. LITERATURE REVIEW

2.1. An Overview of Ecosystem Approach Management

The ecosystem concept is central to the new era in land stewardship and natural resource conservation. *Ecosystem* means a *dynamic complex* of plant, animal and micro-organism communities and their non-living environment *interacting* as a functional unit (CBD, 2004). Inherently ecosystems are described as complexity,

integrity and dynamic. Due to the fact that, ecosystems are highly sensitive to human interferences, and the scale of their management is also remaining controversial. Ecosystem complexity is often distinguished by three attributes. These are: *composition*, the identity and variety of biotic units at any level; *structure (pattern)*, the organization or pattern of these elements; and the various *processes (function)* that may affect the composition and structural integrity (Brussard *et al.*, 1998; Kay *et al.*, 1999). That means the ecosystem possesses an internal structure of many different processes, subsystems and interconnections in which subsystems assume specific functions. Unfortunately, the factors such as: uncertainty, non-linear feedback, cross-scale interactions, self-organisation and emergence causes complexity in social and ecological systems (Glaser, 2006). Because of misunderstandings about these attributes, the previous natural resources management in ecosystem context was failed or remaining unsatisfactory. This could be seen in two points of view. On one side, the previous ecosystem management was dominated by ecological science. It largely focused on conserving species at smaller spatial scales (protected area) rather than a system, for example the national parks. Biodiversity will not be conserved effectively at protected area alone because it undermines about human aspects and the whole system (Pirot *et al.*, 2000), but local community must be the integral part of ecosystem as they dependent on and can affect natural resources. On the other hand, there was no inclusive consensus on the scale of ecosystem management, yet it approached at any scale of any functioning unit.

The concept of ecosystem approach management (EAM) has been raised and acknowledged as an appropriate problem solving strategy of this era. It has been advocated to protecting the environment, maintaining healthy ecosystems, preserving biological diversity, and ensuring sustainable development (Boesch, 2006; Lackey, 1998 ; Slocombe, 1998) even though it was remaining in theory than practical or it must of learning from the experiences (Shepherd, 2008).

Therefore, at the global level, the Convention on Biological Diversity delivers the international framework for biodiversity legislation. The Convention is an international treaty set up in 1992 at the United Nations Conference on Environment and Development, or the so-called “Rio Earth Summit”. Convention on Biological Diversity (CBD) is the first and only international treaty to take a holistic, ecosystem-based approach aimed to biodiversity conservation, sustainable use of the components of biological diversity and it to be the fair and equitable sharing of the benefits arising out of the utilisation (Spray, 2012). Thus, *Ecosystem Approach* is defined as strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The convention also provided descriptions, operational guidance and twelve principles which can and should be applied to any decision-making process or plan. The 12 Malawi principles (1998) are:

Principle 1: The objectives of management of land, water and living resources are a matter of societal choices.

Principle 2: Management should be decentralized to the lowest appropriate level.

Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Principle 4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context.

Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

Principle 6: Ecosystem must be managed within the limits of their functioning.

Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Principle 8: Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

Principle 9: Management must recognize that change is inevitable.

Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

Principle 12: The ecosystem approach should involve all relevant sectors of society and related disciplines.

Even though these principles are complementary and interlinked, for this paper *Principles 5, 7& 12* were selected to be described specifically. Unfortunately, the statements in each principle were modified as the title. For example: “*Priority Targets of Ecosystem Approach Management*” title was adapted for Principle 5.

2.2. Priority Targets of Ecosystem Approach Management

Naturally, all ecosystems vary across time and space, even without human influence. They are self-sustaining and high integrity, because ecosystem structures, composition, and functions have been shaped through various processes within a long period of time (Brussard, 1998). An ecosystem can be classified into two main components. They are: Biotic (living) elements such as: plants, animals and micro-organisms; and Abiotic (non-living) elements e.g. air, water, heat, nutrients, rock, etc. The former elements have a dynamic complex

relationship, and they are an inevitable interaction *with their* non-living environments to form a functional unit (CBD, 2004). A well-defined ecosystem has strong interactions among its components and weak interactions across its boundaries. A species can perform diverse ecological functions (Peterson, 1998). It may regulate climate and biogeochemical cycles; regulate ecological processes through trophic interactions (predation or parasitism) or functional interactions (pollination and seed dispersal) etc. Human beings are also considered as an integral part of an ecosystem, and they depend on ecosystems goods and services.

The ecosystems provide well-recognized goods, including food, shelter, timber, forage, fuels, medicines, and precursors to industrial products. The ecosystems also provide under recognized services, such as recycling of water and chemicals, regulation of the climate via carbon sequestration, flood control, pollination of crops, and spiritual enrichment, recreational and aesthetic values (Kremen, 2005; Chapin *et al.*, 2002). Many studies have confirmed that higher biodiversity usually increases ecosystem efficiency and productivity, stabilizes overall ecosystem functioning, and makes ecosystems more resistant to perturbations (Sekercioglu, 2010; SEP, 2015). In addition, ecosystem services and resilience depends on the presence of each component, and a function is meaningless without inclusion of the others. In generally, the principal framework for expressing the “usefulness” of biodiversity is through the concept of these ecosystem services.

Unfortunately, human over-exploitation, land use change, pollution, climate change and spread of invasive species etc are causing loss of biodiversity and altering the functioning of ecosystems and the services they provide. Land use change, for example, can degrade the capacity of watersheds to purify water, and it highly affects the downstream (Bullock *et al.*, 2011). These impacts might be direct or indirect, destroyed (complete loss) or degraded (quality decline), can be at local, regional or global; and in some cases, if activities are promoting conservation biodiversity and ecosystem services might be restored or created. Moreover, traditional approaches to conserving diversity not only have relied on a species-by-species approach (i.e., fine filter) which more emphasized maintaining habitat for threatened, endangered, and sensitive species but also they have ignored the social dimensions; and then these approaches were failed or remaining unsatisfactory (Meffe *et al.*, 2002; Loreau *et al.*, 2001)

Therefore, Coarse-filter conservation strategy; conservation of biodiversity (e.g., species, ecosystem processes, and landscape patterns) is becoming as the primary method for maintaining the resilience and productivity of ecological systems (Schwartz *et al.*, 2000; Jensen and Bourgeron, 1994). Ecosystem is offered as a management approach to solve complex ecological and social problems; and the basic idea behind a management paradigm is to maximize benefits from ecosystems services (Lackey, 1998). There are three important aspects to ecosystem-based management such as: *the ultimate objectives*, *ecosystem boundaries* and *management actions* (Pirot *et al.*, 2000). An application of this concept requires an understanding of the natural variability of landscape patterns and processes; the ecosystem components and the interrelationships between them comprise the ecosystem’s structure and functions; and the people who considered as an integral component of the natural world have always interacted with and transformed ecosystems in a variety of ways to take advantage of the goods and services. It is the fact that ecosystem goods and services and their continued delivery are essential to our economic prosperity and well-being, but, modifications of ecosystems to enhance one service have generally come at a cost of other services (Young *et al.*, 2008). For instance human interventions to increase food and timber production have often resulted in changes to services such as water regulation and recreation activities.

In general, biodiversity conservation and restoration of their interrelationships, interactions and processes; in which, it appropriate is necessarily to sustain the ecosystem services, and should be priority target of the ecosystem approach. Therefore, conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

2.3. Spatial and Temporal Scales in Ecosystem Approach Management

Ecosystems are scale independent because they can refer to any functioning unit at any scale. It means ecosystems can occur from microscopic scales to the scale of the whole biosphere; and the rates of their processes are changing on time scales ranging from microseconds to millions of years. Defining ecosystem boundary is difficult, but it can be delineated based on climate, soil types, the distribution of organisms, drainage basins, and dominant land use, artificial and political factors (Crober, 1999), because they are the place where discontinuities coincide. A well-defined ecosystem has strong interactions among its components and weak interactions across its boundaries for instance, species that operate at the same scale interact strongly with one another, but the organization and context of these interactions are determined by the cross-scale organization of an ecosystem (Peterson *et al.*, 1998).

Understandings of the spatial scales at which ecosystem services operate will be essential (Kremen, 2005; Klijn and Udo de Haes, 1994). Indeed, an ecosystem management unit can be defined at any scale depending on management goals, the type of disturbance or the limiting resource that is stressing the system (Brussard *et al.*, 1998). Moreover, ecosystem boundaries must be defined operationally by users, managers,

scientists and indigenous and local peoples (Sexton *et al.*, 1998; Wagner *et al.*, 1998).

Landscape is considered as the working scales for ecosystem approach management, and it became an integrative concept in many disciplines. Because landscape focuses on an actual space within its properties and components (Potschin and Young, 2012; Müller *et al.*, 2010; Carmel and Naveh, 2002; Opdam *et al.*, 2002), and landscape allows for a holistic view of the competing land-use interests and an understanding of inherent trade-offs within the system to better achieve multiple objectives connecting the local to the global (Freeman *et al.*, 2015).

However, landscapes are dynamic systems; they can be changed in space and time by natural processes and anthropogenic activities (Gökyer, 2013). Landscape exists in a nested hierarchy; the higher levels contain and are composed of all ecosystems at lower levels. In addition, the processes occurring at one scale can have important effects on attributes at other scales, and no single scale has primacy in regulating species abundances or ecosystem processes (Brussard *et al.*, 1998).

According to Sexton *et al.*, (1998), the essential nature of scale to ecosystem approach management is addressed into four dimensions. Such as: biological, temporal, social and spatial scales. *Biological scale* is the biological or ecological organization typically related to specific levels of hierarchical relationship, which generalized by the cell, organism, population, community, ecosystem, landscape, biome and biosphere. *Temporal scale* is the scale of time in which the ecological processes, human events, and landscape changes occur. The changes may occur in tiny fractions of seconds or millions of years. Ecosystems always shifting and changing from one condition to the next by systematic forces such as: succession and erosion; and catastrophic forces such as: fires, storms, insect outbreaks, flooding and short and long-term disturbances by humans. The potential for these changes emphasizes the importance of considering temporal dimensions in the implementation of ecosystem management. Shorter and more commonly recognized scales of human perception of time include the changes, cycles and events that characterize seasons within a year for example. *Social scale* is the scales applicable to human relations and values. Human has been created his landscapes. For example: geographically related societies, cultures and economies create definable human landscapes. Institutions also reflect human derived landscapes, in affecting how the environment is viewed and managed through their laws, policies, and incentives and approved operational activities. Hence, social scale is equally as important as physical scale for natural systems. The last described area of scale is *spatial scale* which greatly influences to assess accurately the impact of land management practices. It is frequently used to refer to the nested or hierarchical nature of the geographic relationship between ecosystems and ecological processes and events.

In general, there is no single scale of ecological organization that is correct for all purposes. It requires considering the impacts of actions on all ecosystem attributes at multiple scales in a more integrative landscape approach (Turner, 2005; Stalmans, 2001; Kay *et al.*, 1999). A combined bottom-up and top-down approach is the best way to identify the most appropriate management scales and mechanisms (Smith and Maltby, 2003). The scale of analysis and action should be determined by the problem being addressed. The local-level actions can contribute to landscape-level implementation of the approach. To meet the expectations and needs of various stakeholders, it must having medium- and long-term aims, but with concrete, short-term actions. To conclude, the ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

2.4. Stakeholders Involvement in Ecosystem Approach Management

The most relevant aspects of the Ecosystem Approach that related to principles 1 (societal choice), 2 (decentralised management) and 12 (the engagement of the widest possible range of stakeholders) are stress societal involvement in the choice of ecosystem and management objectives, and in the range of skills which will be needed. A critical aspect of successful ecosystem approach management is engaging and working with a broad range of stakeholders toward common goals. So that, knowing who the stakeholders and what their interests and expectations is the central to successful implementation of the ecosystem approach. *Stakeholder* is any person or group with a legitimate interest in the conservation and management of the natural resources. According to Shepherd (2004) stakeholders are categorized as primary, secondary or tertiary stakeholders. The primary stakeholders are those mostly dependent upon the resource and likely to take an active part in managing natural resources. The common examples of primary stakeholders are the local community. Local government officials and those who live near the natural resources but do not greatly depend on them are secondary stakeholders; whereas, national level government officials and international conservation organisations are considered as the tertiary stakeholders. Similarly; Meffe *et al.*, (2002) suggested that stakeholders fit into one or more of the five categories: people who live, work, play, or worship in or near an ecosystem; people interested in the natural resource, its users, its use, or its non-use; people interested in the processes used to make decisions; people who pay the bills; and people who represent citizens or are legally responsible for public resources. Even if including all potential stakeholders in every decision or action is impossible, they can be involved through individual level of interests, representatives, and public involvement.

Stakeholders play a relevant role in the integration of knowledge which has been acquired through

different perspectives; and their participation may lead to emphasis empowerment, equity, trust and learning (Slocumbe, 1998). Among other stakeholders, indigenous peoples and other local communities are strongly important stakeholders. Because they are directly depend upon the natural resources, consequently they perceived ecosystems in terms of their own economic, cultural and societal needs. Therefore, recognizing their choices, values, perceptions, rights and interests are very important. Because, this recognition provides the greater responsibility, ownership and accountability over the natural resources existed in their local areas. In addition, of accepting their local knowledge and participation may lead to greater efficiency, effectiveness and equity of ecosystem approach management programmes.

It is obvious that most problems of biological diversity management are complex, with many interactions, side-effects and implications. Hence, the combination of both local and scientific knowledge was not only provided a more comprehensive understanding of complex and dynamic socio-ecological systems and processes but also can be used to evaluate the appropriateness of potential technical and local solutions to environmental problems (Reed, 2008).

In general, any ecosystem approach management of natural resources must be in line with the societal choices at the lowest appropriate level. It should also be involve all relevant sectors of society and related disciplines.

3. CONCLUSION AND RECOMMENDATION

An ever increasing of population growth, land use change, lack of tenure security, poverty, climate change, human settlement and others anthropogenic activities are adversely impacts on the precious natural resources and altering the functioning of ecosystems. This is due to the misunderstandings on the integrity, dynamic, complex relations and interactions among ecosystem components. The traditional ecosystem management was dominated by ecological perspective; which largely focused on conserving species at smaller spatial scales rather than the whole system in general. The scale of management is remaining controversial. In addition, they have ignored the social dimensions; especially the local communities and they have expected human beings apart of a system. However, without the existence of one aspect in an ecosystem, it is meaningless to the other aspects, because the components are highly interlinked to form a functional unit. So that, ecosystem approach was emerged early as a central strategy for the Integrated Management of Natural Resources that promotes conservation and sustainable use through equitable sharing of benefits. At the global level Convention on Biological Diversity has been provided different descriptions, operational guidance and principles which can and should be applied to any decision-making process. The author also recommended it to change this typical approach into the practical paradigm.

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