

# AGROFORESTRY SOLUTIONS TO REHABILITATE IMPERATA GRASSLANDS: A SYSTEMS APPROACH.

Dennis P. Garrity

## THE PROBLEM

The Imperata grasslands of southeast Asia represent a vast underutilized natural resource. They cover an aerial extent exceeding 50 million hectares. Fifteen to twenty million hectares are estimated to have terrain characteristics that do not inhibit agriculture, and are free from forest concessions, yet are in unmanaged condition (World Bank, 1974). Much of the rest is on steeper, more marginal soils classified as forest land but without tree cover.

Most *Imperata cylindrica* grasslands (known as alang-alang, cogon, lalang in local languages) in the region were derived through slash and burn cultivation, linked with logging activities, and maintained through the frequent occurrence of fire. As long as there is forest land available, most small-scale cultivators find higher returns to labor by abandoning depleted lands as Imperata invades, and opening more forest through slash-and-burn.

As human population densities increase on the forest margins, and worldwide concern intensifies to protect the dwindling area of humid tropical forests, increasing interest is focusing on land use alternatives for these grasslands. One of the most effective means of reducing pressure on natural forests would be to bring the abandoned lands into sustained production. Estimates of the economic benefits to the farm families and to the national economy in adopting small-scale agroforestry systems substantially exceed those from shifting cultivation or large-scale industrial timber plantations (World Bank, 1990).

Little systematic knowledge exists concerning the rehabilitation of degraded grasslands. Several reviews on the Imperata problem have been published (Brook, 1989; Sukmana, 1986; Holm et al, 1977; Eussen and Soerjani, 1976; Soerjani, 1970; Hubbard et al. 1944). But the problem tends to be viewed as one of Imperata weed control methods. Largely ignored is the reality that the presence of Imperata grasslands is symptomatic of a complex interaction of human and environmental factors (Dove, 1986). A more holistic understanding of the agroecosystem is essential in developing truly practical and comprehensive ways of managing and exploiting the potential of these lands.

The hypothesis that the indigenous practical experience of farmers, both local and in-migrant, has resulted in some suitable land use solutions; and likewise the experience of researchers and extensionists in agriculture and forestry have also resulted in useful components of prospective systems. But this knowledge has not been accumulated and synthesized systematically enough to provide clear grounds for the development of a comprehensive research and development strategy.

There are important examples of farmer rehabilitation of Imperata grasslands. Some transmigrant small-scale farming communities have evolved successful food crop farming systems with modest fertilization on red-yellow podzolic soils (Ultisol/Oxisols) in Lampung Province, Sumatra and Baturaja in South Sumatra Province. One adaptation under situations where animal draft power is not available is an intercropping system composed of upland rice, maize and cassava, observed widely in Indonesia. It maintains ground cover most of the year with only one primary tillage operation (Suryatna and McIntosh, 1982.) Animal draft power has been hypothesized as a key element enabling more diversified farming on larger farm areas, making it unnecessary to abandon land to Imperata (Suryatna and McIntosh, 1980).

In limited parts of the eastern islands of Indonesia, agroforestry systems have been notably effective in rehabilitating Imperata grasslands. The lamtoroniasi system of alley cropping with *Leucaena leucocephala* has been widely adopted for soil conservation and nutrient recycling. A hypothesis currently being investigated is that hedgerow systems incorporating exotic or indigenous Imperata-suppressing species (eg *Peltophorum pterocarpa*) will also prove viable on strongly acid soils in Sumatra (Hairiah et al., 1992.)

Another hypothesis with major implications is that woody species can be used as improved fallows to regenerate soil fertility on degraded sites, later followed by clearing and establishment of food crop, agroforestry, plantation forests, or enriched natural regeneration. In eastern Indonesia *Leucaena* is used as a woody fallow species to regenerate soil fertility on degraded sites, followed by slash and burn cultivation. On acid soils *Acacia mangium* has received particular interest as a potential woody fallow species. It has shown exceptional ability to establish with minimal management in Imperata swards and regenerate a dense forest within a few years. Other acacia species, particularly *A. crassiparpa* and *A. auriculiformis*, may exhibit the same or greater promise. However, the woody fallow hypothesis has not been critically analyzed or adequately tested on acid soils. It needs to be compared with other fallowing options, such as natural woody revegetation through fire control.

A 2 years research project has been developed by ICRAF and collaborating institutions in Indonesia to conduct a systems analysis of the Imperata lands.

## THE OBJECTIVES

The general objective is to provide a systems framework and empirical and policy foundation for the development of a major, longterm research and development initiative on land use systems that will enhance the economically productive and environmentally protective value of Imperata grasslands in Indonesia.

The specific objectives are to

- 1) Classify and map the Imperata grasslands of Indonesia into a limited number of contrasting ecosystems, on the basis of land tenure, biophysical environment, and economic infrastructure.

2) Identify a limited number of sites representative of the major classes of Imperata grasslands, where agroforestry solutions have been indigenously or experimentally developed, and analyse systematically the agroecosystem, the performance of the prospective solutions, and the implications of the observed interactions.

3) Synthesize the data and experience from the study sites, and from other primary and secondary sources, into a monograph that provides a definitive appraisal of current knowledge of the practical systems of solutions for rehabilitating Imperata lands.

4) On the basis of objectives 1 to 3 develop a framework for a major long-term research effort on the rehabilitation of Imperata grasslands for presentation and discussion at the International Conference on Rehabilitation of Imperata Grasslands Through Agroforestry.

## THE METHODOLOGY

(a) Classification of Imperata grassland ecosystems and selection of research sites representative of each ecosystem. A geographic information systems approach will be used to collect and analyse mapped data on the location and human and natural ecology of the grasslands. A country-wide macro analysis will be succeeded by meso-level analysis in key provinces, particularly in Kalimantan and Sumatra. Classification of the major typologies will proceed from the GIS results.

(b) Agroecosystems analysis of selected Imperata rehabilitation experiences. Six sites in contrasting Imperata ecosystems will be selected. The agroecosystems analysis will follow methods of Conway (1988), with suitable modifications from the local experience of the Indonesian KEPAS program. This will include thorough characterization of the physical environment. Historical changes in land use will be analyzed with aerial photo analysis where possible. Participatory rural appraisal approaches will be employed in eliciting experiential information.

(c) Systems Analysis. The case studies will be incorporated into a systems analysis framework that isolates key indicators of sustainability. The range of hypothesized solutions will be matched with the key indicators and ecological constraints. A model of Imperata grasslands and rehabilitation will be proposed based on agroecological and economic factors.

## LINKAGES

An International conference on Imperata Grassland Rehabilitation through Agroforestry Systems is scheduled to be held in November 1994. The conference will provide the framework to launch the overall research effort. To maximize the effectiveness of the conference, it is imperative to synthesize as much pertinent knowledge as possible prior to the meeting. This project will provide an important part of this synthesis.

The research will also be allied with a global program on Alternatives to Slash and Burn, to be implemented by a consortium of IARCs (ICRAF, IRRI, CIAT, IITA, and probably CIFOR) and other national and international organizations beginning in 1993. It will also directly contribute to the research agenda for CIFOR-ICRAF collaboration, but will focus on agroforestry rather than plantation forestry options per se.

Within Indonesia, the project will forge collaborative linkages between several institutions that have a major role in the rehabilitation of Imperata grasslands. The systems approach will foster mechanisms that will build a sustained team approach to these problems on an ecosystems basis.

#### CITATION

Brook, R M. 1989. Review of literature on *Imperata cylindrica* (L.) Raeuschel with particular reference to South East Asia. *Tropical Pest Management* 35:12-25.

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Hubbard, C E, Whyte, R O, Brown, D, and Gray, A P. 1944. *Imperata cylindrica*. Taxonomy, distribution, economic significance and control. *Imperial Agricultural Bureaux Joint Publication* No 7.

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