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Multiple uses of forest resources in small and medium farms in the tropics: Economic and social contributions

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In complex systems, small anthropogenic changes of the initial conditions could lead to profound changes in the entire system. In this sense, the present literature review has surveyed several studies related to the multiple uses of forest resources and sustainability in small and medium-sized farms in the tropics. In 1985, Food and Agriculture Organization of the United Nations (FAO) published a work addressing multiple uses of forests in the tropics. Since then, despite the technological advances, multiple practices in forest management have not expanded as expected. The Forest Principles from 1992 emphasizes that forests should be managed to meet social, economic, ecological, cultural and spiritual needs of present and future generations. In many tropical countries, multiple use management of forest products and services has traditionally been neglected or it is not well known by policy makers and farmers. Laws are usually written with narrow objectives and tend to decrease social inclusion because of the limited cross-sector dialogue. In spite of these issues, several success stories are reported around the world.

Key words: Forestry enterprises, natural resources management, sustainable use of forest resources, land use, multiple use.

INTRODUCTION

Society and the global economy are dependent and closely linked to forests. Data from the Food and Agriculture Organization of United Nations (FAO, 2015) show that more than 1 billion people depend on forests for their livelihood and forest ecosystems play a critical and essential role in climate stabilization and consequent improvement of quality of life, protection of water sources, food supply, timber and medicinal products,

while maintaining much of the world's biodiversity. However, deforestation has led to damages on water sources and silting of rivers around the world.

Climate change and increased variations in temperature might have widespread economic, social and environmental repercussions. Addressing these challenges requires changes and adjustments in forest management strategies, either in native or planted

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forests, aiming to adapt to climate change and, thereby, mitigate its effects (FAO, 2010).

Since the forest sector needs to keep up with development, it is necessary to adapt. This involves changes in management practices, aiming to reduce forest vulnerability to interventions, which will reduce impact on livelihoods communities that depend on forest resources. Although, deforestation rates are declining in some regions, several forest ecosystems are still under threat worldwide. In Brazil, they are concentrated in Amazon, especially in the States that make up the Brazilian Legal Amazon (Amazônia Legal), that is, Mato Grosso, Amazonas, Rondônia and Pará.

Toledo (2003) concluded that, in general terms, rural development in the humid tropics has been a catastrophic process accompanied by deforestation all over the world, with serious implications for wetlands, reducing biodiversity and displacing productive strategies for management of tropical forests. The natural consequence of this situation is the bioecological, economic and social impoverishment of land, biota and people.

Modernization had an undesirable effect from the environmental perspective (Tudela, 1989), which led to high rates of deforestation and a significant reduction in mature tropical forests to almost 10% on the original geographic distribution (Maser et al., 1997).

Also, according to FAO et al. (2012), in face of the alarming fact that there are no substitutes for environmental services provided by natural forests, efforts are being made to create and restore forest areas, in order to convert net losses of forest cover into net gains.

Ehrlich (1988) reported that the increase in human population and its activities have resulted in destruction, degradation and fragmentation of habitats, to the point that this process is now the leading cause of decline on biodiversity. Therefore, this review aimed to assess the progress in sustainable forest management by knowing the current state and trends of socio-economic benefits from the forests.

MATERIALS AND METHODS

This manuscript is based on a literature review related to multiple uses of forests in small and medium farms in the tropics around the world. The selected manuscripts show the current practical aspects as well as the economic and social contributions of forest utilization.

RESULTS AND DISCUSSION

Multiple-use forestry around the world

Among the numerous trials of implementing multiple uses forests, in Table 1, are listed the major cases which are

discussed in this text. It can be noticed that in all experiences reported in the case studies and published papers, adoption and/or implementation of multiple use of forests brings economic, social and environmental impact, improving quality of life, adding income and, especially, contributing to the maintenance of the forest ecosystem. These aspects meet what is defined as sustainability, with emphasis on economic, environmental and social balance.

Multiple-use forest in the tropics

After the UNO Conferences on Environment and Sustainable Development, with highlight on Eco-92, there were major changes related to environmental awareness, making the world to look more closely at the potential risks of impacts caused by man on ecosystems. Since then, there has been research on more sustainable solutions, considering not only environmental but also social and economic aspects of human activities.

Costa and Scariot (2003) claimed that the removal of forests for various purposes, such as agricultural expansion, roads and hydropower dams, among others, lead to fragmentation of important habitats in small or medium areas that support only a small number of species. The authors point out that this process has its roots in the perception of early European settlers that resources from natural forests were there to be exploited without a long-term perspective.

This fragmentation highlighted by Costa and Scariot (2003) is consistent with Viana (1995), who showed that the fragmentation process is present through land use by farmers in Central Brazil. The value of multiple nature of forests has been appreciated and used by people who depend on forests in the tropics. The goal of multiple use forest management is included in laws of many countries, as well as the guiding principles of sustainable forest management, became an integral part of laws following the Earth Summit in Rio in 1992 (Sabogal et al., 2013). There are several countries where forest production is limited only to wood, prevailing specialization in forest use, which does not help to achieve the goals of maximum land yields for the benefit of the community as a whole.

For purposes of sustainability, the ideal is the adoption of multiple use of forests, understood by Mcardle (2011) as a term that prevails when there is no abundance of natural resources, that is, in times of shortage and many people in need of these resources. This aspect pointed out in the past represents the current scenario.

CNI and BRACELPA (2012) also highlight the importance of the adoption of forest certification, which began to develop internationally in the 1980s as a result of initiatives aimed at environmental conservation, reducing deforestation and sustaining development of

Table 1. Experiences on multiple uses of forestry around the tropics.

Article titles	Author(s): and synopsis of the article	Site of the study and year of publication
The Contribution of Multiple Use Forest Management to Small Farmers' Annual Incomes in the Eastern Amazon	Sist et al. (2014) The article reports the implementation experience of multiple use of forests by family farming communities.	Amazon Brazilian (2014)
Issues of Conservation and Livelihood in a Forest Village of Assam (India)	Sharma and Indrani (2014) This article discusses the application of Multiple Use of Forests in a location India.	Forest village in Assam region – India (2014)
The Multiple Use of Tropical Forests by Indigenous Peoples in Mexico: the Case of Adaptive Management	Toledo et al. (2003). This article presents the experience of adopting Multiple Use of Forest by indigenous People in Mexico.	Mexico (2003)
Multiple Use Forest Management in the humid tropics: Opportunities and challenges for sustainable forest management.	Sabogal et al. (2013). This article brings the FAO researcher's experience in the implementation of Multiple Use of Forests in humid tropical forests.	Amazon Basin, Congo Basin and Southeast Asia (2013)
Multiple-use forestry vs forestland-use specialization revisited	Zhang (2003) This article provides a counter argument to the adoption of Multiple Use of Forests, including a case study to support the argument.	United States (2003)
Multiple Use forest management: an alternative to the extinction of the Araucaria Forest?	Rosot (2007) This article reports a case study of applying of Multiple Use Forest Management as an alternative to prevent extinction of Araucaria, in Parana, Brazil.	Southern Brazil (2007)
Biodiversity and Social Carbon	Rezende and Melin, (2005) This book report a case Surrounding communities of Bananal Island, in the state of Tocantins, in 1999, from which arises the concept of Social Carbon, according to the social benefits generated for the local community.	Bananal Island, Tocantins, Brazil (1999)

forests in the world, through rational use of forest resources to ensure their existence in the long run. Gradually, forest certification grew in importance for marketing timber and products from forests in the global market, as a way to ensure access and permanence in tighter markets and to introduce new products, maintaining jobs and paying back investments.

In this context, certification constitutes an important instrument because it enables consumers to be sure that best practices (legal, social, labor) with less environmental impact area adopted.

Multiple-use forest: An alternative for sustainability

In 1954, Mcardle defended the multiple use (Mcardle, 2011) as an alternative to sustainability, when, in the

opening speech of the V World Forestry Congress, stated that competition for land use is growing worldwide. This dispute will increase as the world population increases. It is important to remember that the author's approach occurs in a context, at a time, when the world population was about 3 billion people. The need for multiple uses becomes more pressing in the current scenario in which the world's population is more than doubled.

Taking Mcardle's concern as a premise, currently, the world's population is approximately 7.6 billion people and the forecast of global organizations (UNO, FAO etc.), is that, in 2050, the world population will reach 9.6 billion. Therefore, concern with depletion of forest resources is now much more latent than it was in 1954 and it will be even greater in 2050.

According to FAO (1984), in the past, very low population densities and limited demand for products

allowed obtaining multiple benefits from humid tropical forests, without conscious effort. Currently, population growth and consumption is required for multiple use forest management, which is essential for management of forest resources, especially in tropical forests, which are carbon sinks and important source of products and environmental services essential to life. According to research from World Resources Institute (WRI, 2015), 30% of global forest cover have been removed, while 20% have been degraded. In addition, a high proportion has been fragmented, with about 15% intact.

Despite reports stating that since 1890, there have been multiple indications of forest use practices of multiple uses in parts of British India and Malaya (Rawat et al., 2011), the development of the practice started in North America and Europe (Sabogal et al., 2013). Nix (2015) referred to the practice as: land or forest management for more than one purpose, such as timber production, water quality, wildlife, recreation, landscape or clean air. It is a concept of forest management that combines two or more goals, such as production of timber or wooden products, fodder and livestock, adequate environmental conditions for wildlife, effects of landscape, protection against flooding and erosion, recreation and protection of water sources.

Sabogal et al. (2013) appraises the multiple use of forest as the deliberate administration of a particular forest area for a certain period, aiming at various goods and services. This definition implies diversification of uses in spatial and temporal terms and covers both, diversification and integration as well as support capacity.

Several authors in different decades produced their particular concepts of multiple use of forests (Ridd, 1965; Panayotou and Ashton, 1992; Vincent and Binkley, 1993; Boscolo, 2000; Campos et al., 2001; Zhang, 2003). Common and final point of the authors is that the practice promotes the sustainability of life on the planet, with the rational use of the forest, combined with market demand for ecosystem services, such as ecotourism, water and soil protection, biodiversity conservation and carbon sequestration.

In this context, it is possible to infer that multiple uses can be understood as the deliberate and carefully planned integration of various uses, so that they interact with each other, saved the appropriate limitations of each system established.

In 2011, came the Bonn Challenge to restore 150 million hectares of deforested and degraded lands by 2020. This ambitious goal was strengthened during the UNO Climate Summit in 2014 in New York, when more than 130 governments, business, civil society and indigenous peoples supported the restoration of more than 350 million hectares of forests and farmland by 2030.

Under the light of this overall goal and the emerging

ambitious of national commitments, it is essential to develop methods and low cost techniques for landscape restoration. The most used methods, such as planting the total area with native species seedlings are often expensive and not feasible on the scale needed to meet the targets set. Thus, other strategies are required. Several case studies show that natural regeneration significantly reduces the cost of restoration also for degraded areas.

Native species recolonize on their own or with some assistance, producing rapid biomass increments due to adaptability to local conditions. Strategies based on natural regeneration also offer low-cost opportunities for biodiversity conservation and interaction of species, carbon fixation and watershed protection. Despite these economic and environmental benefits, natural regeneration is often neglected when policies and restoration programs are designed.

On the other hand, global warming, caused by the increase of greenhouse gases emissions due to human activities, is one of the main environmental problems today. Scientific studies commissioned by the United Nations (UNO) warn that changes in climate can cause serious environmental, economic and social impacts.

According to scientists, there are two ways to fight global warming: reduce pollution and remove carbon dioxide (CO₂) released in the atmosphere. Some authors argue that planted forests are great allies of the planet towards the second alternative.

Reforestation for industrial purposes, being deployed around the world, specifically in regions with vast degraded areas and available land, is one of the examples showing that multiple use of forests is most promising alternative for preservation and sustainability.

In this scenario, according to CNI and BRACELPA (2012), the use of planted forests for industrial purposes is relevant to environmental conservation, as the trees provide raw material in a renewable basis, while they protect biodiversity, conserve soil and water and help to reduce climate change.

CNI and BRACELPA (2012) also highlight that planted forests contribute to recovering degraded areas; increase efficiency on agriculture; optimize the use of areas disturbed through human occupation; absorb and store large amounts of carbon; support farmers without jeopardizing food production; promote biodiversity conservation; prevent erosion and silting of rivers, as well as appropriate extensive degraded areas unattractive for other crops. Some examples of multiple uses of forests in the tropics are shown in Tables 2. Environmental or ecosystem services are those that man gets from ecosystems and can be divided into 4 (four) classes, as shown in Table 3.

Among the evaluated ecosystem services, 60% have been used in a non-sustainable way (such as pure water,

Table 2. Non-timber forest products (NTFPs) and by-products related to multiple uses of forests in the tropics.

NTFP	Products	Byproducts
Barks	Ornamental Medicinal Food Religious Handcraft and natural fertilizers.	Tannins Medicinal active ingredients Cosmetics Dyes Vegetable Fibers
Leaves	Decoration Handcraft Fodder for Medicinal Food Animals Religious and Construction	Vegetable fibers Medicinal Cosmetics Waxes Natural Fertilizers Dyes
Fruits	Handcraft Food Medicinal Fodder Seed lings production Decoration (landscaping)	Vegetable oils Water Purification Food Manufacturing
Seeds	Handcraft Religious Food Decoration Fodder	Oils (biofuels, pharmaceuticals etc.) Gums Natural biocides Seedlings food
Roots	Food religious Medicinal	Natural biocides food Colorants
Flowers	Decoration Food crafts religious	Dyes honey production Flavouring cosmetics
Branches	Handcrafts Household items Religious	Firewood Resins Dyes Lates
Trunks (stems)	Resins dyes Latex and essential oils	Food Handcrafts (from lianas)
Latex	Medicinal Waterproofing and varnishes	Rubbers
Resins	Medicinal varnishes	Wood glues repellents Flavoring products
Tannins	Natural biocides Watter treatments Protectors and tanning	Plant resins
Oils	Food (for frying food) medicinal and Repellents	Medical Cosmetics
Dyes	Food Paintings for Ritualistic purposes Fabrics dyeing	Food

Source:Valverde et al. (2015).

Table 3. Classification of ecosystem environmental services.

Types of ecosystems services	Ecosystems services
Provision of services	Food, Water Timber
Regulatory services	Climatic, Hidrological Flows and Disease Control
Cultural services	Recreation, Scenic beauty and Spiritual
Support services	Soil Formation Nutrient Cycling

Source: adapted from Valverde et al. (2015).

catch fishery and climate regulation), and many have deteriorated as a result of actions to enhance the delivery of others, such as food (Millennium Ecosystem Assessment, 2005). In their turn, degradation costs are passed on from a group of people to another or to future generations, falling disproportionately on poorer populations, increasing socioeconomic inequalities.

Multiple-use forest in small and medium properties

Mcardle (2011) stated that multiple uses would always have less applicability to smaller private farms. However, the author explained that many small and medium owners, in time and according to their own interests, find some way to practice, to some degree, the multiple uses. This assumption has proved to be consistent with the reality over time and, especially in the tropics.

Experiences of multiple uses of forests have been implemented around the world, successfully recovering landscapes aiming at sustainability, as has already occurred in Africa. Pretty (2014), presents results from the *Foresight Program* from the United Kingdom Government. The author examined 40 projects in 20 countries in Africa, from a program through which more than 3 million hectares of land were rehabilitated and are now productive. Besides providing jobs for thousands of Africans with the implementation of sustainable agriculture, this has enabled increase in yields through combination of new varieties with new management practices for agroecological farming as well as plant breeding, among others. This experience had as main result a larger diversity of trees and crops, which has helped to reduce leaching soil runoff and, thus, increase groundwater reserves.

A study conducted by Sist (2014), in the Brazilian Amazon, showed that until recently, large farms accounted for 75% of deforestation, while 25% were caused by smallholders. On the other hand, recent satellite imagery analysis showed that deforestation in smaller plots has increased significantly in recent years.

Toledo (2003) reported the experience of multiple use implementation of forests by indigenous community in Mexico, which can be considered a case of adaptive

management and can be considered as one of the most successful cases of rainforest utilization in terms of biodiversity conservation, resilience and sustainability.

According to reports from Alcorn (1990), managed or "artificial" forests are masses of vegetation where the useful non-native species are introduced and manipulated. As in the rest of the Neotropical region, managed forests in Mexico, from primary or mature forests that have been enriched with some non-native species to turn into plantations where a single species of tree or shrub (such as, coffee or cocoa) is planted in association with some native species. Thus, it is possible to have a range of managed forests, from those almost entirely dominated by native tree species to those dominated by non-native trees.

Finally, in smallholdings, the multiple uses of forests is complemented with vegetables gardens and where water bodies are present, it is also possible to integrate their use. As in other areas of the humid tropics of Latin America, there are agroforestry systems, which are usually located next to the house, being managed by women (Alcorn, 1990). Aside from the Lacandones (inhabiting the southern border of the Mexican territory), gardens are found in all the reviewed studies on indigenous management of natural resources. In short, the sustainable multiple uses consolidates itself in the creation of a diversified production system, where crop farming, livestock, forestry and others are implemented in an equitable manner, keeping a set of production units. Even the *Tzeltal indigenous* communities, who settled the lowlands of the Lacandona forest in Chiapas, Mexico, have a subsistence strategy that is based on multiple uses of natural resources (Toledo and Carrillo, 1992).

This landscape diversity has a dynamic based on cycles of forest-crop farming-forestry, which is the result of permanent tension between regenerative natural forces from forest against human forces that transform forest ecosystems. The indigenous multiple use strategies, as the experience from Toledo (2003), also in Mexico, involves six main production units: corn, crop fields, vegetable gardens or solariums, livestock areas, vanilla orchards and secondary and mature forests. As a result, indigenous farmers in Mexico are a case of success in production, both for consumption and for marketing, thus

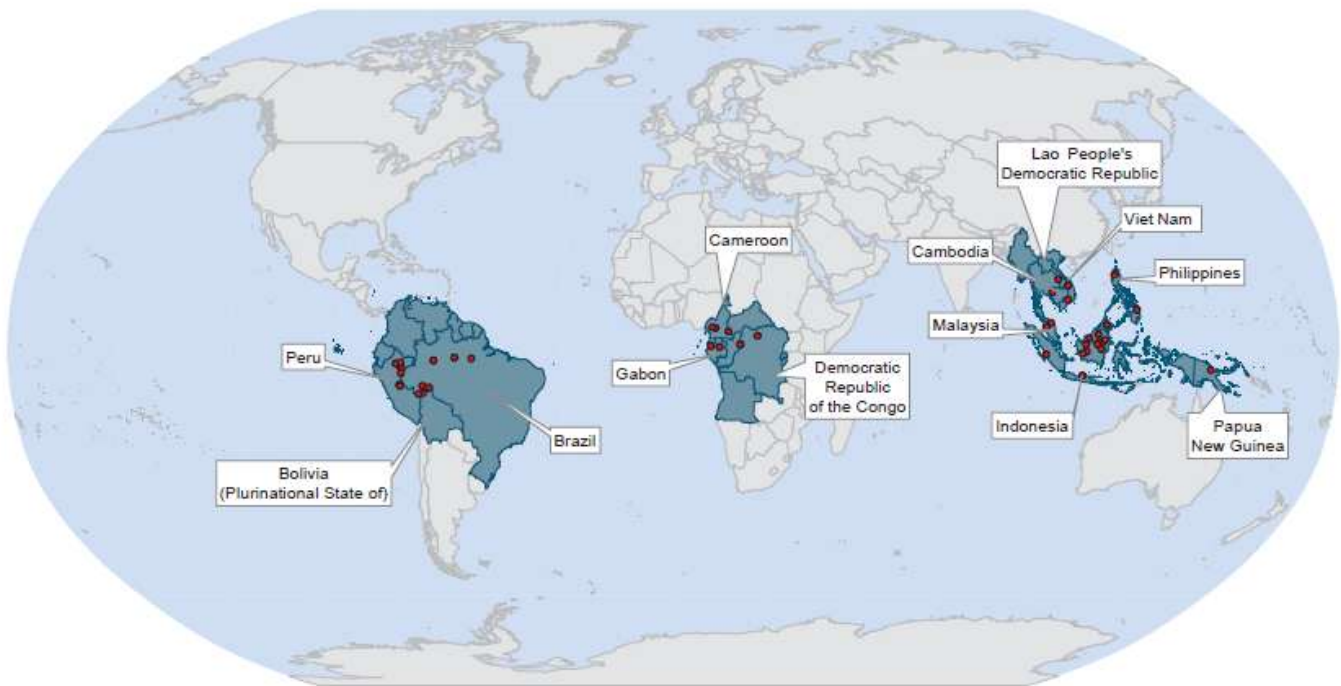


Figure 1. Location of identified multiple-use forest management initiatives in the three tropical rainforest regions. Source: Sabogal et al. (2013).

achieving an economy where self-sufficiency is complemented by excess.

Thus, Toledo (2003) concludes, like Holling et al. (1998) and Toledo (2001), that contemporary scientists, academic institutions and rural development agencies involved in the search for sustainable management systems of natural resources in the humid tropics, should pay attention to the lessons from indigenous socio-ecological systems or to productive and innovative local systems.

The experience of multiple use of forests by indigenous people in Mexico, reported by Toledo (2003) was for many years the most commented and quoted, being considered the single case in tropical forest in South America and in the southern hemisphere. But, in recent years, several papers have been published by Brazilian researchers and other countries, as well as by FAO, with cases of multiple use of tropical forests in Brazil and also in Africa, with reports of success.

Other implementation experiences of multiple use of forests were presented by Sabogal (2013), in surveys carried out in countries located in the tropics with wetlands, among which, three evaluations were carried out with information on the Amazon Basin, Congo Basin and Southeast Asian. In these regions, information was collected through interviews with experts, managers and

foresters. Additionally, a questionnaire was applied, identifying in 13 countries (Figure 1), a range of 46 initiatives in progress or completed. Of the surveyed initiatives, timber production is the predominant objective, followed by production of non-timber forest products. Also found by the survey, there were activities of economic importance in at least some (21%) of the surveyed initiatives, including fishing, ecotourism, forest conservation, and firewood and charcoal production and ecosystem services.

Sabogal (2013) concluded that more effort is necessary to eliminate unfair competition from traders whose sole goal is to extract timber, with little or no concern in adding value to the practice of multiple uses. Thus, the forestry component through silvicultural treatments would lead to a more appropriate management of areas with forest cover.

Relevant study in tropical forests was carried out in the Brazilian Amazon by Sist (2014), in which the author found that small holders in the Brazilian Amazon hold possession of more than 12 million hectares of permanent forest reserves, equivalent to 60% of the public forests in the region. It evaluates economic performance and the management system in a multiple-use forest in a settlement of small farmers and provides information on its potential and limitations.

Sist (2014) has also assessed the potential income for farmers generated by multiple use forest management and compared it with the potential income from six other uses of arable land. The author pointed out that within the communities using familiar forest management, multiple use of the forest has been considered as a possible way to increase income from forests, while preserving the ecological function of forest ecosystems.

The study revealed that within the Amazon, forest management for multiple uses has a high potential, since more than 40% of wood species are also included as non-timber products, some considered as the main product for the market, such as andiroba oil (*Carapa guianensis* Aubl.), cumbaru seeds (*Dipteryx odorata* Aubl. Willd), copaiba oil (*Copaifera* spp.) and Brazil nuts (*Bertholletia excels* Humb. & Bonpl), among others. This scenario shows that the prospects for use of different species in many tropical environments are feasible, with possible compatibility between the use of wood and seeds, especially those producing oil for energy production or in different combinations of these two uses. On the other hand, considering the conditions of small farmers or communities with low investment capacity, lack of knowledge on forestry techniques and reduced connectivity to wood markets, the legislation is undoubtedly more favorable to mechanization for selective logging practiced by forestry companies than to use at small local scale.

Sist (2014) concluded that the average annual economic benefits of multiple use of forests in the Amazon are well below the regional and international levels, representing only 25% of the annual income from the most productive system. These numbers reveal the limits of multiple uses of forests when compared with income from agriculture. However, although the income generated by logging can be considered low when calculated on an annual basis and as compared to the income generated by agriculture, payment in cash after extraction represents a significant amount of financial resources. These could be used in the implementation of more intensive production systems, changing or improving current practices by adopting more sustainable farming techniques, with technical and legal public support, aiming to integrate forest management into sustainable agricultural production systems.

Another key issue that should be highlighted with regard to sustainable forest management is the perception that its success lies not only in the adoption of appropriate technical and silvicultural practices, but that it depends largely on external factors such as market, policies and interests of multiple stakeholders (Louman and Camino, 2004). In this case, the multiple use of forests for carbon sequestration, creating a market in the stock exchanges around the world, reducing deforestation around water sources and maintaining the

water table among others can be highlighted.

From other activities of economic importance, in at least some of the initiatives surveyed for multiple use of forests, were found fishing, ecotourism, forest conservation, firewood and charcoal production and ecosystem services. The dominant model of logging, however, is jeopardized in some regions by the arrival of investors interested in agro-industrial activity or mining projects, due to higher financial benefits as compared to those associated with sustainable logging.

According to BRACELPA (2010), in Brazil, companies operating in the logging industry, specifically the pulp and paper industries, invest in alternatives to the practice of multiple use of forests at small farms. It is worth noting the Forest Development Program from Klabin, created in the 80's, in partnership with the Brazilian Federal Government, the National Bank for Economic and Social Development (BNDES), and institutions linked to forest and environment preservation. It is active in the state of Santa Catarina and arose from the company's need to integrate itself with local communities. This program provides support to development areas, incorporating them into the productive process of the company, increasing the company's forest base. Program participants are also involved in other practices, such as forestry (both, pine/eucalyptus and native species), enrichment of secondary forests, organic farming, ecotourism and livestock husbandry (BRACELPA, 2010). With this practice, farmers do not need to abandon their traditional activities, pine and eucalyptus plantation do not use areas occupied by the major activities of the farmer. The program can, therefore, be classified as multiple-use of forests, contributing to the sustainability environmental, since it brings the following benefits to farmers:

- a) Environmental conservation and protection;
- b) Social inclusion and improved quality of life;
- c) Empowerment of rural development;
- d) Promotion of planned and ordered occupation of rural landscape;
- e) Encouraging agroforestry systems to obtain certifications;
- d) It creates opportunities for employment and income;
- g) Expands knowledge through exchange of experiences;
- h) Encourages preservation and monitoring of fauna, flora and water resources.

Funding for multiple-uses of forest program implementation

The world, about to collapse, seeks alternatives for sustainability in all its dimensions. To achieve the much-desired balance that will lead to sustainability, the main

obstacle is funding for improvement of environmental management. Actions for implementation require high volumes of financial resources with public and private contributions, which are not always available. Ideally, sustainable forest management should be self-financed through sales of forest goods and services (Panayotou and Ashton, 1992).

Each country, in its own way, faces the challenge of seeking the best way to finance sustainable forest management; however, if the profits from the use of resources are not enough, there is a great tendency to replace timber production by agriculture.

According to FAO (2010), alternatives for financing are being developed and tested in many countries. They include a wide range of schemes, such as concessions for conservation, debt for nature swaps, payments for environmental services, including "green funds" (payments for carbon offsets), and compensatory payments, to name a few.

The most complex task is the identification of the most suitable financing alternatives for sustainable forest management, since roles, priorities and needs of the various funding bodies are not quite clear to many people and entities.

The economic contributions related to forests in its different environments refer to rural development, poverty reduction and other sectors of the economy that have received increased attention in recent years. Although, bids and payments associated with carbon sequestration and sources of clean water may represent a potential source of significant funding for sustainable forest management, market development based on Payment for Environmental Services (PES) is still in its early stages.

Obtaining additional funding for sustainable forest management is essential, increasing the level of understanding and awareness on traditional and innovative financing options. Policies, regulatory and administrative constraints limit efforts for identification and diversification of funding sources, as well as the legal and institutional reforms that create obstacles to actions to be undertaken.

Final considerations

This century will witness in-depth debate on the limits of sustainability. The global agenda lists issues such as: water conservation, climate change, biodiversity, renewable energy, food security and safety, among others. The conceptual basis for multiple uses in forest management for timber and non-timber products in tropical forests was established almost 20 years ago. Since then, only a few multiple-use forest management systems, some of them discussed in this article, were implemented in the tropics. The most referred examples are those from Guatemala and Mexico.

If multiple use of tropical forest is a desirable alternative, it is still a distant goal, usually ignored as a management alternative by stakeholders in the forestry sector. Government, private and non-profit institutions and other stakeholders involved with sustainability that have multiple use of forests as alternative for sustainability, should establish partnerships with international entities public and/or private, to support implementation of new projects around the world.

Governments have a fundamental role to play in creating favorable environments. Non-governmental organizations and financial institutions are also key to actively establish or support strategies and measures to overcome the economic (market), financial, social and technical barriers for multiple uses, in particular for communities and small holders, as sustainability is the product of joint actions for the common good, mainly the binomial: forests and water.

Conclusion

Therefore, this work concluded that there are laws on forest management; however, they have narrow goals and tend not to favor social inclusion due to a limited inter-sector dialogue when establishing them. Nevertheless, this work concludes that there are promising perspectives on the subject, with success cases in the tropics with a tendency to expand in this area. They prove to be social inclusive for local communities of smallholders that use forest resources in a sustainable way. They achieve conservation of native species with social and economic benefits that reflect in their livelihoods.

Conflict of Interests

The authors have not declared any conflict of interests.

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