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Advancing assisted natural regeneration (ANR) in Asia and the Pacific

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Advancing assisted natural regeneration (ANR) in Asia and the Pacific

Compiled and edited by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
REGIONAL OFFICE FOR ASIA AND THE PACIFIC
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Abbreviations

ANR	assisted natural regeneration
APFReN	Asia Pacific Forest Rehabilitation Network
CBD	Convention on Biological Diversity
CBFM	community-based forest management
CBFMP	Community-Based Forest Management Program
CIFOR	Center for International Forestry Research
CPF	Convertible Production Forest
DENR	Department of Environment and Natural Resources (Philippines)
DFID	Department for International Development (United Kingdom)
DTI	Department of Trade and Industry (Philippines)
FAO	Food and Agriculture Organization of the United Nations
FORSPA	Forestry Research Support Programme for Asia and the Pacific
GTZ	Gesellschaft für Technische Zusammenarbeit
HPH	forest concessions (Indonesia)
IK	indigenous knowledge
IPF	inconvertible production forest (Indonesia)
JICA	Japanese International Co-operation Agency
LPF	limited production forest
NGOs	non-government organizations
NRP	Natural Reserves and Recreational Forests, including National Parks
PF	protection forest
SALT	sloping agricultural land technology
TPTI	Indonesian silvicultural system utilizing selective cutting and natural regeneration.
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States dollar

FOREWORD

Deforestation and the degradation of forests continue to cause serious problems in many regions of the world. The situation is particularly acute with the tropical forests in Asia and the Pacific. A variety of measures have been tried in the past to address the problem, with varying degrees of success. Among the silvicultural tools employed is assisted natural regeneration (ANR), a variation of enrichment planting which was first developed for tropical forests with poor natural regeneration. Assisted natural regeneration however, has not received the attention it deserves. The technology is based on the ecological principle of secondary forest succession, utilizes natural processes, and promotes the regeneration of indigenous species. Because ANR relies on natural processes, it is especially effective in restoring and enhancing biological diversity and ecological processes.

Assisted natural regeneration has been well developed in the Philippines, and as a result, it is now being utilized extensively to restore former forested areas that have become degraded and covered by *Imperata cylindrica* grass. The same principles are also being used to address the problems of poor regeneration in logged over forests in several other Southeast Asian countries. The value of the ANR techniques is that it is easily understood by the field staff, species of best economic value and good silvicultural properties are used, and costs of production, planting and tending are kept minimal.

FAO has been promoting these techniques widely in the region, through long term demonstration plots, study tours and technology transfer. To highlight the opportunities and potential of ANR, FAO and partner organizations convened a workshop and study tour in the Philippines in April 2002. The discussions and presentations at the workshop underscore the importance of ANR in the broader context of sustainable forest management and the potential for cost-effective rehabilitation of forestlands through more aggressive implementation of ANR. To enhance awareness and understanding of the concepts and practices of ANR, and to encourage wider application, FAO is pleased to publish and disseminate this compilation of papers highlighting experiences with ANR in the region. This publication includes selected papers dealing with the technical, environmental and social dimensions of ANR as well as papers describing country initiatives. The publication represents one element of FAO's ongoing efforts to promote more effective forest rehabilitation and restoration for the benefit of local people.

He Changchui
Assistant Director-General and
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ASSISTED NATURAL REGENERATION: AN OVERVIEW

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Introduction

The basic philosophies of assisted natural regeneration (ANR) have been used on a limited scale to rehabilitate degraded forests and *Imperata* grasslands in the Philippines for more than 30 years. ANR is a simple, inexpensive and effective technique for converting *Imperata* areas to more productive forests. The key elements of ANR in the Philippines are quite basic: control fire, restrict grazing, suppress *Imperata* growth and involve local people. The benefits of ANR are equally fundamental. The cost of reforestation is far less than traditional plantation development. The technologies are simple and easy to implement. The resulting forest is highly diverse biologically and there are substantial benefits for local people.

Over the past several decades, scattered efforts have been made to develop and apply ANR approaches to forest restoration. Whilst knowledge in this area has grown considerably, it is now apparent that there are additional opportunities to diversify strategies and to expand restoration work. Given the low cost and numerous benefits from ANR, it would seem logical that ANR be accepted and applied broadly. Surprisingly, however, ANR techniques are still vastly under-appreciated and under-utilized in the region. This is in part due to the fact that few efforts have been made to promote ANR.

In an effort to overcome these constraints, increase awareness of the potential of ANR and promote the broader application of ANR, the Regional Office for Asia and the Pacific of the Food and Agriculture Organization of the United Nations and the Philippine's Department of Environment and Natural Resources (DENR), co-organized a workshop and study tour in the Philippines in April 2002. Additional support was provided by the International Plant Genetic Resources Institute (IPGRI), the Center for International Forestry Research (CIFOR), and the International Center for Research in Agroforestry (ICRAF). FAO enlisted the services of Bagong Pagasa Foundation (BPF), a Philippine non-governmental organization, to plan, coordinate and manage activities. Representatives from 11 Asia-Pacific countries met in the Philippines to discuss ANR, exchange information related to the application and implementation of ANR, and formulate recommendations for broader application of ANR in the rehabilitation of denuded and degraded lands.

It is in this context that this selection of papers has been compiled, to synthesize the current knowledge on ANR. This overview presents a short summary of the selected papers and some general themes emerging from the workshop.

Summary of general themes

Technical papers

Percy Sajise presents a thorough analysis of deforestation and its causes in the tropics of Asia. Sajise introduces a conceptual framework based upon the relationships between the technological, socio-cultural dimensions and natural resource base. Although ANR approaches should embody the ecological principles involved in the technological interventions, they must also be socially acceptable and institutionally supported. Sajise also provides a comprehensive look at the integral elements of an ANR approach from species selection to maintenance and protection.

Peter Walpole presents ten points which attempt to highlight the state of the art of ANR approaches. His paper describes some of the difficult questions facing ANR, including some definitional distinctions that need to be made before it progresses further. He states that the whole discourse on ANR could focus on traditional systems and knowledge. Furthermore, Walpole provides some insights into the challenges facing ANR development in the region. Some of these challenges include broad ranging impacts from competition with plantations, insecure tenure and extraction rights, over regulation of communities, poverty and marginalization.

Moises Butic and Robert Ngidlo describe the Ifugao muyong system, as an ANR strategy, within the context of traditional forest management. It is with the objective of linking indigenous approaches with learned forestry interventions that ANR can be used and diversified to meet both the micro and macro levels of integrated restoration work. Butic and Ngidlo suggest that the Ifugaos have shown that ANR can be used effectively to transform woodlots into multiple-use centers without disturbing the ecological functions of the natural forest.

The role of communities

Communities can play a significant role in ANR, especially in Southeast Asia where people are the primary cause of land-use change (clearing through the use of fire or otherwise). In many instances, the use of ANR approaches is inherent in the daily lives of people. Considered an integral part of ANR in the Philippines, communities have a significant role to play in prevention and suppression of fires that have a detrimental impact on their lives. There are many examples in the region of local communities taking action to protect forest resources, not just for their own benefit, but also for the benefit of broader society. Many of these cases exist in remote locations where government approaches are typically ineffective in protecting the forest resource. However, communities cannot do everything. It is not fair or feasible to expect communities to be responsible for large-scale forest restoration efforts. This task requires significant human resources which are externally organized, led and supported with equipment and supplies over long periods of time. Communities and their members can be an important, perhaps pivotal, component but should not shoulder the entire burden for promoting and implementing large-scale restoration efforts.

There are a number of practical steps which should be adopted to promote ANR within community-based natural resource management. Firstly, there are ample opportunities from which to learn, both within community forestry and from other associated disciplines. Secondly, there is a need for each interested country to experiment with new approaches of user-centered ANR technologies and to develop workable approaches compatible with local conditions. Elsewhere, policies will need to be adjusted to provide the needed support for ANR.

Further research

Continued research is required to guide rational and effective decision making for ANR formulation, implementation and evaluation at local, national, and regional levels. Sajise states that the “lack of knowledge of the ecological processes in plant succession makes it difficult to operationalize ANR”. In general, an increased understanding of ecological interactions is necessary for more effective science-based management of forest ecosystems in Asia and the Pacific. To improve the local, national and regional capacity for studying ANR and understanding its role in forest ecosystem restoration, support is required for:

- investment in new and better scientific methods and in the development of regional scientific standards for studying ANR and restoration practices;
- improved understanding of plant succession in region and the integration of the autecology of the desired plant species into ANR approaches;

- increased understanding of the positive and negative impacts of restoration practices, as well as the interactions between desired plant species, fire, soil ecology, hydrology, geomorphology, atmospheric chemistry and other biophysical aspects; and
- better translation of scientific results into a format readily usable by policy-makers and the general public.

Social trends with potential impacts on ANR development

There are also widespread social trends, intrinsically linked to forestry and the environment, that have feedback effects on ANR development, notably:

- an increase in inequality, both among and within nations, in a region that is generally healthier and wealthier;
- a continuation, at least in the near future, of hunger and poverty despite the fact that the region produces adequate food and natural resources;
- greater human health risks resulting from continued resource degradation;
- an increase in international pressure to preserve biological diversity, which may or may not consider local needs and cultural/social dimensions of natural resource management; and
- an increase in short-term investment planning.

Country planning

In addition to the technical and country ANR perspectives provided by the workshop, a country planning exercise was conducted. During this process, participants explored options for promoting ANR, identified constraints and formulated the following recommendations to FAO and donor organizations:

- Fund pilot projects in each country to expedite the promotion of ANR, while concurrently creating venues for training and demonstration.
- Update documentation on ANR to facilitate cross-country exchange of information.
- Support research on the comparative costs and benefits of ANR versus conventional reforestation methods.
- Formulate, adopt and implement policies that prioritize ANR as a strategy for achieving forestland rehabilitation and biodiversity, focusing in particular on watershed catchments and *Imperata* grasslands.
- Support additional study tours, training and workshops to increase awareness of ANR methods and advantages among national decision makers, project design teams, international donors, the media, and government/non-government agencies implementing rural development and forestland rehabilitation projects.

Conclusion

Forest restoration can no longer be ignored as big challenge in forestry, natural resource management and development activities. The FAO supported workshop underscored the importance that people in the region are now giving to restoration efforts, particularly those associated with assisted natural regeneration. The connection between communities and restoration is often based on economic interests (livelihoods, commercial activities and impacts) and in the longer term, through public health (water quality and aesthetics).

ANR is very compatible with traditional systems of natural resource management. Therefore, a clear examination of community approaches to the management of native plant communities is necessary to promote ANR at higher levels. This could serve as the basis for clarifying objectives and concrete actions to restore native plant communities and ecosystems using

ANR approaches. It is essential that constructive partnerships be formed among NGOs, governments, the private sector and communities to design effective ANR approaches, which will have mutual long-term gains for all stakeholders.

The ANR workshop and study tour was an important step towards recognizing the role of ANR in forest restoration. It identified the steps needed for its further promotion in the region and the many ways in which communities can and have taken action in native plant management.

WORKING WITH NATURE: TECHNICAL AND SOCIAL DIMENSIONS OF ASSISTED NATURAL REGENERATION

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Introduction

Around the world today, especially in the tropics, deforestation has become one of the most serious threats to biodiversity conservation, livelihood systems, ecosystem functions, peoples' welfare and sustainable development. On average, the global figure of deforestation has been 14.6 million hectares per year between 1990 and 2000. Most of this occurred in the tropics due to the conversion of forest to agriculture (FAO, 2001). As a result of this conversion process and the dynamics associated with vegetation transformation, secondary forests are increasingly prominent in the landscape in tropical countries (UNESCO, 1978; FAO, 1996; Smith et al., 1999). In situations where forest conversion is accompanied by highly degraded conditions, "green deserts" or grassland disclimax stages of low quality and productivity predominate. There is an urgent need for forest restoration, which has been a subject of intense interest worldwide.

FAO defines deforestation as the conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum of 10 percent threshold. Forest restoration, on the other hand, involves both reforestation and afforestation. Afforestation is the establishment of forest plantations in areas that were not previously covered by forest and denotes a change from non-forest to forest. Reforestation is the establishment of forests through planting, seeding or other means after a temporary loss of the forest cover (FAO, 2001). In the context of these definitions, most of the forest restoration process in the tropics will, therefore, involve reforestation, as opposed to afforestation.

Reforestation as a national, regional or global task is not easy to achieve, as shown by past experiences. It can be expensive, ineffective and even a constraint to enhancing biodiversity, depending on how it is implemented and the objectives of the reforestation process. In the Philippines, for example, the cost of reforestation varied from US$500-1000 per hectare, at 1983-85 price levels (Castillo, 1986). Thus, there is a need to look for options which will effectively and efficiently bring back the forest, with as much of its original characteristics and functions of productivity, stability and sustainability, as possible. This is one of the major reasons for the formation of the FAO-FORSPA-initiated network known as the Asia Pacific Forest Rehabilitation Network (APFReN). APFReN was established in 1997 to foster the distribution of information on forest rehabilitation in the region. This network provides technical support on how to implement rehabilitation activities in practice and has demonstration sites in Lao PDR, Viet Nam, Sri Lanka, Cambodia and Papua New Guinea.

Assisted natural regeneration and forest restoration

Deforestation in the tropics is, most often, the result of human activities such as exploitative logging, land conversion to other uses (such as grazing), frequent occurrence of fire, disruptive agricultural practices in open access land, fuel wood collection, and others (Lanh, 1994; Schmidt-Vogt, 2000). At present there have been a number of priority areas identified for the reforestation of deforested and degraded areas, in the Asian region. These priority areas include: upland watershed development, developing biological diversity, amelioration of environmental problems such as soil erosion, flooding and drought, providing forest products such as fuelwood and fodder for local communities and reducing subsistence pressures on other forests (Chokkalingam, 2001).

There has been some degree of success with reforestation in the region by assisting the natural tendency and process of ecological succession. Ecological succession is an apparently orderly process of community changes, which is directional and often predictable. It can be described in terms of plant community changes, referred to as plant succession. In the tropics, an area where the tropical rainforest vegetation has been removed will have this natural tendency to revert back to forest cover. In general, depending on the level of degradation, this process will involve the replacement of annuals, which have a relatively short life cycle, by perennials and pioneer or gap species, which have longer life cycle; finally these are replaced by climax-based tree species.

This fundamental ecological process has been used as a forest restoration strategy in the Philippines (Sajise, 1989), Brazil (Goetsch, 1992) and Thailand (Pakkad et al., 2002). There could be more cases of this type of strategy in forest restoration, as it is given different names in different countries, although the principles are almost the same. Assisted natural regeneration (ANR) in the Philippines, forest restoration in Thailand and imitating nature in Brazil, are a few examples of this principle being implemented.

The advantages of ANR or similar strategies in forest restoration can be summarized as follows (Sajise, 1989):

- faster and cheaper (it may not be necessary to establish a nursery);
- promotes and conserves biodiversity;
- maintains the original vegetation stand and corresponding ecosystem functions;
- maintains the integrity of the soil and involves minimum soil disturbance;
- labor intensive and provides employment for the local community and promotes use of indigenous knowledge (IK);
- can promote people empowerment if IK and traditional institutions are used and valued; and
- promotes hydrologic integrity and biotic functions.

Based on experience in the Philippines, ANR is most suited for areas where the objective is to establish a protection forest cover as quickly as possible, such as:

- ecologically vulnerable areas such as steep slopes, i.e., greater than 30 percent in critical watersheds;
- areas where biological diversity and maintenance of the original flora and fauna is needed, i.e., national parks and reserves; and
- community forestry or social forestry areas where communal reforestation is needed and where bio-physical and social conditions for ANR are favorable.

Preference for ANR may also be given to areas where enrichment planting is carried out, favoring natural and local species used as sources of premium wood or non-timber forest products such as rattan, resin, honey and other valuable products. The use of ANR in agroforestry systems has also been reported in Brazil (Goetsch, 1992).

Like any other forest restoration interventions, ANR has technological, bio-physical and socio-cultural (including economics and institutional) dimensions (Figure 1). These three dimensions must work in a complementary manner to ensure success.

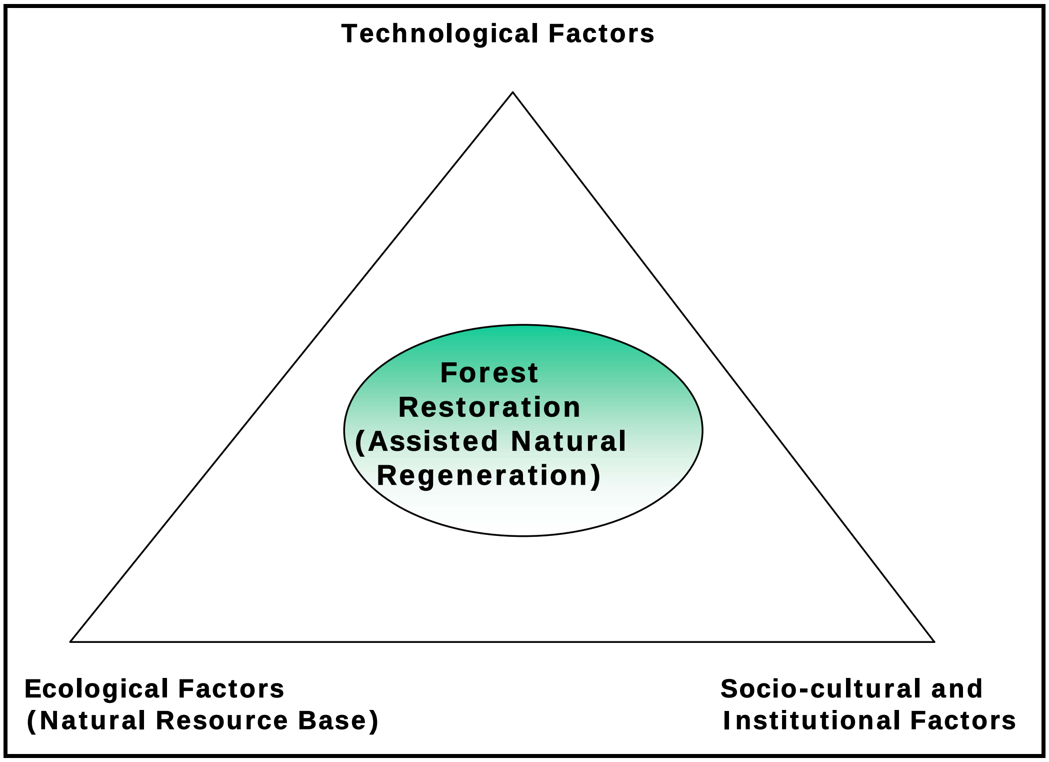

Figure 1: Conceptual Framework of assisted natural regeneration strategy for forest rehabilitation

Ecological principles of ANR

The basic ecological principles of community succession involved in ANR were described by Sajise (1984). Succession initially developed as a botanical concept and is apparent in the early writings of plant geographers and taxonomists such as Von Humboldt and de Candolle. It was Clements (1916) who first developed a comprehensive theory on plant succession, which involved the recognition of successional stages and their associated habitat factors. Since then, succession has been defined in many different ways showing varied emphasis by different workers; vegetation composition (Mueller-Dombois, 1974), vegetation composition and disturbances (Horn, 1974) and reciprocity between plants and their environment (Margalef, 1968).

There are two basic assumptions inherent to the concept of plant succession: a) that species replacement during succession occurs because populations tend to modify the environment, making conditions less favorable for their own existence, thus leading to progressive substitutions; and b) climax is the end point consisting of a plant community that is self-perpetuating and in equilibrium. There are also two types of succession: a) autogenic, in which changes are internally generated or self-propelled; and b) allogenic, in which changes are brought about by external factors such as fire, volcanic eruption, earthquakes and even climatic change. Succession that begins on bare rock and reaches a climax is known as primary succession. Succession that occurs after the disruption of a previously well-developed community is known as secondary succession. In the tropics, most types of plant succession are secondary plant succession.

The distinct and recognizable stages of plant succession are known as seral stages. The final steady state is a climax which, in the humid tropics, is tropical rainforest. The climax is generally believed to be a function of the prevailing climate or edaphic conditions. In certain instances, however, the climax is not reached because of the occurrence of a dominant external factor such as regular burning, grazing and others. In such instances, a particular plant community will persist that is quite different from the climatic or edaphic climax. If these regularly occurring disturbances are prevented, then the normal course of succession will take place leading to the formation of a climatic or edaphic climax.

It is in this area where the socio-cultural and institutional dimensions interact with the natural resource base, because many of these disturbances are human-induced and their prevention is also a function of human interventions. The decision as to what kinds of human-induced disturbances or interventions will prevail depends on: knowledge (both indigenous and formal knowledge); technological availability; cultural beliefs and practices; economic incentives or disincentives; and the prevailing policy, or lack of it, including the effectiveness of its implementation.

It is also important to recognize that ecological succession as an ecological process is not only confined to changes in plant community composition in a given area. During community succession, there is an interaction between the biotic (plants, animals, microbial organisms and other living organisms) as well as with its abiotic environment. For example, a recent report on the effect of logging in a primary forest in Ulu Muda Forest Reserve, Kedah, Malaysia, indicated that the arboreal foliage-gleaning insectivore guild of bird species declined immediately after logging, while the seed feeders increased, indicating their importance in seed dispersal for plant succession (Rosli and Zakaria, 2002). Bird perches were found to promote accelerated plant colonization in landslides in Puerto Rico, indicating the importance of the role of biotic seed dispersal agents (Shiels and Walker, 2001). Native earthworm species which are litter-feeding were found to dominate in a forest area, compared to a disturbed area in Puerto Rico (Sanchez et al., 2001).

Succession as an ecological concept has dominated the thinking of ecologists for many years. However, it has also been subjected to criticism on two points: a) implications within the concept of a purposive or directed change, which reminds one of some teleological concept; and b) the debate on whether there really is a climax. Nevertheless, a common and readily accepted notion is that plant succession is initiated and sustained by some disturbances that create change and destabilization in the system. This becomes the window for management to use these ecological processes, provided these changes and the long-term consequences in terms of forest ecosystem characteristics are well understood.

ANR Technology

Based on the conceptual framework of the relationships between the technological, the natural resource base and the socio-cultural dimensions, it is necessary that the technology for ANR conforms to or enhances the ecological principles involved in the process. These technological interventions must be socially acceptable and institutionally supported. In general, the ANR technologies comprise site selection, site assessment, site-species matching, site modification such as shade opening, supplemental or enrichment planting of appropriate species, protection and maintenance and monitoring.

Site selection and site assessment

Site assessment is an important first step in ANR, as it determines the seral stage of plant succession which is going to be used as the starting point for forest restoration. It also identifies the type of site enhancement which will be applicable to enhance plant succession. In general, ANR will mainly be implemented in areas where the main objectives are protection forest, biodiversity conservation, quick establishment of protection cover for hydrologically critical areas and for soil conservation. However, for economic reasons, site assessment should also determine the cost of forest restoration, as the more retrogressive the seral stage is, the more expensive it will be to restore. For example, if the initial seral stage is a degraded grassland area, it will take longer and require more inputs to push it to an advanced stage of plant succession, like secondary forest. If seedlings of the appropriate species are no longer present in the area and the biotic components for seed dispersal no longer exist, then collection, transport and distribution of these materials will entail higher costs. For a successful ANR project, it is important to ensure that there are sufficient numbers of seedlings of natural species in the area and the appropriate soil conditions. This will enable enhancement of the regeneration without additional external inputs. It is also important to have sufficient seed dispersal agents (both biotic and abiotic) so that the natural process of forest restoration can proceed by protection alone.

Site-species matching

This is the weakest part of ANR, as there is limited knowledge of the specific ecological requirements of natural forest tree seedlings (Kartawinata et al., 2001). In the absence of any information on the niche requirements of the various seedlings and saplings located in the area, it is possible to make use of local knowledge. This type of information can be obtained by means of discussions with some key members of the community. Site-species matching in ANR is critical because a mismatch will result in the loss of propagules and regeneration materials. It will also result in a waste of time and money invested in the ANR sites. Several earlier studies have suggested that local people possess more knowledge concerning their local resources than is often appreciated by experts or accepted by government officials (Leach et al., 1999).

This technological step will also require good information on site characteristics such as biotic agents of dispersal, soil characteristics in relation to nutrient and moisture status, light quality and quantity, temperature, rainfall, organic matter and others. The key factor to this process is to be able to characterize site quality in terms of some key edaphic, hydrologic, biotic and other abiotic conditions.

Site modification

This part of the ANR technology is designed to favor the species that will catalyze an autogenic change to move the plant succession process to a higher seral stage. However, it should be designed to bring about an intervention that will enhance the growth of the preferred species, based on the ecological requirements of these species in the ANR site. For example, liberation thinning or canopy opening stimulated the growth of *Eusideroxylon zwageri, Shorea leprosula* and *S. bracteolate* seedlings and saplings in a secondary forest in Indonesia. However, poor performance was shown by *Dipterocarpus* spp. (Sastrawinata and Effendy, 1991). The pruning of pioneer tree species in a Brazilian secondary succession area enhanced the growth of both natural and agricultural crops, as the faster recycling of vegetation promoted nutrient enrichment (Goetsch, 1992).

In rehabilitating *Imperata* grasslands in the Philippines, plant competition between this grass species and tree seedlings is reduced by pressing the grass stand. This reduces the apical dominance of *Imperata,* thereby reducing its tillering regeneration capacity. If this were done by cutting, it would enhance tillering and increase competition between the grass and the tree seedlings (Sajise, 1972). This process also enhances the return of organic matter to the soil, while dramatically reducing labor requirements and expenses.

Enrichment or supplemental planting

This step in the ANR technology is derived from site-species matching. It involves species identification, assessment of appropriate planting density and site treatments. In some cases, depending on site conditions, leguminous species are planted to enrich the soil and pioneer species such as *Trema, Macaranga* and *Erythrina* are planted for both shade and soil enrichment. In Brazil, the herbaceous species capeba (*Pothomorphe umbellate* L.) is planted to stimulate earthworm activities and the bean feijao de porco (*Canavalia ensiformis* L.) serves as an effective repellent for the notorious leaf cutter ants (Goetsch, 1992).

Protection and maintenance
If adequately protected from significant disturbances such as fire, grazing, fuelwood cutting and others, a regenerating area will undergo ecological succession (Figure 2). In relatively wet areas in the Philippines, Sajise and Orlido (1973) observed that *Imperata*-dominated grassland is replaced by a shrub community of the *Mikamia*-*Melastoma*-*Solanum* association, after three years without fire and agricultural cultivation. Sajise (1972) demonstrated that 50 percent shading of *Imperata* reduces its net photosynsthesis capacity and consequently its rhizome production. This effect of shading is important because 60 percent of the total dry matter produced by this grass species is stored below the ground in the form of rhizomes, which are the main source of energy for rapid regeneration after burning and cutting. The shrub communities persist for four to six years and are gradually replaced by softwood species such as *Ficus* spp., *Mallotus* spp., *Trema orientalis* and *Homolanthus populneus* (Figure 2).

In order to succeed, ANR areas must have adequate protection and maintenance procedures, which involve both technological and social considerations. In the Philippines, successful social forestry projects will have more success with reforestation, as the community can effectively protect their areas from grassland and dry season fires. In India and Nepal, successful forest regeneration is also evident in community-based forestry programs.

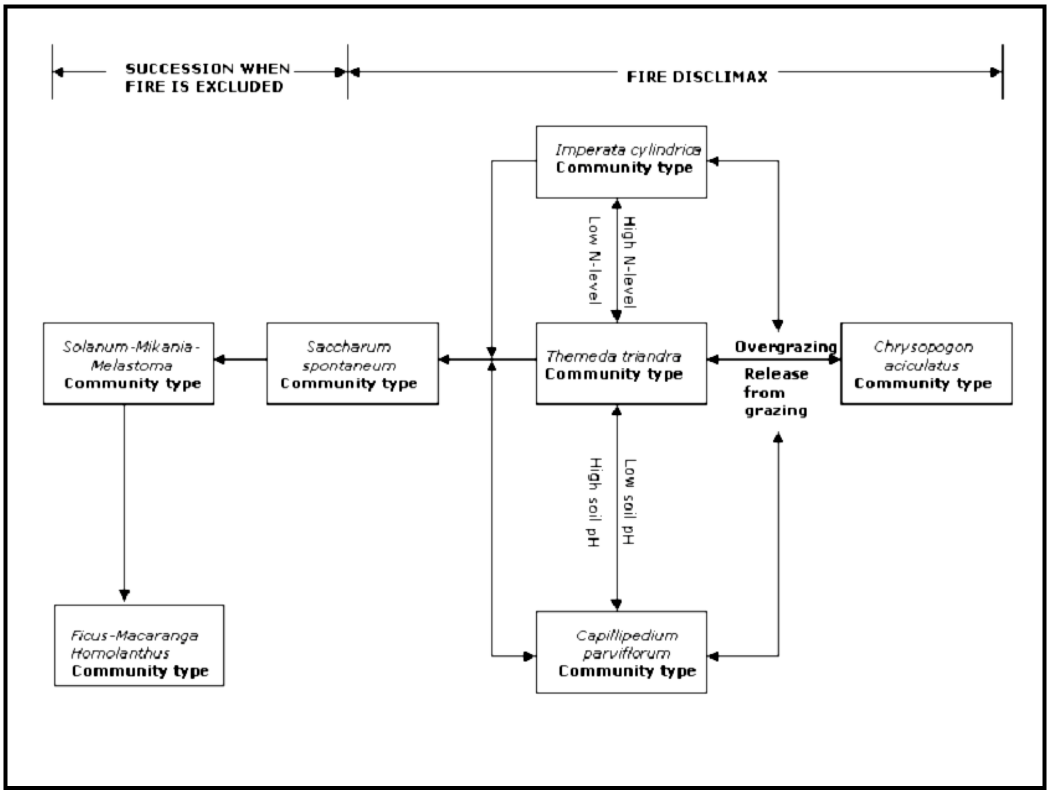

Figure 2: Pattern of plant succession in a Philippine grassland ecosystem. Source: Sajise et al., 1976

Socio-cultural and institutional aspects of ANR

The third and equally important element in the triangle of a successful ANR project are the socio-cultural and institutional elements. These elements comprise the socio-cultural values of communities involved and the prevailing policies regarding the use of natural resources. These values can be in the form of the relationships that exist between the human communities and the natural resource base such as, the economic products and services provided by the restored forest ecosystem. It can also be in the form of human activities which are protective and promote the efficient restoration of the forest ecosystem.

The report of the World Commission on Forests and Sustainable Development (WCFSD) reported that these relationships can be promoted by the following (Poffenberger, 2000):

- The process of decision making about the disposition of the forest should be open to widespread participation of the most affected, including women and indigenous people.
- Land and resource tenure arrangements should be reviewed to make them more conducive to conservation.
- Mechanisms need to be created that involve communities in monitoring what goes on in their local areas.
- Local communities should be involved in all stages of planning and implementing forestry projects.
- National and global governance structures need to be created that encourage transparency and redress corrupt practices.

These socio-economic and institutional arrangements are designed to ensure that local communities will have both the responsibility and accountability for protecting and enhancing forest restoration through ANR or other appropriate means, while at the same time securing the benefits that should accrue to them in a more sustainable and equitable manner. For example, at the national level in the Philippines, the implementation of ANR was facilitated by the issuance of Memorandum Circular Number 17, Series of 1989, which prioritized the application of the ANR method in the development of watersheds, protection and production forests. In the International Convention on Biological Diversity (CBD) and the recently adopted FAO-initiated International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA), these rights of communities to equitably share the benefits derived from use of these local plant genetic resources and indigenous knowledge are also secured. At the local level, the use of appropriate local and traditional institutions to support and implement ANR or any other community-based natural resource management has also proved to be effective in many situations.

Implementation constraints of ANR

There are some constraints in the application of ANR as a forest restoration strategy. These include:

- A lack of basic knowledge of ecosystem dynamics, which would facilitate the application of ANR technology, including the ecological requirements of natural regeneration species.
- The labor and knowledge intensive nature of the strategy, which can make it costly if not done properly.
- Weak policy and incentive systems associated with the need for appropriate land tenure and benefits derived from the restoration of forest diversity.

Ecological knowledge limitations

The current level of knowledge about the interrelationships among components of the ecosystems where ANR is to be applied is very limited. For example, neither the intra- and inter plant species interactions, nor the plant-animal interactions, including soil microbial organisms, are understood clearly. More directly, the knowledge of the ecological requirements of the species involved in ANR is inadequate. For ANR to succeed, this basic ecological knowledge must be strengthened as forest restoration must meet the objectives of attaining not only a desirable level of biodiversity, but more significantly a functional type of diversity. This functional diversity should enhance productivity, the protective character of the forest cover and the sustainability of the products and services it generates.

An immediate and long-term concern is the impact of ANR on plant genetic diversity. In forest restoration, a key element of long-term significance to the productivity and sustainability of this ecosystem is plant genetic diversity. For example, the study of Wickneswari and Lee (2001) indicates that there is an apparent decline in the genetic diversity of *Scapium macropodum* in the logged areas in Malaysia. This aspect is very important to consider as one of the objectives of ANR is the restoration of the genetic diversity of the ecosystem. Genetic diversity forms the basis of adaptive flexibility in populations and the ultimate evolutionary potential of a particular species.

This lack of knowledge of the ecological processes in plant succession makes it difficult to operationalize ANR. For example, site assessment, which is an important aspect of ANR, entails an extensive analysis of the above and below ground processes (soil, light temperature). This analysis is both time consuming and expensive and forms a barrier to the simple implementation of ANR. There is a need to look for simple indicators of tree seedling density and soil conditions using specific biotic indicators (plant species, arthropods or insects and other animals). The monitoring and assessment of the effectiveness of ANR can also be a labor-intensive and costly process. This is especially so if there is a regular survival monitoring process, instead of just a total protection approach, combined with fast but effective monitoring. Such monitoring could be achieved through an indicator such as canopy development, provided that the macro-level site conditions are closely associated with the requirements of the key species in the ANR area.

Socio-cultural and institutional constraints

The biggest challenge is to overcome the constraints of inappropriate or lack of economic incentives, land tenure and national policies, which limit the benefits derived by communities in forest restoration through ANR. In this regard, the provision of mechanisms for community participation and the use of local knowledge in the implementation of ANR is critical. If the communities are to become effective implementers of ANR, they must have some security and assurance that they will benefit from this ecosystem restoration process, especially with regards to its long-term products and services. This can be in terms of promoting high value and market-oriented products such as medicinal plants, as long as this is done in a sustainable manner. For protection forest, local communities can be contracted by the government for the establishment of forest cover through ANR. However, their relationship to the accruing benefits should also be discussed and agreed upon on a long-term basis. An appropriate national land-use policy which contextualizes the appropriate use of ANR technologies for forest restoration will provide an overall framework to enhance its effectiveness and efficiency.

Another urgent need is to systematically document and assess the experiences and lessons learned from the implementation of ANR in other regions. This can be used as a source of feedback for the identification of priority research and the improvement of future implementation of similar strategies for forest restoration.

Conclusion

Forest restoration is needed in many areas in the tropics and poses a big challenge for national governments and international organizations. In many instances, this process is not only expensive but also ineffective. One option or strategy for forest restoration is ANR. ANR is beginning to gain ground because it works with or mimics nature, which makes it less costly, enhances biodiversity and is more effective.

However, to be effective, the ANR strategy should develop as a result of the synergistic and complementary interactions between the technological factors, socio-cultural elements and the natural resource base, with the ecological process of plant succession. These interactions and relationships must be well understood and used as the basis for the application of this forest restoration strategy.

The constraints to effective implementation of ANR require more research, especially on the basic ecological relationships which drive plant succession. It is only through an improved understanding that one can enhance the effectiveness of ANR. Similarly, the socio-cultural and institutional context of ANR should also be studied and effectively used as leverage for its effective implementation. After all, it is still people and human societies who must work with nature to fully benefit from this nature-people relationship in support of sustainable development.

References

Adjers, G., Hadengganan S., Kuusipalo J., Nuryanto K. & Vesa L. 1995. Enrichment Planting of Dipterocarp in Logged-Over Secondary Forest- Effect of Width, Direction and Maintenance Method of Planting Line on Selected Species of *Shorea* species. *Forest Ecology and Management,* 73:259-270.

Ashton, P. S. 1969. Speciation Among Tropical Forest Trees: Some Deductions in the Light of Recent Evidence. *Biological Journal of the Linnaean Society,* 1: 155-196.

Castillo, A. Sta Ana. 1986. *An Analysis of Selected Reforestation Projects in the Philippines*. University of the Philippines at Los Banos, College, Laguna. 199pp. (Ph.D. Thesis)

Clements, F.E. 1916. *Plant Succession: An Analysis of the Development of Vegetation*. Washington: Carnegie Institute of Publications, No. 242.

Chokkalingham, U. 2001. Secondary Forests Associated with the Rehabilitation of Degraded Lands in Tropical Asia: A Synthesis. *Journal of Tropical Forest Science,* 13(4): 816-31.

FAO. 1996. *Forest Resources Assessment 1990. Survey of Tropical Forest Cover and Study of Change Processes*. FAO Forestry Paper 130. Rome, Italy, 152pp

FAO. 2001. *Global Forest Resources Assessment 2000*. FAO Forestry Paper 140. Rome, Italy, 479 pp.

Goetsch, E. 1992. *Natural Succession of Species in Agroforestry and in Soil Recovery*. Unpublished.

Horn, H.S. 1974. The Ecology of Secondary Succession. *Annual Review of Ecology and Systematics*, 5: 25-37.

Kartawinata, K., Riswan S., Gintings A.N. & Puspitojati T. 2001. An Overview of Post-Extraction Secondary Forests in Indonesia. *Journal of Tropical Forest Science*, 13(4):621-638.

Kuusipalo, J., Jafarsidik Y., Adjers G. & Toumela K. 1996. Population Dynamics of Tree Seedlings in a Mixed Dipterocarp Rainforest Before and After Logging and Crown Liberation. *Forest Ecology and Management*, 81:85-94.

Lanh, L.V. 1994. Establishment of Ecological Models for Rehabilitation of Degraded Barren Midland in Northern Viet Nam. *Journal of Tropical Forest Science*, 7: 143-156.

Leach, M., R. Mearns & Scooners, I. 1999. Environmental Entitlements: Dynamics and Institutions in Community-Based Natural Resource Management. *World Dev*., 27: 225 247.

Margalef, R. 1968. *Perspectives in Ecological Theory*. University of Chicago Press, Chicago.

Mueller-Dombois, D. & Ellenberg, H. 1974. *Aims and Methods of Vegetation Ecology*. New York, John Wiley and Sons.

Pakkad, G., James C., Elliot S., Anusarnsunthorn V. & Blaksley D. 2002. Forest Restoration Planting in Northern Thailand. *In* Koskela, J., Appanah S., and Pedersen A.P. (eds), *Proceedings of the Southeast Asian Moving Workshop on Conservation, Management and Utilisation of Forest Genetic Resources.* FORGENMAP/IPGRI/ FORSPA/DFSC/RFD. In press.

Poffenberger, M. (ed). 2000. *Communities and Forest Management in Southeast Asia*. WG-CIFM, IUCN, FF, DFID and AFN, 137 pp.

Rosli, Z. & Zakaria, M. 2002. Immediate Effects of Selective Logging on the Feeding Guild of the Understorey Insectivorous Birds in Ulu Muda Forest Reserve, Kedah, Malaysia. *Proceedings, Regional Symposium on Environment and Natural Resources*. Hotel Renaissance, Kuala Lumpur, Malaysia, April 10-11, 2002.

Sajise, P.E. 1972. *Evaluation of Cogon (Imperata cylindrica* (L.) Beauv.*) as a Seral Stage in Philippine Vegetational Succession: I. Cogon as a Seral Stage in Plant Succession, II. Autecological Studies in Cogon.* Cornell University, Ithaca, New York. (Ph.D. thesis).

Sajise, P.E. & Orlido, N. 1973. Cogon as a Seral Stage in Philippine Vegetational Succession. *The Philippine BIOTA*, 6:4

Sajise, P.E., Orlido N.M., Lales J.S., Castillo L.C. &. Atabay R. 1976. The Ecology of Philippine Grasslands: I. Floristic Composition and Community Dynamics. *Philippine Agriculturist*, 59: 317-334.

Sajise, P.E. 1989. Plant Succession and Agroecosystem Management, pp 141-153, *In* Rambo, A. T. and P. E. Sajise (eds), *An Introduction to Human Ecology Research on Agricultural Systems in Southeast Asia*. UPLB, College, Laguna, Philippines, 327 pp.

Sajise, P.E. 1989. *Assisted Natural Regeneration (ANR) as an Approach to Reforestation. Assisted Natural Regeneration Training Manual.* DENR, Quezon City, Philippines. Unpublished.

Sanchez, Y., Zhou X. & Borges, S. 2001. Increase in Earthworm Diversity and Recovery of Native Earthworms During Secondary Succession in Old Tropical Pastures. Pp 480-482. *In* Ganesh, K.N., Uma Shaanker R., and Bawa K.S. (eds), *Tropical Ecosystems: Structure, Diversity and Human Welfare*. ATREE, New Delhi, India, 792 pp.

Sastrawinata, H.A. & Effendy, R. 1991. The Influences of Several Liberation Treatments on the Natural Regeneration of Dipterocarps in Logged-Over Forest in Kintap, South Kalimantan. Pp 395-405. *In* Sorieanegara, I., Tjitrosomo, S.S., and Umaly, R. (eds) *Proceedings of the Fourth Round Table Conference on Dipterocarps.* BIOTROP, Bogor, Indonesia, 12-15 December, 1989.

Schmidt-Vogt, D. 2000. Secondary Forests in Swidden Agriculture in the Highlands of Thailand. Tropical Secondary Forests in Asia: Introduction and Synthesis. Paper prepared for the "*Tropical Secondary Forests in Asia: Reality and Perspectives Workshop*", 10-14 April, 2000. Samarinda, Indonesia. Center for International Forestry Research, Bogor, Indonesia.

Shiels, A.B. & Walker, L. 2001. Accelerating Plant Colonization on Landslides in Puerto Rico by Additions of Bird Perches and Organic Matter. Pp 661-664. *In* Ganesh, K.N., Uma Shaanker R., and Bawa K.S. (eds), *Tropical Ecosystems: Structure, Diversity and Human Welfare*. ATREE, New Delhi, India, 792 pp.

Smith, J., van de Kop, Reategui P., Lombardi K., Sabogal C. &. Diaz, A. 1999. Dynamics of secondary forests in slash-and-burn farming: interactions among land use types in the Peruvian Amazon. *Agriculture, Ecosystems and Environment*, 76:85-98.

Tuomela K., Kuusipalo J., Vesa L., Nuryanto K., Sagala K. & Adjers G. 1996. Growth of Dipterocarp Seedlings in Artificial Gaps: An Experiment in Logged-Over Rainforest in South Kalimantan, Indonesia. *Forest Ecology and Management*, 81: 95-100.

UNESCO. 1978. *Tropical Forest Ecosystems*. A State of Knowledge Report Prepared by UNESCO/UNEP/FAO. UNESCO-UNEP, Paris, 670pp.

Wicknaswari, R. & Lee, Chai-Ting. 2001. Assessment of Genetic Diversity of *Scaphium macropodum* in Logged Over Forests Using Isozyme and RAPD Markers. Pp 104-109. *In* Ganesh, K.N., Uma Shaanker R., and Bawa K.S. (eds), *Tropical Ecosystems: Structure, Diversity and Human Welfare*. ATREE, New Delhi, India, 792 pp

TEN ASPECTS OF ASSISTED NATURAL REGENERATION IN THE ASIA-PACIFIC REGION

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Introduction

The recent report on the *State of the World's Forests* (FAO, 2001), highlighted the increasing roles of communities in forest management. However, no emphasis was placed on the significant potential of assisted natural regeneration. This exemplifies the overall lack of attention given to this promising approach. This paper highlights ten aspects of assisted natural regeneration (ANR) that warrant increased attention if ANR is to move forward successfully. These are:

1. Environments or biomes of the region
2. Different forms and understanding of ANR
3. Traditional systems
4. Relation to local communities
5. Constraints and impediments
6. State of the art of ANR
7. Patterns of regeneration
8. Development mechanisms
9. Research needs and topics
10. Building strategies and agendas

Environments of the region

Whitmore (1990) describes 14 tropical forest formations in the Asia-Pacific region. These forest types and their characteristic ecologies require ongoing study for their regeneration to be understood, not to mention the diversity of responses and levels of technical and social consideration that are just as complex. For example:

- Today nearly all environments and their distribution are understood to be affected by human activities. All of the ecosystems we are now trying to rehabilitate in different areas, whether forest or not, have been significantly altered by human activities.
- People tend to only consider forests in the uplands and, if they exist, in the lowlands. However, mossy forests, swamp forests and coastal mangroves, even though just as important, are often regarded as being marginal rather than critical.
- The bio-physical factors of climate, soils, etc., influence natural regeneration through very different time frames; therefore, the effort of assistance requires the knowledge of how to align these factors for more rapid change while reducing the risk.

Different forms and understanding of ANR

There are numerous forms and understanding of what constitutes ANR in different places. These need further consideration and deliberation in order to reach common understanding. Among the relevant questions to be resolved are the following:

- If human interaction affects all forests, do the compensatory activities have to be both conscious and area-focused to be considered ANR?
- "Natural" or "original" cover usually refers to the ecosystem (or at least the species composition) that occurs in undisturbed areas. Therefore, to assist –

where the natural vegetation has largely been lost – is to do so with pioneer species, or those that would play that role in the path of succession. Can this be considered ANR, as long as the effort is focused on attaining the original species, albeit selected with a bias?

- When farmers develop whole new plant "cultures" of agroforestry species that mimic the structure or diversity of the original forest, but do not include the species of the original forest, should these areas be considered as ANR?

Traditional systems

It is in traditional systems that people are most convinced of the efficiency of ANR. People are more easily convinced once seeing the how local people apply ANR. However, the challenge is for the "culture" of broader society to translate such integrity of local action into national strategies. The daily operations of a globalizing society must integrate such traditional knowledge in such a way that it becomes indispensable to the daily understanding of sustainability in our society. Attention needs to be given to the following issues:

- All countries have traditional systems of various forms. Government institutions, however, often fail to recognize the need to learn from such systems and to give them greater support.
- The historical labeling of traditional systems, such as "slash-and-burn," needs to be revised. It must also be recognized that the pressures are becoming increasingly too great for any single culture to maintain a sustainable forest regeneration system by traditional means alone.
- Culturally, traditional systems of ANR are usually managed in conjunction with a whole way of life and broader land-use management approaches. What consideration is given to the total cultural picture and how much attention do we give to the part that is not focused on the "natural" but on the "cultural"?

Relation to communities

The greater recognition of traditional practices is undeniable, and much is being learned from studying and working with these systems. However, the extent of involvement on the ground has to be much broader and has to incorporate social units that are more extensive in area and more connected to the political economy. Communities are restricted in many ways by the limited legal agreements and by the limited and often contradictory support or incentives given:

- Area appropriateness and the extent of possible management needs to be understood for the individual, village and broader social grouping.
- Costs in terms of time spent and lag times in returns from the new level of protection and limited extraction have to be creatively compensated, without creating dependencies.
- Benefit sharing and remuneration for maintaining areas in the long term are few, yet it is often not practical to leave these areas under government management.

Constraints and impediments

There are widespread constraints and impediments that face most environmental recovery efforts in the rural environment. The following constraints need to be reviewed specifically with respect to ANR:

- Poverty, the lack of basic social services and instability, illegal extraction and forest violence amidst the full range of social and economic pressures are prevalent.
- Basic policy is lacking for ANR, and there is over regulation of communities, inadequate program implementation and a lack of support for communities in their efforts to stop illegal activities.
- The fast returns from plantations, involving more direct and simple economic planning compared to the lack of technical know-how, financial support and tenure and extraction rights for ANR, put ANR at a fundamental disadvantage in many areas.

State of the art of ANR

"State of the art" is one of the few phrases that incorporates the sense of modernity and culture, the technology and the uniqueness of human creativity. The present state runs from the most basic to the most recent discoveries:

- Fire management is one of the most basic and traditional crafts in land-use management; controlling fire is essential to assisting natural regeneration.
- Existing practices amid the diversity of cultural, ecological and political contexts are being documented and need adequate circulation and incorporation into policy, planning and programming.
- Tissue culture is now possible in most countries and allows for a level of reproduction of planting materials and a diversity not previously attainable.

Patterns of regeneration

Along with agricultural intensification, the global pattern of vegetation cover is expected to alter strategically, in terms of area and composition (Wood et al., 2000). The difficulty is to protect critical areas, especially in the uplands.

In many countries of Asia, attempts to increase forest cover have been largely unsuccessful. The pattern of regeneration in different areas is patchy and the density of regeneration is inadequate in many cases. There are, however, an increasing number of substantial reports indicating the success and extent of ANR, including the following:

- There is a shift from discarding patches of undetermined cover, peripheral or wasteland that are seen to regenerate, to seeing such lands as directly buffering the forest from further ecological damage. Increasingly, patches of regeneration need to be seen as critical, integral, accumulative, enriching and diversifying in sustainable forest land management.
- There is widespread confirmation, by remote sensing data, of area-specific regeneration along old forest margins.
- The quality of regeneration in terms of biodiversity and ecological services is increasingly being considered in planning and programming.

Development mechanisms

Translation of existing and emerging knowledge on ANR into effective support mechanisms for forest regeneration is an ongoing challenge. A serious shift in support mechanisms beyond studies and pilot activities needs to enter national and bilateral agendas. Maintaining forest must be seen as an active process, in the light of pressures and competition from other sectors; the approach requires careful identification of stakeholders and development of organizational relations, silvicultural skills, sustainable extraction practices and market linkages. The “quality of life” concept needs to be reintroduced into development paradigms to replace the present overly politicized “terrorism and poverty alleviation” phraseology frenzy.

Research needs and topics

There are both technical and social research considerations that need greater attention and effective development. Complementing studies are needed in the following areas:

- Management initiatives and mechanisms (as introduced above).
- Bio-physical and physiological aspects of plants, especially as related to conservation of plant genetic resources and the access and utilization of related technologies.
- Environmental, social and area impacts of ANR and the breadth of its impact on how society and global systems operate.

Building strategies and agendas

Challenges remain on all fronts while the importance and potential of ANR is known and internalized by only a few at present. Part of trying to make ANR an acceptable and obvious strategy is that it loses its specific and decisive focus and becomes part of a general plan (sometimes in relation to poverty alleviation etc.), in which it is the weaker component and loses out. There is a need for much greater discussion and publicizing of its potential for forest regeneration. A primary agenda has to be developed with local governments to define their role in environmental management and protection of ecological services, while simultaneously instilling a sense of local value. The nature of support needed to enhance ANR is not that of typical development loans; rather, such assistance could focus on changing the political attitude and policy environment.

Conclusion

ANR has the potential to contribute significantly in addressing the region’s forest rehabilitation challenges. Although there are still several needs and requirements to fulfill in order to ensure widespread successful application of ANR, these constraints can be overcome with increased awareness, commitment, research and training.

References

FAO. 2001. *State of the World's Forests 2001*. Rome. FAO.

Whitmore, T. C.1990. *An Introduction to Tropical Rainforests*. Oxford. Clarendon Press.

Wood, S., Sebastian, K., & Scherr, S.J. 2000. Agricultural Extent and Agricultural Land Use Changes. Pilot Analysis of Global Ecosystems (PAGE). *Agroecosystems*. pp. 17-30. Source: www.wri.org/wr2000/agroecosystems-page.htm

MUYONG FOREST OF IFUGAO: ASSISTED NATURAL REGENERATION IN TRADITIONAL FOREST MANAGEMENT

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Introduction

The inhabitants of Ifugao, in the Philippines, have developed a unique way of life, reflected in the way they grow and tend forests. This unique system of tending forests has been referred to in the literature as the "muyong system," coined from the local dialect meaning forest or woodlot. The muyong system has been recognized internationally as an ideal forest management strategy that is deeply ingrained in the culture of the Ifugao people.

The muyong system can be viewed from different perspectives, either as a forest conservation strategy, a watershed rehabilitation technique, a farming system or an assisted natural regeneration (ANR) strategy. While the system can be viewed from different perspectives, the role of culture in the development and continued maintenance of the system is pervasive. Although not readily apparent to the casual observer, an intricate web of relationships exists between the human and non-human resources of the system, which move to a higher sphere in the spirit world (Ngidlo, 1998). Ifugao culture and laws revolve around their physical environment, expressed in customs and taboos prescribing the treatment and use of environment and natural resources.

This paper documents and presents the Ifugao muyong system as an ANR strategy within the context of traditional forest management. It is with such blending of indigenous frameworks with learned forestry interventions that significant progress can be made in developing viable ANR alternatives.

The Ifugao muyong system

Muyong are traditionally inherited properties and are privately owned, although owners do not possess title deeds. Ownership is simply defined by inheritance and this mode of ownership transfer is highly respected and recognized by everybody within the cultural vein. The muyong plays an important role within the tribal economy. It is the primary source of fuelwood, construction materials, food and medicines.

Dacawi (1982) reported that the typical muyong consists of a few hundred square meters to about 5 hectares. Klock and Tindungan (1995), on the other hand, discovered that in Mt. Amuyao (the second highest peak in Ifugao) the standard muyong woodlot ranged from 0.6 to 2.4 hectares.

The muyong is a storehouse of both flora and fauna (Ngidlo, 1998). A recent study conducted by Rondolo (2001) found that the muyong contained 264 species, mainly indigenous, belonging to 71 plant families. *Euphorbiacea* was the most dominant family followed by *Moracea, Meliacea, Leguminosae, Poacea, Anacardiacea* and *Rubiacea* respectively. The number of species per woodlot ranged from 13 to 47 species, mostly endemic in the region. Out of the 264 species, 234 were considered useful and the rest (mostly grasses) were reported to have no known use.

The Ifugao agro-ecological zones consist of five key components, namely: micro forest (*muyong* or *pinugo*), swidden fields (*habal*), terraced paddies (*payo*), settlement districts (*boble*) and braided riverbeds (*wangwang*). As a whole, Ifugao agroecological zones represent a hilly type or a watershed model production system.

The subsistence economy in Ifugao revolves around the production of rice in terraced paddies (Klock and Tindungan, 1995). Cultivation of rice paddies is highly dependent on water. The muyong is a major component of the production system serving as the primary recharge zone. As the recharge zone, it provides water and stability to the other components of the production system. Water flowing out of the muyong, located at the upper fringe, dictates the overall physical soundness of terrace cultivation and the condition of the whole watershed unit. Traditionally, the Ifugaos give utmost emphasis to the proper management of muyong resources. This is in recognition of its significant role in the long-term sustainability of the rice-based terrace cultivation system.

The muyong as ANR strategy

The muyong is living proof of the Ifugao's knowledge of silviculture, agroforestry, horticulture and soil and water conservation. The Ifugaos successfully practiced ANR before its recognition in the forestry sector as a strategy for forest regeneration. The Ifugaos attribute value to the forest on the basis of their cultural ways and practices.

Forestry development nowadays recognizes the value of integrating indigenous systems of forest management. In the search for alternative ANR frameworks and strategies, it is befitting to consider the muyong system of the Ifugaos. The ANR strategies adopted in the muyong are discussed below.

Agroforestry and multiple cropping

The Ifugaos are considered traditional practitioners of agroforestry. The Ifugaos adopted agroforestry in woodlots and multiple cropping in swiddens as an economic insurance in case of crop failure in the terraces. The integration of value-added tree crops and herbs in natural muyong vegetation and swiddens has been found to be highly compatible. Species preferred for integration in natural vegetation are: rattan, coffee, santol and citrus, while bananas, taro and cadios (*Cajanus cajan*) are integrated in swidden farms. A study by Rondolo (2001) found that almost all woodlots contained commercial plantings of coffee (88 percent), bananas (66 percent), and citrus (49 percent). Edible rattan (*Calamus manillensis*, littuko) is also included in almost all woodlots. Rattan is integrated in woodlots for its edible fruits and poles/canes for handicraft. Bettle palm (*Areca catechu*) and ikmo (*Piper* spp.) are also cultivated in the woodlots for bettle nut chewing, ritual purposes and their medicinal values.

Enrichment planting and protection

Enrichment planting with forest species is also done in woodlots to enhance diversity. Included in enrichment planting are fast-growing reforestation species and other fruit trees. The Ifugaos have the propensity to grab every opportunity to plant trees whenever seedlings are available. In the traditional tourism areas in Banaue, particularly Cambulu and Battad, hamlets of 10 to 30 families have banded together to protect whole hillside areas of public forest to ensure that their terrace paddies will have water in perpetuity. Forest protection is a common traditional concern of all villagers in Ifugao. Intrusion in muyong areas is dealt with severely. A person caught cutting trees without permission is fined and required to pay with pigs and chickens corresponding to the value of the trees cut. In the past, the guilty individual usually had to pay the fine or else face the possibility of being banished or killed.

Efficient silvicultural systems

The Ifugaos have been using ANR quite successfully without professional intervention for many years. Implicit in the application of ANR is an array of silvicultural systems learned by the Ifugaos through constant interaction with their muyong resources. Activities include thinning, cleaning, pruning and salvage cutting. These activities are done to enhance the growth and development of natural stands. In addition, harvesting of timber crops is highly selective by nature. Selection is based on the muyong owner's extensive knowledge of the various tree species and their uses. According to Rondolo (2001), the Ifugaos have their own plant classification system. Plants are classified based on taxo-morphological characteristics and according to use. The Ifaguos' knowledge of rattan classification is more detailed and accurate than most formally trained botanists.

Harvesting of timber crops is seasonal, except in extreme cases where wood is urgently needed. Seasonal cutting is an important silvicultural practice, which is highly beneficial as it allows the forest to recover from previous disturbances prior to harvesting again.

Whole tree harvesting and good wood utilization practice

Muyong owners follow an efficient system of timber utilization referred to as whole tree harvesting. In most cases, trees are harvested for multiple uses as may be defined by each muyong owner. Roots and buttresses are often excavated from the ground with a few feet of remaining trunks cut according to length for use as vertical columns (gamut) to support four cornered single room native houses. The remaining branches are cut according to length and then brought home for general use. Branches and small twigs are also gathered and then bundled for fuelwood or fencing purposes. Only the leaves are left in the forest to decompose. The Ifugaos who own woodlots share the bounty by allowing their co-villagers to avail of the remnants of the harvested trees for fuelwood. It is common practice among muyong owners to allow the have-nots to harvest one or two trees for house construction, after proper permission has been obtained.

Many authors contend that Ifugaos are natural tree growers. However, it was only recently that Ifugaos adopted tree planting in sparsely vegetated woodlots, as a measure to restore depleted wood cover. In the past, the Ifugaos migrated to areas where forests existed and from there began to transform the landscape into other productive uses. What is most convincing, however, is the wealth of indigenous knowledge systems employed by muyong owners in the management of forest resources.

While others may call it superstitious, the Ifugaos harvest their trees only when their leaves are matured and not when they have just changed leaves. They believe that felling mature trees that have new or young leaves renders the wood susceptible to insect attack. They also avoid cutting down trees when there is a full moon because they believe that the wood is easily destroyed by wood-boring insects. During felling operations, the Ifugaos ensure that a tree falls directly to the ground. A tree that leans and keeps hanging or suspended on a neighboring tree is a bad omen. The wood is no longer used for construction, instead, it is utilized for less important uses.

Lessons learned

The Ifugaos have aptly shown that ANR can be used effectively to transform woodlots into multiple-use centers without disturbing the pristine condition of the natural forest. Among the factors related to the success of ANR within the Ifugao landscapes are the following:

Linkage with economic values

Successful ANR strategies have been tied to and integrated with economic values. The profit function of the forest can be further enhanced when linked to the prospect of getting profits in the future. The Ifugaos have taken advantage of the beneficial effects of natural stands by converting them into tree-based agroforestry schemes. The prospects for adoption can be enhanced if ANR focuses on tree species with economic value. Tree planting for protection purposes alone is now an outdated paradigm. There is a need to put economic value on trees as an ultimate goal of forest regeneration. ANR should seen as a tool for promoting rural livelihoods.

Linkage with environmental values

ANR should support other environmental concerns. For example, ANR in the muyong serves to support not only the economic activities of the inhabitants but also the integrity of other agroecological zones dependent on the forest itself. The rallying point of many reforestation projects is that of supporting macro-economic structures such as hydroelectric power sources and other concerns of general welfare. It is difficult for local communities to see the values of such assertions. What is more important in rallying public support for ANR activities is that is based on site-specific or locality-based economic concerns. The Ifugaos' need for more wood raw material for the expanding wood carving industry could be such a demand-focused ANR concern.

Issues and recommendations

Some of the issues and problems affecting the Ifugao muyong system inlude:

Use of fast-growing species

Muyong owners are now practicing enrichment planting to enhance depleted muyong areas. While many would like to use indigenous tree species, muyong owners have no other recourse than exotic species, since seedlings for these species are rare to find. Some examples are kalantas (*Toona kalantas*) and sangilo (*Pistacia chinensis*). However, some muyong owners are deliberately using fast-growing species for ANR or enrichment planting to take advantage of the short rotation periods. Use of fast-growing species like *Gmelina arborea Swietenia macrophylla* and *Cassia spectabilis* are threats to muyong biodiversity. It is recommended that research be conducted on the mass propagation of muyong species for reforestation. Building linkages with academic and other research institutions could help achieve this.

Inappropriate extension strategies

There have been instances of inappropriate approaches being encouraged by development projects, ostensibly to help muyong owners cope with the various problems besetting the wood carving industry of the Ifugaos. For instance, there have been cases where muyong owners were enticed to clear portions of their woodlots for replacement with exotics. In some cases, local people were taught to clear muyong forests for tambo or tiger grass production, or to implement sloping agricultural land technology (SALT), which is completely alien to what the people have been doing in the area. There is a need to reorient extension strategies to start with what the people have, before expanding into other areas, if necessary.

Incorrect perceptions of government policies and laws

In many cases, people have a misperception of various government policies and laws, which hamper people from participating effectively in government-sponsored programs. Even under the Community Based Forest Management Program (CBFMP), people fear that the government might take the land from them. The deep-seated animosity between government forestry officials and local people could be an after-effect of the punitive approaches practiced by the government in the past. Strategies to promote ANR should be backed up by massive information-education-communication campaigns to improve social and technical integration. Moreover, policy measures that impinge upon the productive existing ANR practices of indigenous peoples should be changed or reconsidered.

Conclusion

Indigenous forest management systems could be very good tools in promoting forest development and watershed management, not to mention agriculture. Perhaps it is time for government officials to listen to the "people in them thar hills", like the Ifugaos who obviously possess time-tested solutions to some problems. As an eminent participant in a recent steering committee meeting of the JICA-assisted CBFM project in the Cagayan and Upper Magat river basins stated in describing the Muyong system, "Why tinker with something that has worked for so many generations?"

References

Dacawi, R. 1982. The Ifugao way of forest conservation. *Philippine Upland World* 1, 2: 14-15.

DTI. 1996. *Gifts, toys and housewares*. Industry Profile. Lagawe, Ifugao

Klock, J. & Tindungan, M. 1995. The Past and the Present. A meeting of forces for a sustainable future. *Forest, Trees and People Newsletter*. Issue no. 29. FTP Program Network.

Ngidlo, R.T. 1998. *Conserving biodiversity: The case of the Ifugao farming system*. PCARRD, Los Baños, Laguna.

Rondolo, M.T. 2001. Fellowship Report. *Tropical Forest Update*. Vol. 11, No. 4. ITTO, Japan.

ASSISTED NATURAL REGENERATION IN CHINA

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Introduction

Approximately 3.67 million square kilometers, or some 38.3 percent of the total land area of China, are seriously eroded. Soil erosion is increasing at a rate of 10 thousand square kilometers per year. The desert soil areas of China cover 2.62 million square kilometers, accounting for 27.3 percent of total land area. Deserts are expanding at an annual rate of 2 460 square kilometers. Since the 1990s, sand storms have occurred more frequently during the spring season, especially in northern China. In brief, environmental degradation is a serious problem demanding immediate and urgent attention to hasten the process of land greening with trees and grasses. Assisted natural regeneration (ANR) can play an important role in this process.

In China, ANR can be divided into two main categories: special ANR and general ANR. *Special ANR* is practiced on cutover land with natural sowing capacity, but lacking some of the essential requirements for natural regeneration. Artificial assistance measures such as soil preparation are conducted to improve site conditions for forest establishment. *General ANR* refers to regeneration and afforestation accompanied by artificial sowing, tending and other treatments. It is conducted on barren hills, waste lands, barren desert lands, cutover lands, river banks with important ecological status, sandy regions damaged by wind and so on. The objective is the establishment of vegetative cover to protect the land. In regions where some natural sowing occurs, hillsides are "closed" to most forms of exploitation for a number of years (depending on local conditions). Use of the land is restricted or prohibited during the closure period in order to facilitate forest establishment from natural seed fall. In regions where natural sowing and natural regeneration are difficult, the practice of closing hillsides is combined with aerial sowing of tree and/or grass seeds.

Hillside closure is a system that includes both administrative and management measures. Three types of hillside closure are distinguished in China:

(1) Full-closure is adopted for a period of three to five years or eight to ten years (depending on local conditions) in regions such as remote mountains, upper reaches of rivers, water catchments of reservoirs, sites characterized by severe soil erosion, desert soil areas subject to wind damage and other regions where natural regeneration is difficult.

(2) Semi-closure is practiced in areas where some target tree species are growing well and where the percentage of forest cover is relatively high. Under semi-closure, strict protection is prescribed to protect the saplings and seedlings of target tree species. However, controlled cutting of firewood and grass may be allowed.

(3) Full-closure and semi-closure are combined in regions where farmers are very poor and firewood is scarce. Full closure periods alternate with semi-closure periods. There are no fixed standards. The lengths of full or semi-closure are variable depending on the progress achieved in restoring vegetative cover.

Forest cultivation refers to the implementation of measures that promote forest establishment. Soil cultivation and other management activities are carried out to improve conditions for tree growth and to harness the natural reproductive capability of trees or grasses. Concurrently, silvicultural treatments are applied to enhance forest quality such as replanting, reseeding, tending and so on.

Aerial sowing is combined with hillside closure. Airplanes are used to spread tree or grass seeds under suitable conditions. The sites selected for aerial seeding include the types of land mentioned above, where the chances of successful regeneration with minimal human assistance are high. Under favorable conditions, the seeds germinate, grow, and eventually mature into a forest.

As of 2001, over 30 million hectares of forest had been established through the hillside closure system. Aerial sowing of tree or grass seeds had been implemented in 931 counties of 26 provinces (autonomous regions and municipalities directly under the Central Government). Approximately 8.68 million hectares of forests had been established via aerial seeding, combined with hillside closure. This accounts for 25 percent of the total artificial forests of China. ANR has played a very important role in expanding forest resources, controlling soil erosion, retarding the process of desertification, improving the ecological environment and improving the living conditions of farmers.

There are five principal constraints that have impeded expansion of ANR practices in China:

1. Most of the forests established through hillside closure, or aerial sowing combined with hillside closure, are "shelter forests." As such, they have relatively low economic value. Given the meager benefits, many farmers are not willing to practice hillside closure.
2. Previous levels of investment in these regeneration patterns were insufficient and the implementation time frame was not long enough to ensure success. Prior to 2000, the investment in hillside closure was only 3.0-7.5 yuan RMB (US$0.35-0.90) per hectare. The amount allocated for aerial sowing combined with hillside closure was only 150 yuan RMB (US$18) per hectare.
3. There are no quantitative technical systems to evaluate the standards of established forest, nor the ecological and economical benefits of these regeneration practices. Consequently, the practices are often perceived as extensive in area, but low in terms of effective forest establishment.
4. In forests established by aerial sowing combined with hillside closure, the density is too high and the quality of these forests is relatively poor. This is due to a lack of appropriate tending and insufficient financial resources to invest in tending.
5. The land types selected for aerial sowing are located in areas that are difficult to afforest due to poor site conditions. There is a need for improved and more advanced techniques. Many techniques have been tried, but few have proven useful or effective to date.

Promoting ANR practices in China

Fortunately, since 1999, the Government has taken new initiatives to accelerate the process of afforestation and improve ecological conditions. First of all, six principal forest ecology programs have been launched covering more than 97 percent of all counties in China. The scale of investment is unprecedented in the history of the country. The goal is equally impressive. Sixty million hectares are targeted for afforestation. Secondly, 685 counties and 24 State Nature Reserves in 11 provinces have been selected for implementation of pilot projects, where the development of eco-forests will be subsidized. The pilot projects cover 13.33 million hectares of shelter forests and special forests.

Under these programmes, the investment and scale of ANR-related initiatives have increased significantly. Based on the overall plan of key forestry ecological programs, hillside closure will be practiced on 13.35 million hectares from 2001 to 2010. Levels of investment will increase from the former 3 to 7.5 yuan RMB per hectare to 1 050 yuan RMB (US$128) per hectare. Total investments in these regeneration practices will reach 14 billion yuan RMB (US$1.7 billion) in the next 10 years.

Aerial sowing of tree seeds combined with hillside closure will be launched on 10.89 million hectares. Budgets for this method of forest regeneration will be increased from 150 yuan RMB per hectare to 1 800 yuan RMB (US$220) per hectare. In the next ten years, 19 billion yuan RMB (US$2.3 billion) will be invested in aerial sowing combined with hillside closure.

Given the increased levels of investment and the new programs, one can anticipate that ANR will henceforth play a more important role in the process of afforestation and improvement of environmental conditions in China.

IMPLEMENTATION OF ACCELERATED NATURAL REGENERATION IN INDONESIA

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Introduction

Forest resources have the potential to continuously create wealth for the nation and for the people living near and within forest areas if appropriate management practices are applied. In order to achieve these objectives, forest management systems must be technically sound and also transparent in all aspects of administration. Transparency will encourage people's participation. Management must provide the people with access to benefits without sacrificing the commitment to maintain a balanced ecosystem.

Strategies pursued in Indonesia to bring about sustainable forest management emphasize the application of silvicultural treatments that enhance forest functions based on intended objectives. These treatments aim at preventing deforestation, while concurrently restoring productive capacity and the stability of forest ecosystems on land that has been degraded and/or deforested. The strategies seek to promote people's participation.

Indonesia has the second largest tropical forest area in the world, second only to Brazil. The total land area of the country is about 189 million hectares. Forest cover in 1980 was about 120.35 million hectares, or around 68 percent of the total land area. Although the actual forest cover has declined since then, forest areas are still classified into the following five categories, based on intended objectives and functions:

- Inconvertible Production Forest (IPF) **-** 35.2 million hectares
- Convertible Production Forest (CPF) **-** 8.07 million hectares
- Limited Production Forest (LPF) **-** 23.06 million hectares
- Protection Forest (PF) **-** 33.52 million hectares
- Natural Reserves and Recreational Forests, including National Parks (NRP) **-** 20.5 million hectares

Indonesian tropical forests are characterized by high biodiversity. In global terms, these forests contain 10 percent of all plant species in the world, 17 percent of all bird species, 12 percent of all mammal species, 16 percent of all reptile species and 16 percent of all amphibian species. Given the large area and high biodiversity of Indonesia's forests, protection and conservation must be sustained for the benefit not only of the Indonesian people, but also for the entire global community.

TPTI[1] as a form of ANR implementation in reforestation programs

In Indonesia, ANR is perceived as an approach to reforestation that relies on human intervention to promote natural regeneration, principally in residual forests. The interventions include various treatments such as liberation, tending and enrichment planting. These treatments are aimed at: (i) eliminating factors that restrict the growth of residual forests; and (ii) improving the microclimate. Human intervention is expected to promote the growth of residual trees and ensure eventual restoration of natural regeneration. As such, ANR is mainly applied within the context of the TPTI silvicultural system in forest concessions.

[1] **TPTI** Indonesian selective cutting and planting system

TPTI is the forest management system prescribed for compliance in HPH[2] concessions. The objective is to ensure a sustainable supply of timber derived from indigenous species. The main activities in TPTI that are relevant to ANR consist of post-logging treatments in the residual stands. Tending treatments are applied to promote the growth of poles, saplings and seedlings that remain after harvesting. These treatments are prescribed for implementation until the natural growth in residual stands reaches maturity and commercial species can be harvested in the next logging cycle. The success of TPTI regeneration is a function of the existing number of nuclei trees (parent trees), poles, saplings and seedlings of acceptable quality. If the number is not sufficient, enrichment planting is carried out using local species found in the area. The principal post-logging treatments in TPTI are: (i) liberation cutting; (ii) enrichment planting; (iii) tending; and (iv) second-stage liberation.

In liberation cutting, vegetation that competes with commercially valuable tree species is removed. These plants consist of lianas, weeds, shrubs, brush, diseased and deformed trees and low-quality trees. In some cases, herbicides are applied in addition to cutting. The purpose of liberation cutting is to ensure enough space, light and nutrients for optimal growth of the desired tree species. Based on TPTI handbooks, optimal conditions for success are as follows:

- Number of nuclei trees **-** >25 per hectare
- Number of pole-size trees **-** >200 per hectare
- Number of saplings **-** >1 600 per hectare
- Number of seedlings – 20 000 per hectare
- Nuclei trees, pole-size trees, saplings and seedlings should be evenly distributed.

Enrichment planting is implemented on sites that do not have a sufficient number of poles, saplings, seedlings and where there are many open spaces (i.e. open canopy). Tending is carried out on areas of enrichment planting to replace seedlings that have died.

Second-stage liberation is applied four to six years after harvesting. These treatments aim to provide vertical space so that residual trees have optimal light and space for maximum growth.

After the treatment period, residual stands are expected to grow optimally until the subsequent rotation when the trees will be ready for harvest. All of the prescribed treatments (except enrichment planting) focus on assisting the growth of natural regeneration. Thus, the treatments can be characterized as ANR. Concession holders have applied TPTI extensively in logged-over lowland forests covered by HPH licenses. However, TPTI treatments have not been used in swamp, peat and mangrove forests.

Constraints affecting ANR implementation in Indonesia

The constraints that are limiting factors in respect of ANR implementation can be classified into two (2) general categories, as discussed below.

Constraints in implementing TPTI

Although TPTI has been applied in logged-over HPH concessions, results have not met expectations. Current findings indicate that harvests in subsequent rotations will be low due to poor growth and poor timber stock. Several causes for this situation have been identified:

- Lack of secure tenure and inadequate incentives.[3]
- Ineffective control and monitoring of HPH performance.

[2] **HPH** Indonesian forest concessions
[3] HPH concession licenses are valid for 20 years but the rotation cutting cycle is 35 years.

- Encroachment combined with forest fires and illegal logging.

Constraints in implementing ANR

- Indonesian foresters are not familiar with the concept of ANR due to insufficient publications, workshops and seminars. Consequently, there is limited experience in ANR implementation on an operational scale. Due to this lack of knowledge and experience with ANR, various plantation establishment approaches are applied instead of ANR for restoring grass land, *Imperata* and bare-land.
- To the limited extent that ANR has been applied, the principal focus has been on environmental objectives. There has been little, if any emphasis, on creating benefits for local people. Under these conditions it is not possible to generate active community participation. Thus, in the absence of strong incentives for participation, ANR may be confined to Reserve Forests where entry by local people is prohibited.
- ANR does not ensure growth of the commercially-important tree species. Consequently, economic and financial viability are perceived to be low.
- The length of time required for forests to reach optimal conditions for timber production is uncertain and perceived to be too long.
- Disturbance factors such as forest fire, illegal logging, climate, infertile soil, and increased wood demand may become dominant limiting factors to successful implementation of ANR.

Conclusion

The ANR approach is not yet well-known in Indonesia. Implementation of rehabilitation programs in deforested areas and degraded lands is primarily pursued through plantation establishment instead of ANR. To increase awareness and appreciation of ANR, there should be more publications, demonstrations, research plots and workshop-study tours in Indonesia. These initiatives will encourage foresters to study and gain a deeper understanding of ANR. With increased knowledge, more foresters will be motivated to consider alternative strategies and methods for dealing with the problem of deforestation, in addition to conventional plantation establishment. Furthermore, successful implementation of ANR will be subject to how effectively foresters are able to deal with the prevailing disturbance factors of encroachment, fire and illegal logging.

ASSISTED NATURAL REGENERATION IN THAILAND

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Introduction

Thailand has a wide range of different forest types. There are evergreen forests in the south where the average annual rainfall is about 1 600 millimeters. The central part of Thailand has a long dry season ranging from five-six months. This region receives less than 100 millimeters of rain per month and it is here that deciduous forests are located. In the mountainous and northern areas of Thailand, there are Pinus forests and dry evergreen forests. The mixed deciduous forests tend to have a high economic value. These forests contain species preferred for building construction and many other uses. For example, teak (Tectona grandis) and bamboo are found throughout the mixed deciduous forests. The dry dipterocarp forests tend to be airy, with relatively clean under-storey and semi-open canopies. Species belonging to the Dipterocarpaceae comprise the predominant trees found in these forests.

Annual forest fires are commonly experienced in the deciduous forest due to the dry conditions. Under these conditions, soil moisture during the dry season is reduced to around 50 percent of wet season levels. The yearly forest fires wreak havoc on both climax and pioneer tree species. If there are no forest fires for 10 years, regeneration will occur, but the original forest status will change. The number of new tree species per hectare is as much as nine times more than in the original forest (Sukwong, 1977).

Natural regeneration of deciduous forest

The deciduous forest has an inherent capability to recover from human disturbance. Roots of the deciduous forest remain viable after clear-cutting or fire. Within one year, these roots will produce new coppice growth. An average of 281 stumps per hectare will emerge. Within three years, up to 2 956 new stumps per hectare can be observed, comprising more than 47 species. This demonstrates the ability of the original plants in the deciduous forest to regenerate without having to rely on the seed-based reproductive systems of the trees (Sukwong, 1978).

Natural regeneration of dry evergreen forest

Studies have shown that in deforested sites formerly covered by dry evergreen forests, very few of the original species will be restored through natural regeneration. Species formerly found in the uppermost succession level do not recover easily. It is difficult and requires a long period of time to bring the forests back to their original status.

Normally, the hill evergreen forest passes through a gap phase lasting up to 50 years. Thereafter, another 50 years will pass comprising the building phase and an additional 100 years will go by before original conditions are restored. (Watershed Conservation Section, 2001). Studies have also been conducted in former dry evergreen forest areas that were cut over, converted to farms, and then abandoned for 18 years. The trees that regenerated naturally were pioneer species common to secondary forests. The original appearance of the dry evergreen forest was altered because the genetic pool was destroyed. If forest destruction continues due to human disturbance and fire, a scrub forest may develop, which indicates severely degraded forest.

Results of research suggest that to positively influence natural regeneration, it is advisable to apply appropriate treatments during the gap phase. Research results indicate that prevention of repeated trespass and forest fires helps to shorten the gap phase from 50 years to only 10 years. Studies also indicate that if root stock from original species with deep-rooting characteristics are planted, forest cover will return to very near its former status within 30 years. Veer (1996) elaborated methods for natural regeneration of forests that include both economic and social factors, in addition to bio-physical considerations. The potential to apply these methods should be explored when formulating plans to restore forests on degraded and denuded land.

ANR in Thailand

Assisted natural regeneration (ANR) is a well-recognized and normal phenomenon in the countryside, especially in areas having an average annual rainfall of 1 500 millimeters. Plant succession is high under these conditions. Regeneration is especially vigorous if communities participate actively in the process. For example, in 1975, the community of Ban Dong Yai in Ubon Ratchathani Province started tending a 400-hectare secondary forest that emerged after the land was converted to farms and then abandoned. Forest cover has since been restored. Similarly, some monks participated with the community and helped restore the forest at Boong Pra Temple, Nakornrachasima Province. Another example can be found in the lowland dry evergreen forest areas of northern Thailand, where communities in Nan and Lampoon worked together to bring back the forests. These experiences strengthened community collaboration and people empowerment. Motivation to work together was based on the desire to ensure stable supplies of water during the dry season. Communities were aware that the drinking water and tap water they used came from underground sources. They also recognized that forests increase rainfall infiltration and replenish underground aquifers, while also creating a sustainable natural storehouse of food, medicine, firewood and charcoal.

Rural poverty is the principal impediment to expansion of ANR in the above-cited communities. Most of the people are poor and farming is their major source of livelihood. Making use of the land for farming has more immediate relevance in their lives than the restoration of forest cover. As the population continues to increase, the pressure to convert forests into farms will continue. Another constraint relates to politics. Politicians often tend to focus on short-term measures that garner votes, rather than the long-term issue of forest conservation. Thus, creation of incentives to practice ANR is not part of their agenda.

Government plans to improve the forest

Several government initiatives aim at restoring forest cover and otherwise improving forest conditions. Some of the plans that include ANR techniques are summarized below.

Watershed improvement plan

This plan calls for tree planting and other measures to restore forest cover on denuded and degraded watershed catchments. The methods include reforestation with the original indigenous species, strict fire prevention and maintenance of pioneer trees and other vegetation that emerges from root stocks.

Construction of check dams

Small dams will be built across second order streams to reduce stream and rainfall run-off as much as possible, in order to increase infiltration that replenishes underground aquifers. The plan also aims to retain moisture and to hasten natural regeneration of stream-bank species, thereby reducing the risk of fire along waterways.

Grass planting

Farmers will be encouraged to plant elephant grass (*Typha* spp.) and *Vetiveria zizanioides*, both of which are deep-rooted species. Planting on horizontal contours will be promoted to prevent soil erosion and moisture loss. This will create favorable conditions for natural regeneration of tree cover, while also improving farm production.

References

Satetarak, A. 1978. *A study comparable of forest fire in 3 years period*. Royal Forestry Department, Bangkok

Sukwong, S. 1977. Some effects of fire on dry dipterocarp forest community. In *BIOTROP – Kasetsart University Symposium on Management of Forest Production in Southeast Asia*. Kasetsart University, Bangkok, Thailand.

Sukwong, S. 1978. *Natural reproduction 3 years after clear felling in teak forest*. Technical Paper No.8, Department of Forest Biology, Faculty of Forestry, Kasetsart University.

Veer, C. 1996. *Forest restoration though natural regeneration in Asia*. Kasetsart University, Bangkok.

Watershed Conservation Section, 2001. *Guide for watershed management unit*. Royal Forestry Department, Bangkok.

Technical Procedures for Forest Rehabilitation in Viet Nam

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Introduction

In Viet Nam, forest rehabilitation first received attention in the 1950s and 1960s. At that time, forest rehabilitation measures were identified as "forest restoration". By the middle of the 1980s, the concept of "forest restoration" was officially defined as "forest rehabilitation through promoting regeneration". In the early 1990s, forest rehabilitation measures through natural regeneration were officially promulgated through the following three sector standards:

- Procedures for silvicultural techniques applied to timber and bamboo production forest (QPN 14-92), issued following Decision No. 200/QD-KT on 31/3/1993, Ministry of Forestry.
- Procedures for forest rehabilitation through promoting regeneration combined with additional planting (QPN 21-98), issued following Decision No. 125/QD/BNN/KHCN on 1/11/1998, MARD.
- Temporary regulations on checking and acceptance contract of forest protection and tending, issued following Decision No 162/1999/QD/BNN/PTLN on 10/12/1999, MARD.

These government standards have resulted in the regeneration of large areas in Viet Nam. A series of surveys in four provinces where Project 327 was implemented for three years (1993-1995), indicated 265 000 hectares had been restored and 871 762 hectares were considered potential areas for rehabilitation. Furthermore, survey results from 10 provinces in Northern Viet Nam revealed that an additional 6.7 million hectares need rehabilitation. These areas include 2.4 million hectares of natural forest (36.2 percent), 0.5 million hectares of plantations and about 3.8 million hectares of barren land and denuded hills (56.6 percent). Of these 6.7 million hectares, 2 million hectares have the potential to be rehabilitated through forest regeneration. During the last two years of Project 327 (1997-1998), and the first two years of Project 661 (1999-2000), about 0.5 million hectares of forest were regenerated in 10 provinces.

Other large areas were also targeted for natural regeneration. Under projects for implementation from 1998-2001, five million hectares of re-afforestation were planned, comprising 2 million hectares of protection and special-use forest and 3 million hectares of production forest. Of this total, one million hectares were targeted for natural regeneration mixed with enrichment planting in the first eight years (1998-2005) (Source: QD 661/QD/TTg, 29/7/1998).

Forest degradation and rehabilitation

Excessive logging and shifting cultivation have increased the pace of deforestation. Controls to ensure efficient forest operations and sustainable forest management, together with settled cultivation and regeneration promotion, are the most effective measures to rehabilitate the forest. Planting and protection are essential for rehabilitation of barren land. But these measures are expensive, difficult to implement, or take a long time to carry out if no regeneration techniques are concurrently applied.

Taking advantage of natural forest succession processes, it is feasible to rehabilitate about one million hectares reserved for protection and special-use forests and also for production forests in qualified areas. This process is facilitated through protection, silvicultural measures and additional planting.

With regards to forest restoration activities, five main land-use categories are distinguished in Viet Nam, according to past or present use. These land-use types are subdivided into three groups according to the desired management objectives. These land-use types and management objectives are summarized in table 1.

Table 1: Land-use types and management objectives, in relation to forest rehabilitation.

Land-use types and management objectives	Quantity of regenerating material
A. Timber tree 1.Deforested areas due to excessive logging 2.Uncultivated land with forest land characteristics 3.Grass, shrub, small trees, soil thickness over 30 cm	Each category must have 1 of the 3 following conditions: -Generated young trees over 50 cm of height, 300 trees/hectares -Coppice regenerated mother stem distributed equally: 150/hectares -Natural seeding mother trees distributed equally: 25 trees/hectares or from neighboring forest
B. Bamboo 4.Rehabilitation after exploitation or shifting cultivation	-Bamboo stands with a coverage of more than 20 percent, equally distributed
C. Protection forest in critical and very critical areas 5. Remote areas that cannot be afforested within the next 10 years.	-Vegetation formation with shrub or grass more than 40 percent, over 1 m high

(Extracted from Article 6/QPN 21-98)

In order to enhance the feasibility and effectiveness of the restoration process, the prevailing conditions are assessed (timber, bamboo, critical area, remoteness of area etc). This assessment includes quantification of the material and regenerative potential of each land-use type, as indicated in Table 1. These establish the rationale for: (i) identification; (ii) selection of targets that apply to production; (iii) choice of suitable interventions; and (iv) cost-effective investments.

Time frames and evaluation criteria

Time frames for the achievement of the restoration objectives have been defined for both protection and production forests. Criteria for the evaluation of the restoration process have also be formulated. These time frames and criteria are summarized according to forest type in Table 2.

Level of interventions

Two main intervention levels have been defined for restoration purposes, namely:

1. Low-level, in which protection is the main activity; and
2. High-level, which includes the low level intervention and additional interventions depending on the restoration objectives and site requirements.

Certain measures are taken for restoration purposes on the basis of the amount of intervention required for the restoration to succeed and the desired management objectives of the rehabilitated forest. Table 3 summarizes the measures taken for both of the interventions.

Table 2: Time frames for achieving forest restoration and evaluation criteria.

Type	Target areas	Criteria to approve forest			
		Time	Target trees	Canopy	Coverage
Protection and special use forest	Deforestation due to excessive logging (1) swidden cultivation (2) grass, shrub (3)	4-6 years		> 0.6 %	Shrubs & low storey vegetation
	Restored bamboo stands	4-6			> 80 %
	Critical protection forest	4-6			Shrubs > 1m in height, > 80 %
Production forest	Deforestation due to excessive logging (1) swidden cultivation (2) grass, shrub (3)	5-8 years	500 trees/hectare, > 4 m of height distributed equally	> 0.5 %	
	Restored Bamboo stand	5-8 years			Bamboo stand > 80 %

(source: Article 6,7 QPN 21-98)

Table 3: The measures taken for the defined intervention levels

Intervention	Measures
Low level	-Cattle grazing is forbidden. -Forest fire-control measures undertaken, for fire sensitive areas. -Cutting the regenerating target tree is forbidden. -Harvesting of non-desirable trees and non-forest products is allowed under technical guidelines. -Planting industrial crops by local people.
High level	-Removal of lianas and shrubs to facilitate the development of target trees. -Piling up soil by to facilitate germination. -Adjusting the density of target trees by thinning. -Sowing additional seeds or planting target trees in open areas larger than one-tenth hectare. -Trimming the stumps and tending coppices. -Production forest: Removal of bad stems, maximum of 3 coppices are kept. -Piling up soil around stumps and newly planted trees 1-2 times per year for 2-3 years. -Removing poor, diseased trees and non-target trees in stands that are too dense. -Bamboo forest: Forbid collection of bamboo shoots within restoration period. Cut and make use of all the diseased, broken, topless trees.

(source: Article 13 and 14 QPN 21-98, summarized)

Investment and benefits

The State only provides budget for protection forests and special-use forests. Budgets cover the costs of: survey, design, protection, labor and other expenses for the implementation of respective technical measures.

Investments will be adjusted, as appropriate, based on the following conditions:

- Issuance and awarding of contracts to rehabilitate protection and special-use forests.
- In addition to payments, contracting parties are also allowed to collect fuel wood and all non-forest products, including the products of thinning (Article 16,17, 18, 19 QPN 21-98, summarized).

The contractor's performance and payment is checked annually. After the final checking, the contractor must complete procedures for transferring the area to the State forest enterprise (Article 20, QPN 21-98, summarized). Checking includes: (i) measurement of the area rehabilitated; (ii) evaluation of the technical measures applied; (iii) survival inventory covering 10 percent of the area or number of trees; and (iv) observation of results. The procedures include local checking and then re-checking by higher level staff (Article 5,7,8 QD 162/1999).

Assisted natural regeneration (ANR) is a forest rehabilitation technique based on the ecological principle of secondary succession. It utilizes natural processes and promotes the regeneration of indigenous species. Because ANR relies on natural processes, it is especially effective in restoring and enhancing biological diversity and ecological processes.

FAO and partner organizations convened a workshop and study on ANR in the Philippines in April 2002 to highlight the potential and opportunities of ANR as a restoration strategy. The workshop discussions and presentations underscored the importance of ANR in the broader context of sustainable forest management and the potential for cost-effective rehabilitation of forestlands through more aggressive implementation of ANR. This publication includes selected papers dealing with the technical, environmental and social dimensions of ANR, as well as papers describing country initiatives.

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