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Ecological and Economic Roles of Agrobiodiversity

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Abstract
Biodiversity is a complex, abstract concept. It can be associated with a wide range of benefits to human society, most of them still ill understood. In general terms, the value of biodiversity can be assessed in terms of its impact on the provision of inputs to production processes, in terms of its direct impact on human welfare, and in terms of its impact on the regulation of the nature-ecosystem-ecological functions relationships. The services that agricultural biodiversity provides are critical to the functioning of food support systems. They contribute to human welfare, both directly and indirectly, and therefore represent part of the total economic value of the planet. The main cause of the loss of biodiversity can be attributes to the influence of human beings on the world's ecosystem, In fact human beings have deeply altered the environment, and have modified the territory, exploiting the species directly, for example by fishing and hunting, changing the biogeochemical cycles and transferring species from one area to another of the Planet. Conserving biodiversity has economic, social, and cultural values. Conservation of biodiversity is integral to the biological and cultural inheritance of many people and the critical components of healthy ecosystems that are used to support economic and social developments. For successful and sustainable conservation there needs to be local community involvement especially for agro ecosystem. Conservation can broadly be achieved into two ways: In-situ -Conservation of habitats, species and ecosystems where they naturally occur. This is in-situ conservation and the natural processes and interaction are conserved as well as the elements of biodiversity and Ex-situ: The conservation of elements of biodiversity out of the context of their natural habitats is referred to as ex-situ conservation. Zoos, botanical gardens and seed banks are all example of ex-situ conservation.
Keywords: Biological diversity, Agrobiodiversity, diversity

1. Introduction

Biological diversity or biodiversity is defined as the variety of life encompassing variation at all levels of complexity genetic, species, ecosystems, and biomes and including functional diversity and diversity across ecosystems (Palumbi *et al.,* 2009).

Agrobiodiversity can be understood as the diversity within and among species found in an agroecosystems that contribute to food and agriculture, including planned (domesticated) biodiversity (i.e., the diversity of crops and livestock genetic resources) as well as all other plant and animal genetic resources(Smale and Drucker, 2008).

The variety of plants and animals that constitute the food we eat are obvious parts of agricultural biodiversity. Less visible but equally important are; soil organisms, pollinators, and natural enemies of pests and diseases that provide essential regulating services that support agricultural production and performs a variety of ecological services beyond that of food, including recycling of nutrients and local hydrological processes (Jackson *et al.*, 2010).

In times of rapid change and uncertainty or unpredictable events such as pest outbreaks and drought, the adaptability of a system plays a major role. Thus it can be seen as a crucial asset to keep multiple options open, sustaining the ability to rapidly adapt and transform farming systems under unpredictable future conditions (Faith *et al*., 2010).

The major causes of biodiversity decline are land use changes, pollution, changes in the nitrogen cycle and acid rain, climate alterations, and the introduction of exotic species, all these are coincident to human population growth. In addition to these other anthropogenic causes of biodiversity loss include urbanization, industrial activities, primitive agricultural practices, land fragmentation, overgrazing, and over-exploitation of species. Others are road construction, in discriminate disposal of toxic wastes, mining and dereliction, poaching, as well as bush burning (Ibimilua and Ibimilua 2011).

A major way of achieving sustainable development is through biodiversity conservation. Biodiversity conservation can be taken to mean the protection, maintenance and/or restoration of living natural resources to ensure their survival over the long term. But it is variously defined depending on different values, objectives and world views (Dilys *et. al*., 2011).

2. Concepts of Biodiversity

According to the convention on Biological Diversity, biodiversity refers to the variability among living organisms (animals, plants, and microorganisms) including inter alia, terrestrial, marine, and other aquatic ecosystems with their ecological complexes. In another expression, biodiversity encompasses the variety and variability of all forms of life on earth that play a great role in human existence. It also includes the ethnical value of biodiversity such as tradition and traditional knowledge of the indigenous and local communities and the diversity within species (genetics), between species and of ecosystems (Antofie, 2011).

Biodiversity is a fundamental part of the Earth's life support system. It supports many basic natural services for humans, such as fresh water, fertile soil and clean air. Biodiversity helps pollinate our flowers and crops clean up our waste and put food on the table. Without it we would not be able to survive and agricultural biodiversity is the first link in the food chain, developed and safeguarded by indigenous people throughout the world, and it makes an essential contribution to feeding the world (Nakhauka, 2009).

Agricultural biodiversity includes all components of biological diversity relevant to the production of goods in agricultural systems: the variety and variability of plants, animals, and microorganisms at genetic, species, and ecosystem levels that are necessary to sustain key functions, structures, and processes in the agro ecosystem. Thus it includes crops, trees, and other associated plants, fish and livestock, and interacting species of pollinators, pests, parasites, predators, and competitors. Cultivated systems contain planned biodiversity, that is, the diversity of plants sown as crops and animals raised as livestock.

In agroecosystems, biodiversity is generally a measure of the relative numbers of types of organisms present. When considering the effects of biodiversity on a system, two concepts are especially important to consider stability and productivity. Most agroecosystems tend to be highly disturbed. Common practices like tillage, planting, application of fertilizers and pesticides, irrigation, and harvest can cause temporary or longer-lasting changes in average environmental conditions that change the functioning of the ecosystem and Stability in ecosystems is a measure of resilience, or ability of the system to recover from a disturbance, and the resistance of the system to change. Threats to biodiversity are global and are usually a direct result of human impact that contributes to reduction of genetic diversity through habitat loss and fragmentation as a result of increased human development (Altieri *et al*., 2005).

Biodiversity is playing a significant role in the social, economic, cultural, and political aspects of any nation. It is a major source of food, nutrients, income, construction, utensils, and transport. Also, it is a good source of employment, fertilizer and traction. It provides materials and facilities for medicine, ecotourism and tradable goods that form the basis for income earning opportunities. In fact, the survival and continual existence of man in the environment depends on the presence of the biological diversities and their habitats Paul and Paul (2011) opined that biodiversity is a key part of the ecological balance that helps the planet to function. They submitted further that biodiversity guarantees the supply of biological resources, protection of habitats and species, as well as the maintenance of the hydrological cycle.

The term biodiversity should also remind us that no one organism lives in isolation. The many different ways that the millions of organisms on the Earth interact with each other contribute to the balance of the global ecosystem and the survival of the planet. Biodiversity may be described in terms of genes, species, and ecosystems, corresponding to three fundamental and hierarchically related levels of biological organization.

2.1 Genetic diversity

Genetic diversity is the sum of genetic information contained in the genes of individuals of plants, animals and micro-organisms. Genetic diversity refers to the total number of genetic characteristics in the genetic makeup of a species. It is distinguished from genetic variability, which describes the tendency of genetic characteristics to vary. It encompasses the components of the genetic coding that structures organisms (nucleotides, genes, chromosomes) and variation in the genetic make-up between individuals within a population and between populations. This is the raw material on which evolutionary processes act.

Perhaps the most basic measure of genetic diversity is genome size or the amount of DNA in one copy of species chromosomes (also called the C-value). This can vary enormously. For example with published eukaryote genome sizes ranging between 0.0023 pg (pictograms) in the parasitic Sporidium Encephalitozoon intestinal is and 1400pg in the free living amoeba Chaos chaos(Gregory2008).

Genetic diversity serves as a way for populations to adapt to changing environments. With more variation, it is more likely that some individuals in a population will possess variations of alleles that are suited for the environment. Those individuals are more likely to survive to produce offspring bearing that allele. The population will continue for more generations because of the success of these individuals.

Genetic diversity plays an important role in the survival and adaptability of a species. When a population's habitat changes, the population may have to adapt for survive. The ability of the population to adapt to the changing environment will determine their ability to cope with an environmental challenge. Genetic diversity is essential for a species to evolve and the vulnerability of a population to certain types of diseases can also increase with reduction in genetic diversity (Frankham *et al.,* 2005).

Genetic differentiation within species occurs as a result of either sexual reproduction, in which genetic differences from individuals may be combined in their offspring to produce new combinations of genes, or from mutations which cause changes in the DNA. The significance of genetic diversity is often highlighted with reference to global agriculture and food security. This stresses the reliance of the majority of the world's human population on a small number of staple food species, which in turn rely on supply of genes from their wild relatives to supply new characteristics, for example to improve resistance to pests and diseases (Letourneau *et al*., 2009).

2.2. Species diversity

Species are regarded as populations within which gene flow occurs under natural conditions. Within a species, all normal individuals are capable of breeding with the other individuals of the opposite sex belonging to the same species, or at least they are capable of being genetically linked with them through chains of other breeding individuals. By definition, members of one species do not breed freely with members of other species. Although this definition works well for many animal and plant species, it is more difficult to delineate species in populations where hybridization, or self fertilization or parthenogenesis occurs .In other words species diversity refers to the variety of species within a geographical area, which become central in the evaluation of diversity, and used as a point of reference in biodiversity conservation (Antofie, 2011).

The composition of species in a given ecosystem is the result of long lasting evolution. Each species has adapted to its own niche, which is characterized by certain features (e.g. temperature range, availability of food or light) enabling the species to reproduce and thus maintain its population. Species diversity is the number of different species in a particular area (species richness) weighted by some measure of abundance such as number of individuals or biomass. However, it is common for conservation biologists to speak of species diversity even when they are actually referring to species richness.

Species richness is a basic surrogate for the more complex concept of ecological diversity. It is broadly used as a measure of biodiversity with various objectives such as monitoring biodiversity in order to prioritize management or conservation actions or design ecological indicators (Rossi and Halder, 2010). There are many other mathematical indices intended to measure species diversity many of which in corporate species abundance (Rossi, 2011).

Another measure of species diversity is the species evenness, which is the relative abundance with which each species is represented in an area. An ecosystem where all the species are represented by the same number of individuals has high species evenness. An ecosystem where some species are represented by many individuals, and other species are represented by very few individuals has low species evenness.

The loss of one species affects many other species and causes imbalance. As a result, several functions within and of the system are not carried out any more. Any species that will take over the lost specie's niche will most certainly not replace all of the functions it used to perform and when species get extinct, their services for the global biosphere are lost forever and it is impossible to replace it.

2.3. Ecosystem diversity

Ecosystem diversity relates to the variety of habitats, biotic communities and ecological processes in the biosphere as well as the diversity within ecosystems. Diversity can be described at a number of different levels and scales:

- Functional diversity is the relative abundance of functionally different kinds of organisms.
- Community diversity is the number, sizes and spatial distribution of communities, and is sometimes referred to as patchiness.
- Landscape diversity is the diversity of scales of patchiness.

No simple relationship exists between the diversity of an ecosystem and ecological processes such as productivity, hydrology, and soil generation. Neither does diversity correlate neatly with ecosystem stability, its resistance to disturbance and its speed of recovery. There is no simple relationship within any ecosystem between a change in its diversity and the resulting change in the system's processes.

For example, the loss of a species from a particular area or region (local extinction) may have little or no effect on net primary productivity if competitors take its place in the community. The converse may be true in other cases. For example, if herbivores such as zebra and wildebeest are removed from the African savanna, net primary productivity of the ecosystem may decreases.

Table1. Summary of Biodiversity Types and Physical expressions

Types of Biodiversity	Type of Physical expression
Gene	Genes, nucleotides, chromosomes,
Species	Kingdom, phyla, families, genera, Subspecies, species,
populations	Ecosystem Bioregions, landscapes, habitats, Ecosystem functional
Functional	robustness, ecosystem resilience, services, goods

Source: Turner et al., (1999).

2.4. Agricultural biodiversity

Agricultural biodiversity is a subset of general biodiversity. It includes all forms of life directly relevant to agriculture: rare seed varieties and animal breeds (farm biodiversity), but also many other organisms such as soil fauna, weeds, pests, predators, and all of the native plants and animals (wild biodiversity) existing on and flowing through the farm.

Agricultural biodiversity or Agrobiodiversity for short includes all components of biological diversity of relevance to food and agriculture and all components of biological diversity that contribute to sustaining the key functions of agroecosystems. It follows that agro biodiversity has two levels:

(1) Genetic resources for food and agriculture, this encompasses all cultivated and domesticated species, including their wild relatives and managed stocks of wild animals and plants.

(2) Components of agrobiodiversity that provide ecological services: This includes, for instance, beneficial organisms that control pests, soil organisms that process nutrients for crop plants, pollinators, and plants that contribute to controlling erosion or stabilizing the water balance.

Agricultural biodiversity is a key for food production and supply. In one view, Agrobiodiversity is a part of natural capital, and the flow of services is the interest on the capital (Kontoleon *et al*., 2009). Farmers and breeders use biodiversity to adapt crops to different and changing production environments.

Crop biodiversity is thus very important for both the functioning of ecological systems and the generation of a vast array of ecosystem services. These functions of biodiversity are crucial from an economic valuation perspective. Following Perrings (2010), there are two main implications.

First, the value of biodiversity derives from the value of the final goods and services it produces. In this setup, biodiversity is an input in to the production of these final goods and services. Second, this approach requires the specification of production functions that embed the ecosystem processes and ecological functions that connect biodiversity and ecosystem services. This article explores the recent contributions to the economics of agrobiodiversity.

Agroecological heterogeneity and harsh weather conditions may increase positive interactions among plants. Plants can exhibit a greater reliance on positive synergies and display facilitation (rather than competition).The implication is that conserving diversity in the field delivers important productive services and allows farmers to mitigate some of the negative effects of harsh weather and agroecological conditions (Falco and Chavas, 2009). Diversity enhances the possibility of species complementarities. Complementarities among crop species imply an efficient use of total available resources both in time and in space. Multiple crop species can also reduce the implication of price and production risk and allow farmers to market their products several times throughout the year (Baumgartner *et al*., 2008).

Agrobiodiversity at the genetic level also provides an insurance value in the face of changing environmental conditions. In food production systems, genetic diversity ensures adaptability and evolution by providing the raw material for desirable genetic traits in crops and livestock.

3. Ecological and Economic Significance of Biodiversity

3.1. Ecological use of biodiversity

Biodiversity supports a variety of natural ecosystem processes and services. Ecological services like photosynthesis, air and water purification, pollination and prevention of soil erosion are provided by biodiversity. Biodiversity plays very important role in human health; about 80% of the world population depends on medicines obtained from nature and Contribution to climate stability, maintenance of ecosystems and Recovery from unpredictable events (Faith *et al*., 2010).

Biodiversity provides many services that we take for granted. It plays a part in regulating the chemistry of our atmosphere and water supply. It is directly involved in recycling nutrients and providing fertile soils. Experiments with controlled environments have shown that we cannot easily build ecosystems to support ourselves.

Almost no information exists on the economic value of most components of biological diversity to human societies and particularly, their indirect value. For example, the diversity in species or functional groups in an ecological community is of value to our society to the extent that it matters to the provision of the services we benefit from, such as nutrient cycling, biomass production, and stability of biomass production. But proving that community diversity does actually matter is extremely difficult, and even more difficult is to identify general ecological rules that can fit the broad purposes of economic valuation.

Cultivated systems contain planned biodiversity, that is, the diversity of plants sown as crops and animals raised as livestock. Together with crop wild relatives, this diversity comprises the gene tic resources of food agriculture. However, agricultural biodiversity is a broader term that also encompasses the associated biodiversity that supports agricultural production through nutrient cycling, pest control, and pollination and through multiple products.

Biological pest control is a complex ecosystem service that is generally positively associated with biodiversity of natural enemy guilds. Biological control is a key ecosystem service that is necessary for sustainable crop production (Bianchi *et al*., 2006). Natural enemies such as predators, parasitoids, and pathogens play a central role in limiting damage from native and exotic pests.

3.1. 1. Biodiversity and Ecological Resilience

Ecological resilience is the capacity of an ecosystem to cope with disturbance or stress and return to a stable state. The concept of ecological resilience is consistent with the notion that ecosystems are complex, dynamic and adaptive systems that are rarely at equilibrium. Most systems can potentially exist in various states. Moreover, they continually change in unpredictable ways in response to a changing environment. This concept measures the amount of stress or disruption required to transform a system that is maintained by one set of structures and processes to a different set of structures and functions (Haeussler *et al*., 2006).

A resilient ecosystem can better withstand shocks and rebuild itself without collapsing into a different state. Ecosystem change can occur suddenly if the resilience that normally buffers change has been reduced. Such changes become more likely when slow variables erode. Slow variables include the diversity of species and their abundance in the ecosystem, and regional variability in the environment due to factors such as climate. All of these variables are affected by human influence (Snetsinger, 2006).

Both functional diversity and response diversity are important to maintain ecological resilience. Functional diversity is the number of functionally different groups of species and consists of two aspects: one that affects the influence of a function within a scale and the other that aggregates that influence across scales. Response diversity is the diversity of responses to environmental change among species contributing to the same ecological function and provides adaptive capacity given complex systems, uncertainty and human influence.

In a rangeland, for example, functional diversity increases the productivity of a plant community as a whole, bringing together species that take water from different depths, grow at different speeds, and store different amounts of carbon and nutrients. Response diversity enables a community to keep performing in the same way in the face of stresses and disturbances such as grazing and drought.

3.2. Economic use of biodiversity

3.2. 1. Direct and Indirect Economic Value of Biodiversity

Biodiversity plays an important role in the global economy and sustainable development due to two main reasons. “The first is that, it provides a wide range of direct or indirect benefits to mankind which occurs on both local and global scales. The second relates to how human activities have contributed to unprecedented rates of biodiversity loss, which threaten the stability and continuity of ecosystems as well as their provision of goods and services to mankind (Nunes and Nijkamp, 2011).

Complex biodiversity indicates a healthy environment and a process of life-support required for the welfare of people through the various goods and services. Biodiversity, which is also an important part of economical development, is classified as scarce resources in the scope of economic goods, with a significant strategic power for both local and global economies (Tisdell and Wilson, 2006). The common and sustainable utilization of this power may be possible with the transformation to an economical value providing all the components of biodiversity (species, genetic, and ecosystem diversity). Therefore, attentions have shifted to the marketable goods and services directly provided from both local and global biodiversity.

Most studies on biodiversity valuation have assessed the direct value of biological resources (i.e., the value that is more readily captured by commercial markets), focusing in particular on plant or crop and animal genetic resources or the direct use of plant species for medicinal or ornamental use. The nonmarket values of genetic resources have been assessed in a very few cases, including livestock genetic resources and most recently components of agricultural biodiversity in home gardens (Birol *et al*., 2004).

Direct use values include such things as ecotourism, exploitation of genetic material for pharmaceuticals and crop breeding. And other direct consumption values like; Nutritional value, raw material, genetic resources, decorative, aesthetic and cultural can be described. The indirect value of biodiversity on biological resources in terms of inputs to the production of market goods pharmaceutical and agriculture industries that use plant and animal material to develop new medicines and new products. Climate regulation, Disruption value, Water regulation and Water reserve, Soil conservation, Soil composition, Nutritional cycle and shelter functions are indirect economic functions of biodiversity.

3.2.2. Recreational and Cultural Roles of Agricultural Biodiversity

A variety of different agricultural land uses can promote scenic beauty, with positive effects on the economy of local communities. For example, it is known that aesthetic properties are associated with heterogeneity in the landscape. Benefit from a rural tourism economy that is based on the diversity of agricultural patches ranging from vineyards, wheat fields, pasture lands, and orchards to olive tree cultivations.

Cultural and recreational services refer to the aesthetic, spiritual, psychological, and other benefits that humans obtain from contact with ecosystems. Such contact need not be direct, as illustrated by the popularity of the virtual experience of distant ecosystems through books, art, cinema, and television. These values are appropriately being placed under provisional services, being of similar importance as food, water, etc. for human wellbeing. For convenience, these services are here considered as falling into two main groups: spiritual, religious, aesthetic and inspirational and sense of place and recreation, ecotourism, cultural heritage and educational services (Butler and Oluoch, 2006).

Agricultural biodiversity is a crucial source of nonmaterial well being that derives from nutrition traditions, dietary diversity, and longstanding knowledge. Plant and animal diversity in small scale farming often can serve the purpose of personal enjoyment or the fulfillment of family or clan tradition or may meet spiritual needs. Biodiversity plays an important role in fostering a sense of place in most societies and has considerable intrinsic cultural value.

Table.2. Summary of Total economic value of biodiversity

Economic value interpretation	Economic Biodiversity Benefits
Gene and specious diversity	Inputs to production processes e.g. pharmaceuticals and agro industries
Natural area and landscape diversity	Provision of natural habitat e.g. protection of wilderness and recreational area
Ecosystem functions and ecological services flow	Ecological value e.g. flood control, nutrient recycling, toxic retention and biodiversity maintenance
Non use values of biodiversity	Existence or moral value e.g. guarantee that a particular specious is kept free from extinction

Source: (Nunes and Nijkamp 2011**).**

From the summary of total economic value of biodiversity as provided in (table 2) each benefits of biodiversity play an important role and these can be described as economic terms in different ways. For example in reducing healthcare costs through the prevention of the spread of disease, natural degradation of chemicals released into the environment, a significant cost savings over physical, chemical and thermal bioremediation and reduction of worldwide poverty in general are main economic importance's of biodiversity.

In addition to domesticated crops and livestock, managed wild biodiversity provides a diverse range of useful plant and animal species, including leafy vegetables, fruits and nuts, fungi, wild game insects and other arthropods, and fish. These sources of food remain particularly important for the poor and landless and are especially important during times of famine and insecurity or conflict where normal food supplies are disrupted. Increase productivity, food security, and economic return

4. Challenges to biodiversity

The principal pressures on biodiversity include habitat loss and degradation, overexploitation, aliening invasive species, climate change or changes in atmospheric carbon dioxide concentrations, pollution, land use changes, changes in the nitrogen cycle and acid rain. All these are coincident to human population growth (Baillie *et al.* 2010).

The main cause of the loss of biodiversity can be attributes to the influence of human beings on the world's ecosystem, In fact human beings have deeply altered the environment and have modified the territory, exploiting the species directly, for example by fishing and hunting, changing the biogeochemical cycles and transferring species from one area to another of the Planet. The threats to biodiversity can be summarized in the following main points:

1. **Human population growth**
   The geometric rise in human population levels is the fundamental cause of the loss of biodiversity. Humans also tend to settle in areas of high biodiversity, which often have relatively rich soils and other attractions for human activities. This leads to great threats to biodiversity, especially since many of these areas have numerous endemic species have demonstrated that human population size in a given tropical area correlates with the number of endangered species (Balmford *et al.*, 2001) that this pattern holds for every taxonomic group. Most of the other effects mentioned below are either consequent to the human population expansion or related to it.
2. **Habitat destruction**
   Habitat destruction is the single most important cause of the loss of rainforest biodiversity and is directly related to human population growth. As rainforest land is converted to agricultural land (and then, frequently, to degraded woodlands, scrubland, or desert), urban areas and other human usages, habitat is lost for forest organisms. Many species are widely distributed and thus, initially, habitat destruction may only reduce local population numbers. Species which are local, endemic, or which have specialized habitats are much more vulnerable to extinction, since once their particular habitat is degraded or converted for human activity, they will disappear.
3. **Pollution**
   Industrial, agricultural and waste-based pollutants can have catastrophic effects on many species. Those species which are more tolerant of pollution will survive; those requiring pristine environments (water,

air, food) will not. Thus, pollution can act as a selective agent. Pollution of water in lakes and rivers has degraded waters so that many freshwater ecosystems are dying. Since almost 12% of animal's species live in these ecosystems, and most others depend on them to some degree. In developing countries approximately 90% of wastewater is discharged, untreated, directly into waterways (Bennun *et al*., 2010).

4. **Agriculture**
The dramatic increase in the number of humans during the twentieth century has instigated a concomitant growth in agriculture, and has led to conversion of wild lands to croplands, massive diversions of water from lakes, rivers and underground aquifers, and, at the same time, has polluted water and land resources with pesticides, fertilizers, and animal wastes. The result has been the destruction, disturbance or disabling of terrestrial ecosystems, and polluted, oxygen-depleted and atrophied water resources.
5. **Global warming**:
Climate change poses major threats to biodiversity (Keith *et al*., 2008).Although a certain variation of climate is compatible with the ecosystem survival and its function, the very rapid shift is detrimental to the variety of life. Climate change is expected to exacerbate biodiversity loss in the future and many species might simply be unable to adapt to the rapidly changing, probably unsuitable conditions and thus will be threatened by extinction (Soto *et al.,* 2012*).*
Climate change is an increasingly important threat to species and natural habitats. There is wide spread evidence that cause changes in the timing of reproduction and migration, physiology, behavior, morphology, population density and distributions of many different types of species are driven by climate change (Rosenzweig *et al.* 2007).
6. **Forest fragmentation**:
The fragmentation of forests is a general consequence of the haphazard logging and agricultural land conversion which is occurring everywhere, but especially in tropical forests. When forests are cut into smaller and smaller pieces, there are many consequences, some of which may be unanticipated.
i. Fragmentation decreases habitat simply through loss of land area, reducing the probability of maintaining effective reproductive units of plant and animal populations. Most tropical trees are pollinated by animals, and therefore the maintenance of adequate pollinator population levels is essential for forest health. When a forest becomes fragmented, trees of many species are isolated because their pollinators cannot cross the non forested areas. Under these conditions, the trees in the fragments will then become inbred and lose genetic variability and vigor.
ii. The "edge" effect: The cutting of forest into fragments creates many "edges" where previously there was deep forest. Many effects are consequent upon this. Edges are lighter, warmer and windier than the forest interior. These changes in microclimate alter plant reproduction, animal distribution, the biological structure and many other features of the forest.
iii. Fire is particularly frequent in fragments. Recently, many forests have been subjected to deliberately set and accidental fires, to which they have little resistance, and to which they are rarely naturally subjected. People often set fire to cut over areas adjacent to forests to clear them of debris. These fires often get out of control and burn large areas, extend into the forest interior, and inhibit edge regeneration by killing pioneer forest vegetation.
iv. The use of herbicides and the introduction of exotic species into areas surrounding forest fragments are detrimental to forest health. Herbicides blow from cleared agricultural areas into forests, and exotic species introduced by farmers often displacing native species.
7. **Overexploitation of resources**:
When the activities connected with capturing and harvesting (hunting, fishing, farming) a renewable natural resource in a particular area is excessively intense, the resource itself may become exhausted, that man captures without leaving enough time for the organisms to reproduce. Overexploitation of wild species to meet consumer demand threatens biodiversity, with unregulated overconsumption contributing to declines in terrestrial, marine and fresh water ecosystems (Peres *et al.,* 2010). Although overexploitation is often difficult to quantify in terrestrial systems, major exploited groups include plants for timber, food and medicine; mammals for wild meat and recreational hunting; birds for food and the pet trade and amphibians for traditional medicine and food.

5. Biodiversity Conservation

5.1. Conservation Concept

Biodiversity conservation refers to the management of human use of biodiversity in order to get the greatest sustainable benefit to present and future generations. Thus, conservation of biodiversity embraces the protection, maintenance, sustainable utilization, restoration, and enhancement of biodiversity and it mainly focuses on genetic conservation with its diverse life-support systems (ecosystems) for the connotation of human well being(Tisdell, 2011).

Sustainable development can be achieved through biodiversity conservation. Biodiversity conservation can be taken to mean the protection, maintenance and/or restoration of living natural resources to ensure their survival over the long term. But it is variously defined depending on different values, objectives and world views (Dilys *et. al*., 2011).

Conserving biodiversity has economic, social, and cultural values. Conservation of biodiversity is integral to the biological and cultural inheritance of many people and the critical components of healthy ecosystems that are used to support economic and social developments. Moreover, it is used to maintain the earth's genetic library from which society has derived the basis of its agriculture and medicine.

Conserving biodiversity means ensuring that natural landscapes, with their array of ecosystems, are maintained, and that species, populations, genes, and the complex interactions between them, persist into the future. Conservation cannot be conducted in isolation from humans and for conservation to be successful and sustainable there needs to be local community involvement.

Biodiversity conservation incorporates the preservation, maintenance, sustainable use (conservation), recovery and enhancement of the components of biological diversity, where:

•Conservation- is the sustainable use of resources and encompasses protection as well as exploitation and;

•Preservation- is an aspect of conservation meaning to keep something without altering or changing it.

5.2. Biodiversity conservation and Sustainable development

Sustainable development refers to development that meets the needs of the current generation without compromising the ability of future generations to meet their needs; it simply refers to intra and intergenerational equity. A balance between the environment, development and society results to sustainable development which ensures biodiversity conservation. This is only possible in the presence of good enforced and implemented policies/ conventions, environmental institutions and political stability among others.

5.3. Types of conservation

5.3.1 In-situ conservation- Conservation of habitats species and ecosystems where they naturally occur. This is in-situ conservation and the natural processes and interaction are conserved as well as the elements of biodiversity. In-situ (on-site) conservation includes the protection of plants and animals within their natural habitats or in protected areas. Protected areas are land or sea dedicated to protect and maintain biodiversity e.g. National parks and sanctuaries. In-situ conservation is not always possible as habitats may have been degraded and there may be competition for land which means species need to be removed from the area to save them.

5.3.2 Ex-situ conservation: The conservation of elements of biodiversity out of the context of their natural habitats is referred to as ex-situ conservation. Zoos, botanical gardens and seed banks are all example of ex-situ conservation. It is mainly used for threatened and endangered species to avoid their extinction; also known as captive conservation.

5.3.2.1Types of Ex-situ Conservation

i. Botanical gardens and zoos

To complement in-situ conservation efforts, ex-situ conservation is being undertaken through setting up botanic gardens, zoos, medicinal plant parks, etc by various agencies.

ii. Gene Banks: Ex-situ collection and preservation of genetic resources is done through.

iii. Cryopreservation: (freeze preservation) is particularly useful for conserving vegetative propagated crops. Cryopreservation is the storage of material at ultra low temperature of liquid nitrogen (-196 degree celcious) and essentially involves suspension of all metabolic processes and activities. It applies to meristems, zygotes and somatic embryos, pollen and protoplasts cells.

(IV). Conservation at molecular level (DNA) level:

Conservation at molecular level is now feasible and attracting attention. Cloned DNA and material having DNA in its native state can all be used for genetic conservation. Furthermore, non-viable material representing valuable genotypes stored in gene banks can all be used as sources of DNA libraries from where a relevant gene or a combination of genes can be recovered.

5.4. Other strategies which are adapted for conservation of biodiversity:

1. Legislation Formal policies and programmers for conservation and sustainable utilization of biodiversity resources.

2. Recording Indigenous Knowledge-The lives of local communities are closely interwoven with their environment, and are dependent upon their immediate resources for meeting their needs. Communities have a vast knowledge about local flora and fauna which is very important for biodiversity conservation.

3. Community Participation in Biodiversity Conservation- It is being recognized that no legal provisions can be effective unless local communities are involved in planning, management and monitoring conservation programmers'. There are several initiatives to do this, both by government as well as non-governmental organizations. For example, the Joint Forest Management philosophy stresses involvement of village communities in regenerating and protecting degraded forest land in the vicinity of villages. Successful conservation strategies will have to have the confidence and participation of the local communities.

4. International Conservation Strategies- Conserving biodiversity is not an issue confined to any one country or community. It is a crucial global concern. Several international treaties and agreements are in place in the attempt to strengthen international participation and commitment towards conserving biodiversity.

Recommendation

- Now a day biodiversity face to decline due to unwise use of the resource. Therefore, any deligated body participates to conserve and save the life.
- NGO, other institution and private sectors facilitate to biodiversity conservation issue is very important.
- More research should be work on importance and significance of biodiversity not only doing the research and put on the shelf, but implementation is very important.
- Further nursery, plantation and boundary of the biological hot spot biodiversity is recommendable.

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