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Bibliographic Review

Recovery of degraded areas and its methodological aspects

Charlys Roweder[1]
Alejandro Fonseca Duarte[2]

Abstract

Since the 70s, the recovery of degraded areas came to be seen as a guarantee instrument of continuity and perpetuation of mankind, thus, isolated projects started to be employed throughout the world, in order to grant the return of initial characteristics of the environment. Since then, new concepts and techniques were incorporated to processes of environmental recovery. The recovery of degraded areas is directly linked to the science of ecological restoration, which is the process of aid to the re-establishment of an ecosystem that was degraded, damaged or destroyed. Thereby, restoration and recovery present different concepts, where: Recovery: restitution of an ecosystem or of a wild population degraded to a condition of non degradation, which can be different from its original condition; Restoration: restitution of an ecosystem or of a wild population degraded as close as possible to its original condition. The process of adoption of new knowledge and technologies in the recovery processes of degraded areas requires changes on society behavior, advances in management, new knowledge and consequent modifications in the production systems. The behavior change is associated with the culture, education and available knowledge.

Keywords: ecology, restoration; direct sowing.

Recuperación de áreas degradadas y sus aspectos metodológicos

Resumen

La recuperación de áreas degradadas, a partir de los años 70, pasó a ser entendida como un instrumento de garantía de la continuación y perpetuación de la humanidad, así proyectos individuales empiezan a ser implantados en el mundo con el fin de garantizar el retorno de las características iníciales del medio ambiente. Desde entonces, nuevos conceptos y técnicas se están incorporando en los procesos de recuperación del medio ambiente. La recuperación de áreas degradadas está directamente relacionada con la ciencia de la restauración ecológica, que es el proceso de asistencia a la restauración de un ecosistema que ha sido degradado, dañado o destruido. Por lo tanto,restauración y recuperación tienen conceptos divergentes, dónde: Recuperación: restitución de un ecosistema o de una población silvestre degradado a una condición no degradado, que puede ser diferente de su estado original; Restauración: regreso de un ecosistema o una población silvestre degradada a lo más cercano posible de su estado original. El proceso de adopción de nuevos conocimientos y tecnologías en los procesos de recuperación de áreas degradadas requiere cambios de comportamiento en la sociedad, avances en la gestión, nuevos conocimientos y los consiguientes cambios en los sistemas de producción. El cambio de comportamiento está ligado a la cultura, a la educación y a los conocimientos disponibles.

Palabras clave: ecología, restauración; siembra directa.

Recuperação de áreas degradadas e seus aspectos metodológicos

Resumo

A recuperação de áreas degradadas, a partir dos anos 70, passou a ser entendida como um meio de assegurar a continuidade e perpetuação da humanidade, e projetos individuais começam a ser implementadas

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1 Doctoral Student - Forestry Engineering - Universidade Estadual do Acre. PPG-Bionorte/UFAC. roweder@gmail.com.
2 Professor - Universidade Estadual do Acre. Full Research Professor. UFAC/ PPG Bionorte. fd.alejandro@ufac.br.

no mundo, a fim de garantir o retorno de as características iniciais do meio ambiente. Desde então, novos conceitos e técnicas estão sendo incorporados ao processo de recuperação ambiental. A recuperação de áreas degradadas está diretamente relacionada com a ciência da restauração ecológica, que está auxiliando o processo de restauração de um ecossistema que foi degradado, danificado ou destruído. Portanto, restauração e recuperação têm conceitos divergentes, onde: Recuperação: retorno de um ecossistema ou uma população selvagem degradada a uma condição não-degradada, que pode ser diferente a partir de seu estado original; Recuperação: retorno de um ecossistema ou rebaixado para uma população selvagem o mais próximo possível ao seu estado original. O processo de adaptação de novos conhecimentos e tecnologias nos processos de recuperação de áreas degradadas exige mudanças de comportamento na sociedade, os avanços na gestão, novos conhecimentos e as consequentes mudanças nos sistemas de produção. Mudança de comportamento está ligada à cultura, da educação e do conhecimento disponível.

Palavras chave: ecologia, restauração; Semeadura direta.

Introduction

Bases and recovery concepts of degraded areas

The study of recovery techniques of degraded environments is increasingly evident worldwide; several models and studies are being tested in order to ensure and subsidize programs and policies of recovery of degraded areas.

The term degraded area can be defined as an environment that, after its correctly or incorrectly use, suffered some kind of change of physical, chemical or biological order in its natural characteristics, decreasing or eliminating its regeneration means, presenting low resilience capacity. Environmental recovery can be understood, according to the International Society of Restoration – SER (2004), as the return of the degraded site to a form of usage. As for the rehabilitation, it is the repair of ecosystem processes and services, whereas restoration includes the re-establishment of the biotic integrity. Thus, the process of forest recomposing of a natural ecosystem, disturbed naturally or by anthropic actions, can be conducted by means of techniques of restoration, recovery or rehabilitation (HERRERA et al, 1993).

By studying the recovery processes of areas, BULLOCK et al. (2011) discuss mainly about the importance of aggregating values of services after its recuperation, in order to guarantee its efficiency and aims; as for LE et al. (2012), they highlight the relation of the community (scientific or governmental) to reach the successes of restoration. On that same line, SHACKELFORD et al. (2013) argue that the socioeconomic aspects are important for the restoration success, regarding the aggregation of social and cultural values.

The need of reversing the degradation processes in the world put demands over the science and art of recovery, in order to seek practical and viable solutions to the degraded environments (CATTERALL, 2013).

The recovery, in its wider role, is primarily aimed at reverting the environmental degradation, increasing the biodiversity resilience and ensuring the essential environmental services. The search of efficient models is being strictly incorporated in recovery strategies that seek the recuperation from a local to a global scenario; however, there is still difficulties regarding the best way of restoring in the several adopted programs (SUDING, 2011).

According to ENGEL and PARROTA (2003), the recuperation cannot have as a concept the construction of the environment exactly as the original, but rather recompose the species with the guarantees that they need in order to develop and renew the environment with their real surviving capacities.

Therewith, the restoration seeks the recovery of part of the local biodiversity, and the facilitation of biological processes linked to the forest ecosystem maintenance, through the planting, conduction and management of native forest species (KAGEYAMA et al., 2003).

The concept of restoration can also be defined as "revegetation" or "reforestation", which, according to KAGEYAMA and GANDARA (2000), are terms used in the recuperation processes and accepted by the International Society of Restoration – SER.

The recovery of degraded areas directly involves the science and the traditional knowledge, that is, the development of methods capable of establishing criteria and techniques for composing the degraded environment. Thus, the isolated use of scientific method has not been traditionally a

strong point in the relation between the ecological restoration and the ecology of restoration. That is, perhaps a function of the general distinction between those conventionally involved on each area, scientists and academics are supported for developing theories and investigation; however in practice, the restoration has been mostly conducted by people with limited abilities and scientific techniques.

According to CARDINALLE (2012), the changes in the biodiversity influence directly the environmental relations, being able to generate economical gains, increasing, for instance, the agricultural production, though decreasing environmental services such as production of drinking water in the world.

Some impacts of the biodiversity and ecosystem changes can be local, regional, national or global. Some occur extremely fast, others occur in longer timescales. Thus, each recuperation strategy must observe the temporal and historical criteria (PERRINGS et al. 2011).

To HOBBS and HARRIS (2001), in their assessment studies of recuperation areas, suggest that the recuperation objectives should consider characteristics that are desirable for the future, instead of situational models. LUGO (1992) highlights the restoration difficulties of degraded forest areas in function of the site.

Moreover, at planning recuperation strategies, aiming punctual objectives, KAGEYAMA and GANDARA (2000) distinguish that the success of regeneration with the aim of recuperation is the species diversity, efficiency of the seed bank, interaction between plant and animal and population representativeness.

Development

The development of methods for recovering degraded areas

The study of recuperation techniques of degraded areas are more and more evident worldwide; several models and studies are being tested in order to ensure and subsidize programs and restoration policies.

At proposing recuperation models or arrangements, it is clear that the policy influences the recuperation methods, where the most economic process is the most suitable one, following the example of Indonesia, where the government, since 2004, changed the management of their production forests, once degraded to a concept of forests in recuperation, in order to ensure that they could return to biological balance conditions (BIRD, 2010).

At proposing new models or testing arrangements conducted in scientific tests, aiming efficiency and economy, BURKE and MITCHALL (2007) encourage the grouped knowledge, that is, science and technique, since the ecological restoration must always involve people who believe in ecological restoration, regardless of their social, cultural, political and economic function or ecological objectives, since the ecology of restoration can, therefore, be clearly appointed as a science involving people and technique in function of combined needs.

For this reason, PICKETTET (1992) studied the contemporary paradigm or the paradigm of non equilibrium, that is, where successive changes can occur following multiple trajectories, without a calculated tendency in order to reach the "climax". Therefore, researchers such as NAVE (2005) are creating new ways and methodologies of recuperation, considering the incorporation of such concepts.

According to the contemporary paradigm, for the recuperation three conditions are necessary: area availability, vegetal species availability and availability of different performances among species (BARBOSA, 1998). However, the strongest conceptual basis adopted for restoration is the principle of natural regeneration (YOUNG., 2000).

Despite the fact that numerous publications, organizations, associations and programs provide indicators of success for restoration, the success assessments are still carried out in practice. Although there is a consensus that the methods and arrangements in practice are key for the future and progress of ecological restoration (HOBBS and HARRIS, 2001), it is difficult to assess the success of these recuperation projects, in part because of limited information after the implantation.

MARTINS (2001) cites that the use of burlap for recovering altered areas comes from the assumption that the burlap presents great quantity of genetic matter, and nutrients capable of re-establishing and ensuring the recovery of the forest population and succession. The same author highlights that the burlap use is controversial, since it can degrade the environment in order to recover another. Thus, it is noticed the need of further researches and new efficient techniques and with increasingly lower costs.

Among the alternative methods, the direct

sowing has been a promising alternative to recovery programs of degraded areas, since it presents reduced costs, when compared to planting seedlings, and even presents a good establishment and development.

CAMARGO et al (2002), aiming to improve the field tests and guarantee success in their work, apply in degraded areas of Amazon the technique of direct sowing, highlighting that the success of direct sowing depends largely on the seed size and the fauna present on the area to be rehabilitated.

At studying the richness of programs of regeneration and direct sowing, RENOFALT and NILSSON (2008) identified that in several cases, the richness of species was affected by the change in the environment. The richness of species on the altered parcels was significantly lower than on the control parcels.

Methods of direct sowing

The direct sowing is an alternative of recuperation of degraded areas, presenting itself as an alternative regeneration system, where the seeds are thrown directly in the soil without the need of forming plants in nursery gardens (TOUMEY and KORSTIAN, 1967). The direct sowing presents several methods with which it is able to perform the sowing, among which we can cite: seed throw, in lines, pits or isles (BARNETT and BAKER, 1991).

In some countries of North America, the policies of recovery and reforestation of environments are being reached through the direct sowing, because of the advantages that the method presents over the plant production, mainly because of the high costs of the latter when compared to the sowing (DERR and MANN, 1971).

The 70s were marked by the introduction of the direct sowing method in the Scandinavian countries, where approximately 30% of recovery and reforestation programs are performed by the technique of direct sowing, in order to minimize costs and maximize the survival of the plant; therewith, scientists, aiming to improve the germination, research and assess the plastic protector in order to provide a small site that is favorable to the germination and initial development of the plants (LAHDE, 1974).

In South America, the first experiences with the use of physical protectors in the direct sowing method relate the beginning of the new millennium, in use of forest species from the *pinus* genus (MATTEI, et al. 2001; FERREIRA et al. 2002).

Tropical Regions

The tropical countries recently started to use the direct sowing technique, though different from temperate zones, where the technique is used for more than 30 years; tropical regions present great environmental differences with sub-ecosystems and great areas, which makes the method more complex and requires special attention.

The use of direct sowing in tropical regions presents several obstacles, the main one being the seed dormancy, a characteristic phenomenon common to various tropical forest species. Therefore, researchers such as BARBOSA et al. (1996) reveal the importance of maintenance of ideal conditions for the establishment and success of direct sowing in recovery and reforesting programs for degraded areas.

In Brazil, researches point out to the use of physical protectors in order to guarantee an ideal microclimate in the seed region, granting, thus, ideal conditions of germination and development (BRUM, et al. 1999; FERREIRA., 2002).

The direct sowing of forest species as a technique tends to be questioned in tropical countries, in function of the great variety of soil disturbance. This method presented efficiency to tropical forest units in Australia, before intense disturbances, according to SUN et al. (1995) in their study of areas in initial stages of degradation.

Still regarding the use of the method as an alternative for the recuperation of degraded areas in the South of Australia, KNIGHT et al. (1998) reveal that the technique of direct sowing of forest species presents itself as an excellent option of low cost and good acceptance by part of the producers.

Experiments conducted with the direct sowing reveal that the competition between species can be a limiting factor when associated with the soil infertility, which could affect the establishment of plants in the field. FLORES-AYLAS (1999), studying direct sowing in Brazil, highlights that a simple increase on the seed density per area is not enough to guarantee the success of the sowing, but rather combine it to a previous preparation of the planting field.

In this sense, SANTOS JUNIOR (2000), reports that the soil preparation before the sowing reduces the physical barriers and increases the water absorption and the nutrient availability, among other factors, guaranteeing the success in the process of re-

establishment of degraded areas, or in reforestation programs.

The competition and allelopathy between species in tropical regions, where the pioneering species can be favored on open areas, the grasses become an important barrier for the initial growth through the use of direct sowing (SOUZA et al. 2004).

SUN and DICKOSON (1996) studied in Australia the competitive effect of brachiaria in the initial development of native pioneering species constituted by direct sowing, and concluded that the brachiaria limited the growth of the forest species studied, due to the competition for light, for which the authors suggest the adoption of techniques of grass control in order to guarantee the success of direct sowing.

In Brazil, several behavior studies were conducted with the aim of verifyng the limitations of the technique of direct sowing, for instance, the research of TOLEDO et al. (2001), who verified that the brachiaria limited the initial growth of eucalyptus, when narrowed together with 4 plants/meter of brachiaria, reducing the biomass of stem, branches and leaves, as well as the number of leaves.

Thereby, the researches show the fragility of the technique and the various possibilities of studies that still lack information for the success of direct sowing in tropical countries.

The use of direct sowing of forest species in Brazil

Brazil, a tropical country of continental territories, has adopted the technique of direct sowing of forest species timidly, when compared to European and North American countries. The researches of direct sowing, aiming the recuperation of degraded areas in the country, are still referenced in form of experiences, in embryonic stages of studies, as we can see from the tests conducted by Almeida (2004) in Minas Gerais, where they test different planting methods, and PARROTA and KNOWLES (1999) in Amazon, who sought alternatives for the forest recovery. The authors corroborate that the technique presents ecological and economical advantages, but researches are still needed in order to integrate and guarantee the success of the method.

The first study with direct sowing with forest species was conducted in the city of Cubatão-SP, where POMPEIA et al. (1989) researched 39 forest species of different forest strata and observed resistance and atmosphere pollution. In the study, the authors pelletized the seeds in order to protect them and guarantee the germination. The results, according to the authors, were of 80% germination, which demonstrated a satisfactorily viable technique.

In the same segment, after the results of Cubatão-SP, BARBOSA et al. (1992) dedicated efforts on recovering degraded areas of riparian forest, where they used the direct sowing methodology with four forest species of riparian environment origin. The results describe that factors such as luminosity must be considered and observed in the act of choosing the specimen that will repopulate the degraded area. However, the authors concluded the viability of the technique and suggest new researches.

SANTOS JÚNIOR (2000), in studying the art of direct sowing for forest species with physical protectors, demonstrated that the method is viable, especially when combined with devices in order to improve the development of the process, since the protector increased the index of emergence speed and plant survival; even so, the authors recommend the direct sowing method and suggest further tests with protectors and other devices in order to express better results.

Researches in degraded areas are conducted in various ways and recuperation models; according to FERREIRA (2002), when studying direct sowing of five native forest species, with the aim of recovering the riparian forest, disbelieves the technique as the most viable and practicable, since in their results, after three months of assessments, the method is trustworthy on preliminary analyses, but it must be given continuity to the research and follow a maintenance of the area.

ALMEIDA (2004) studied researches regarding the establishment and repopulation of degraded riparian areas, where the author uses the direct sowing of 12 native forest species, pelletized with mechanized planting in different spacing; in this sense, the author affirms that, out of the twelve species tested, only one did not present viability, the others presented high rates of germination and initial establishment, suggesting the direct sowing as an efficient method for the recovery of riparian forests.

Discussions

The number of scientific studies about restoration, reforestation and recuperation of degraded environments has grown considerably over the past 20 years, mainly in the past five years,

considered the most relevant ones. This supports the idea that the environmental recuperation is a research field in increasing development, and of significant interests, mostly for dealing with priority matters, such as permanent preservation areas with social role.

The recovery of degraded areas is a role that directly involves science and traditional knowledge, that is, the development of methods capable of establishing criteria and techniques that are able to restore the environment. Thus, the use of scientific method separately has not been traditionally a strong point on the relation between ecological restoration and ecology of restoration; that is, perhaps, one of the functions of the general distinction between those conventionally involved on each area: scientists and academics that have been given support for developing theories of investigation; however, in practice, the restoration has been mostly conducted by people with limited abilities regarding scientific techniques.

According to a study published by UNESCO (2003), the anthropogenic changes of landscapes caused the elimination of about 50% of the original vegetal coverage in the world, mainly of permanent preservation areas – APPs. The threats to the biodiversity are various, among which we can highlight the climate change, air and water pollution, desertification, erosion, illegal hunting and overfishing; however, the deforestation can be considered one of the biggest threats for the extinction of species and biodiversity loss in the world. According to CARDINALLE (2012), the biodiversity changes influence directly the environmental relations, being able to generate economic gains, increasing, for instance, the agricultural production, though decreasing environmental services.

Some impacts of the biodiversity and ecosystem change can be local, regional, national and global. Some occur extremely fast, others happen in more distinct scales of time along with the climate change. Therefore, each recuperation strategy must observe the criteria above (PERRINGS et al. 2011).

Conclusions

After several positions, the research reveals that the recuperation processes are more and more developed and in marked increase of expansion, mainly in the forms of technological studies and environmental enterprises. However, it is important to highlight for the socioeconomic aspects of the recuperation that the literature acknowledges the importance of these attributes for the success of the programs, being necessary further researches about the social and economic results performed and its impacts in the recuperation process of degraded areas. This way, this discussion is necessary to political actions, not only for the development of practices and methodologies, but also to support ongoing projects of recuperation of degraded areas as a primary tool of natural resources.

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