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Environmental and Social Sustainability: The role of Forest as the most influential ecosystem

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Abstract. There are many environmentally essential issues having close relationships with forest existence. Forests which are very crucial to balance the short-term requirements of today's human needs, to anticipate the necessities of the next generations, as well as to preserve long-term ecosystem situations and functions to support other living creatures, are therefore very vital to be well maintained. The best operative way to fulfill these requirements is to practice the forest ecosystem management paradigm as the template. In an ecosystem where the green plants are dominant or inhabit the greater proportion of occupancy, more energy and biological cycling useful for other living creatures will be available. Forest ecosystem which is dominated by big and long-standing trees influence the most to the environment compare to other types of ecosystems. For the complete sustainability problematic to be resolved, the Three Pillars of Sustainability must be viable and environmental sustainability need to be the top priority. All of these require careful thoughts, tradeoffs and compromises and often need sacrificing to some extent so that other needs can be pursued.

1. Introduction

Nowadays, there are environmentally essential issues that have been raised which are human overpopulation, hydrology, intensive farming, land use, nanotechnology, natural disasters, nuclear issues and ocean trash. Among those issues, the first 4 concerns have close relationship with forest existence. Forest is a large area with long-lived vegetation or tree domination luring the emergence of other living creatures which among them create complex interactions [1,2]. Forests fulfill human being needs, prevent natural disaster and keep the water balance and consequently they should not be overridden by excessive farming and other land use. Maintaining forest existence is very crucial to balance the short-term requirements of today's human needs and to anticipate the necessities of the next generations, as well as to preserve long-term ecosystem situations and functions to support other living creatures.

The best operative way to fulfill these requirements is to practice the forest ecosystem management (FEM) paradigm as the model. Management of forest for individual values hardly ever tolerates other values. Therefore forests must be managed as complete ecological systems. To be Successful in managing forests, it involves addressing all biological, human social and physical complexities. Among the requirements for Ecosystem Management are proper tenure systems, long term objectives of desired forest in the future, acceptable inventory, approval of the dynamic nature of forest ecosystems, and basic model on the ecological rotations [3,4].

Forests existence in the old periods which dominated by vegetation has proven contributing our earth well-being we face in recent life. Carbon, an element that influence the global warming and climate change which most is in the form of CO₂, were stored well by vegetation in the universe in many terrestrial



places. Table 1 show that, apart from ocean and atmosphere, vegetation were able to significantly store carbon through physiologically process, both in its body and as organic material in soil as well as vegetation-based fossil [5]. This vegetation function to store carbon, help to mitigate the global climate change and therefore maintain the earth environment.

Table 1. Carbon storage of systems on earth

Part of System on Earth	Carbon Storage (billion ton)	Note
Vegetation	600	Forest exploitation causing carbon emission of 1,7 billion ton/year to the atmosphere. Fertilized vegetation with high CO ₂ absorb 1.9 billion
Soil and organic materials	1500	
Fossil fuel	3700	
Ocean	38000	
Atmosphere	590	<ul style="list-style-type: none"> - Most in the form of CO₂ - Between 1750- 21st century, there has been an additional of 200 billion ton to the atmosphere - 300 billion ton from burning fossil fuel - 120 billion ton from forest exploitation and soil oxidation

Source: Centre for Climatic Research, Institute for environmental studies, PCC2, UNEP and WMO [5].

Forests including artificial forest increase the environment quality in many ways [6,7]. Restoring forests, decrease surface water flow, reducing the erosion of soil components, decrease wind effect and stabilize temperature. Forests improve soil fertility from decomposing leaves and branches on the ground and this organic materials absorb water and help the forests maintain humidity and groundwater resources as well as luring other living creatures to grow. Forests also keep biodiversity that stabilizing and balancing ecosystems. Vegetation in the forests have essential roles in releasing enormous volumes of oxygen, purifying pollutants in the air and absorbing CO₂ becoming important pools to conserve carbon to mitigate global warming [8]. Forests greatly improve seepage, decreasing runoff and supplying ground water in hilly and mountainous regions able to generate springs in lower elevation. All these functions draw other living creatures including animals and microbial for ecosystem balance.

2. Differences of Forest from Other Type of Terrestrial Ecosystems

Ecosystem is described as the community of living-organism that lives in an area which interacts with other biotic, abiotic components and elements of the environment. Harmonious interactions in a complex system create a balance, while this balance will fail if little degree of instability occurs. The environment is our surrounding where we live in. Environment always changes and it is determined by the surrounding

elements. Ecosystem is the functional unit of environment, therefore balanced ecosystem will create appropriate environment for living creatures to live.

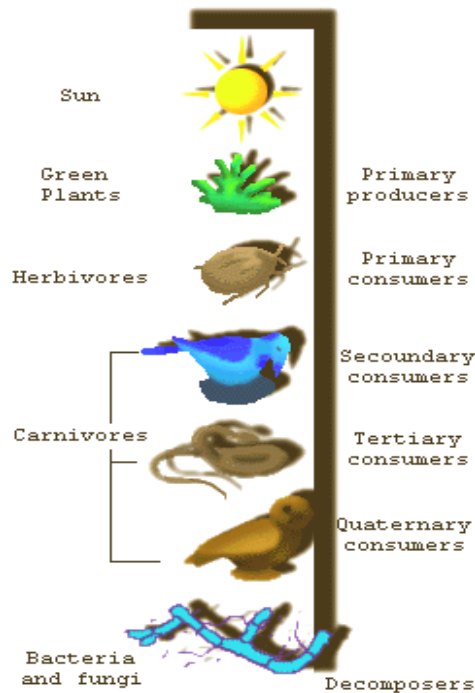


Figure 1. Roles of component in the ecosystem [9].

Inside the ecosystems, plants practically are the primary producers. The primary step in energy production for living things are from plants, which supporting the surviving of other living creatures and interactions among them in the ecosystem. Working through this simple example (Figure 1), it illustrates how complex the issue of all interactions to perform sustainability. This will influence the stock, balance, rate, time and negative/positive feedback during the interactions of the biological community to the non-living or abiotic component [9]. This mainly will talk about two main processes in the community which are biological cycling and energy transformation in the system. In this process, plants are the only main producers that determine how those two processes are working. Therefore in an ecosystem where the green plants are dominant or inhabit the greater proportion of occupancy, more energy and biological cycling useful for other living creatures will be available. This condition is especially referred to forest ecosystem which is dominated by big and long-standing trees. That answers why forest is the most influential ecosystem for sustainability on earth among other types of terrestrial ecosystems, like grassland, savanna, tundra, mountain and desert in which plants as the main producers are less occupying. In details, vegetation, especially big trees will play an important role in ecosystem, and they are [10].

- key component of an ecosystem involving various biogeochemical cycles, e.g., water, carbon, nitrogen.
- converts solar energy into biomass
- influences the energy balance on earth's surface atmosphere & mitigating extremes climate.
- releases O₂ and sequesters C
- affects soil development over time

- provides wildlife habitat and food.
- provides direct (e.g., timber) and indirect (e.g., watershed protection) socioeconomic products and services for humans.
- gives spiritual and cultural experiences to some people.
- can be easily described and mapped for monitoring cover, composition, and structure due to natural or human-influenced events.
- set conservation and habitat management goals.
- etc.

3. Sustainability

Sustainability is the capacity to endure a certain behavior indefinitely. When we discuss about sustainability, there are ‘Three Pillars of Sustainability’ that related to Forest. The essential principal of Three Pillars of Sustainability states that for the complete sustainability problematic to be resolved, complete three pillars of sustainability must be viable Those three pillars are environmental sustainability, social sustainability and economic sustainability [11]. Among those three pillars, the most essential is environmental sustainability. If it is not well resolved, no matter how tough we work on the other pillars, they cannot be durable and strong because they rely on the greater system they have to live within, the environment.

3.1 Environmental Sustainability

Environmental sustainability is the capability to sustain rates of harvesting the renewable resource, minimum pollution emission, and lessening and weakening state of non-renewable resource, that can be maintained indefinitely. However, very often this environment consideration become being less concerned than other factors. Even poverty must not take “overriding priority” over the environmental sustainability. Because whenever environmental sustainability problematic is finely resolved catastrophic collapse would unlikely to occur [12]. Poverty problem is not new and it has occurred since ancient times. However, the problem of worldwide environmental sustainability problem is recent and threatens species well-being and therefore deserves highest priority. Environmental sustainability don’t rely on local, national or international limitations, and to maintain it, we need to work worldwide together and incorporated into all aspects of our live such as: building eco homes, raise awareness to create environmentally conscious communities, establishing sustainable food, sustainable water and sustainable renewable energy, create low impact furniture and clothing, etc.[13,14].

3.2 Social Sustainability

Social sustainability is described as the capability of a social system, like a country, to function in achieving well-defined level of social well-being indeterminately. This social sustainability is determined by economic sustainability, and vice versa, while both social and economic sustainability will be depended on environmental sustainability. The human system rely on other larger system where it lives within: the environment. As a result, among the three, environmental sustainability should become society's first priority [15].

Environmental management should take into account the poverty-environment linkages which are multidimensional and dynamic in nature. So that environmental management should encompasses far out beyond the environmental concerns to come across those two fundamental and inter-related tasks. There are necessities to sustain the long-term environment capacity. This is to make available goods and services on which human development rely on. The requirement to guarantee secure and reasonable access of the poor to environmental resources is essential and these benefits would expand opportunities for people’s livelihood, health, capability to work, and lessening their susceptibility to environment-related threats [16].

3.3 Economic Sustainability

Economic sustainability is described as the ability to maintain a defined stage of economic production indeterminately. Together with environmental sustainability, economic priorities, both are basically like two sides of the coin [15]. Generally, it is the process of economic development which gives effects on the environment, both positively and negatively. Better management, should be based on achieving goals involving the 3 essential considerations which are improving people lives and prospects in environmental, social and economic aspects, and this will vary among countries. Collaboration between the developed and developing countries would be best as a vital dimension of development [17,18].

4. Maintaining Sustainable Forest

There are many factors that determine Forest Sustainability. This is due to diversity of forests, diversity of values and objectives among public and private sectors as well as concerns on spatial and temporal scales that will vary among regions. Discussions among all involving sectors are essential to obtain the best resolution agreed by all sides. Important considerations have been offered to maintain Sustainable Forest Management [19], which include tangible and intangible values.

- a. Sustain a stable forest due to the fact that forest goods and services are irreplaceable
- b. Sustain diversity of: population, native plants, animals, ecosystem, habitat, genetic structure. More focus on restoring threatened habitat and species
- c. Sustain forest structure and species composition for healthy forest by avoiding over harvesting to elude fire, insects, diseases, invasive species and to maintain strong forest function
- d. Sustain or improve water quality and quantity from forest ecosystem
- e. Sustain or improve soil productivity and minimize erosion and soil contamination
- f. Sustain or improve capacity for continuous yield (timber and non-timber)
- g. Sustain forest-based community stability and employment and culture
- h. Sustain quality and quantity of forest recreation and other opportunities for people to learn more about forest
- i. Sustain institution, policies, incentives and regulation to support forest sustainability
- j. Improve environmental awareness and literacy that cover a wide range of society and community level about sustainable forest management
- k. Etc.

All of these require careful thoughts, tradeoffs and compromises and often need sacrificing to some extent so that other needs can be pursued. The tradeoffs often need to be scaled up at larger spatial level because the effects are not border reliance. One essential contribution that are required to judge all considerations are data and assessments to enable the fruitful results from the discussion. This is significant in producing the best options and judgments and maximum decision at the expense of other acceptable advantages that need to be sacrificed. This is the work for the sake of the general public. This should be resolved through dialogue, regulation, policies, expressed opinions and investments [19].

5. Conclusion

Among the three pillars, environmental sustainability needs to be at the top priority because of its greater system where people live within. Forests which are very functional, influence the most to the environment, and maintaining long-term forest ecosystem are very vital. To maintain the environment, people need to take actions which are incorporated into all aspects of daily life and to involve careful thoughts, tradeoffs and compromises for resolving it through dialogue, regulation, policies, expressed opinions and investments. Environments don't rely on local, national or international boundaries, therefore worldwide collaboration are compulsory.

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