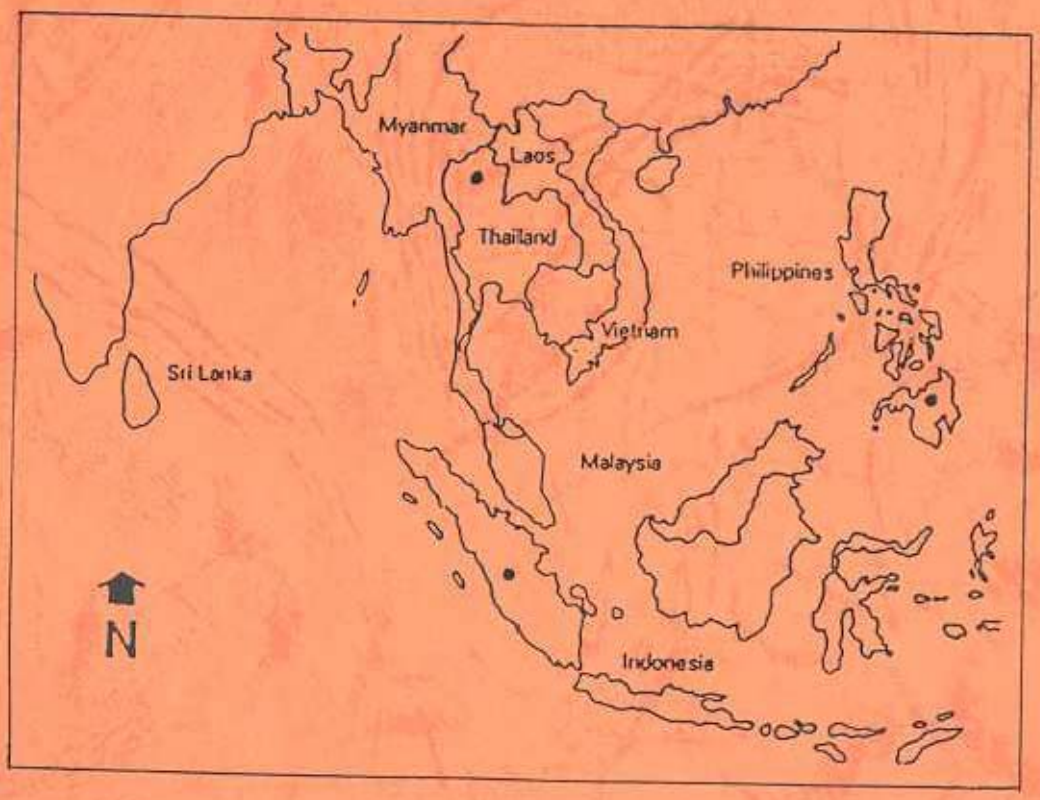
ICRAF Southeast Asia: Implementing the Vision

DENNIS P. GARRITY



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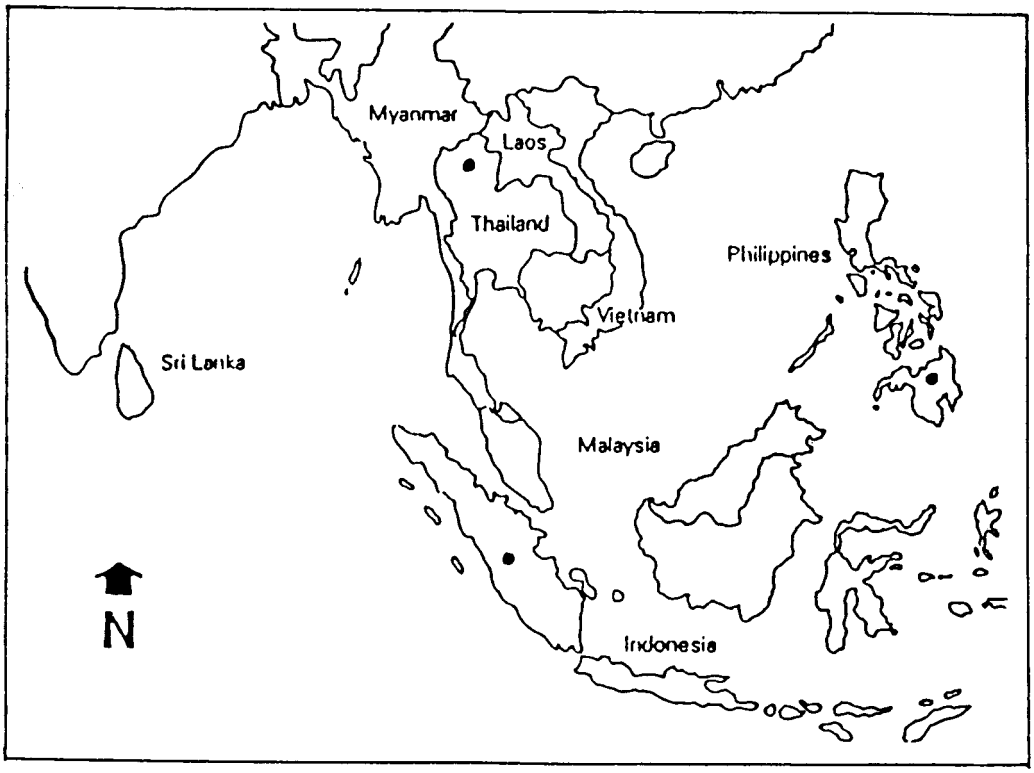

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Abstract

ICRAF established a regional research program in Southeast Asia in April, 1992, through a memorandum of agreement with the Indonesian Ministry of Forestry. A regional research coordinator was appointed in July, 1992, and assumed his post at the Forest Research and Development Centre in Bogor on November 1. During the subsequent months, wide-ranging consultations were held with colleagues from national and international partner and client institutions throughout Asia. From this process a focussed strategy for ICRAFs work in the region has been evolving. This paper reviews the current status of our vision for Southeast Asia, and how we intend to accomplish it. It is presented as a proposal for constructive review and revision.

The basic objective of the Southeast Asian Regional Research Program (SEARRP) is to implement ICRAFs mission in the context of the unique agroecological and institutional circumstances of the nations of southeastern Asia. Defined in ecological terms the region includes the continuum of humid, tropical environments that stretches from Indonesia and the Philippines in the south and east, through Indochina and southern China, to Thailand, Myanmar, and the northeastern hill states of India. This is an exceedingly diverse and dynamic region. It includes several growing, self-confident economies, alongside some of the poorest countries on earth. It includes countries with immense areas of tropical rainforest (104 m ha in Indonesia) and many countries dominated by denuded, wasted hilly lands whose forest is only a memory.

ICRAFs direct presence in this region prior to 1992 had been quite modest. But knowledge of its work was widespread. The initiation of the regional program was received with deep enthusiasm and goodwill. It was also accompanied by immense and wide-ranging expectations. The region is certainly ready for ICRAF. The institute must now gain the effort and resources to meet the expectations its presence has unleashed.

Although the recognized products that ICRAF can deliver are substantial, the prospective resources are modest. Therefore, SEARRP must necessarily focus on a few key objectives, and strive to accomplish these well.

In defining what we do, we propose that our activities be limited to strategic and applied research in agroforestry. The attendant training and dissemination that we

do would be directly targeted to enriching the capacity for strategic and applied research in the institutions with whom we collaborate. It follows that the direct clients for our work are those institutions and individuals who are conducting research, training, dissemination, or policy implementation, at the governmental or non-governmental levels.

Our analysis addresses the reality that ICRAFs mission in southeastern Asia can only be judged successful if it produces an appropriate balance between the our self-perceived role, and the genuine needs of our clients in the region.

The paper defines a conceptual model of the ecosystems in southeastern Asia. We propose that ICRAF target its work exclusively within three of the seven ecosystems specified. The three target ecosystems are: The forest margins, the imperata grasslands, and the hill-slope farmlands. They generally occur on a landscape continuum. Their choice is consistent with the broad themes of our work: Rehabilitating degraded uplands, and developing alternatives to slash and burn agriculture.

We propose that our research address three systems hypotheses. These will be the unifying focus of our research and training. Each systems hypothesis is associated with one of the three ecosystems. After discussing the rationale for each hypothesis, we outline the strategic and applied research needed to test them.

The composition and role of the prospective members of the ICRAF scientific team are discussed, within the context of our systems hypotheses. Then the rationale behind the tentative choice of research sites and collaborating institutions is presented. To accomplish our objectives, and to leverage SEARRP's small size and resources, we propose a research consortium model as the structure through which the institute's strategic and applied research will be conducted.

Agroforestry in Southeast Asia: The Setting

From the home gardens observed in Bangladesh and Indonesia; to the millions of hectares of rubber and fruit agroforests of Sumatra and Kalimantan; to the government-fostered taungya systems of Burma, Thailand and Java; and from the tree-cultured swiddens observed from Assam to Mindoro, agroforestry has been woven indelibly into the fabric of land use in Southeast Asia for many generations.

An astounding array of agroforestry systems are observed, evolving in response to market changes, new technical options, and the inexorable pressure of more people on the land. Agroforestry systems were always there, particularly in the uplands. But their potential to solve land use problems was not recognized by mainstream research and extension institutions, and consequently they were given little notice. Until recently. But the situation has changed.

There are perhaps two underlying reasons. First, until recently, the production of enough rice and basic staple food was the predominant focus of nearly all Asian countries. Research priorities strongly reflected this: Rice research got the lion's share of research budgets. There was little left for anything else. But most countries have attained basic self-sufficiency in rice. Indeed, many have unsettling surpluses which have driven real farm incomes downward for the past decade. Governments have adopted the theme of 'increase farm income through enterprise diversification' in lieu of 'produce more rice'. Lowland agroforestry is widely seen as an fitting way of accomplishing this.

Second, as the staple food production problems in the lowlands were successfully coped with, governments had the breathing space to begin seriously grappling with the ecological and poverty crisis in the uplands. Widespread interest has mounted in implementing upland agroforestry development programs, often involving non-traditional land tenure arrangements. In socialist (eg China and Vietnam) as well as in free-market economies (eg Philippines and Thailand) major programs are evolving that essentially involve the transfer of millions of hectares of hilly land from government control to family farmers. Agroforestry has now been popularized among decision makers as an attractive conservation farming solution to sustain the productivity of fragile lands. Consequently, there is enormous demand for sound upland agroforestry technology, but a major short fall in the research needed to provide sound answers.

Given the very real political, economic, and ecological spinoffs of agroforestry solutions in the Asian context, ICRAFs presence in the region has engendered intense interest, and enormous expectations on the part of its clients. Knowledge of its work is widespread. We must now cope with how a small program can best serve these expectations.

Program Initiation

ICRAF established its regional research program in Southeast Asia in April, 1992. The regional headquarters is located at the Forest Research and Development Centre in Bogor. The ICRAF operates in Indonesia through a memorandum of agreement with the Indonesian Ministry of Forestry. A regional research coordinator was appointed in July, 1992. He assumed his post at the Forest Research and Development Centre in Bogor on November 1. He has been joined by a soil fertility specialist since June 1, 1993. Selection is currently in progress for the positions of social scientist (natural resource economist) and multipurpose tree improvement specialist, who would also be located at Bogor.

ICRAFs offices are located directly adjacent to those of the Asia-Pacific Agroforestry Network (APAN), and the global headquarters of the Centre for International Forestry Research (CIFOR). Thus, the location is exceptional. It enables ICRAF to collaborate closely with the FAO-sponsored network that supports agroforestry training and information dissemination in 10 Asian countries. It integrates ICRAF with the global forest science community that is assembling at CIFOR. And it places ICRAF in a position to link with the Indonesian forestry and agricultural science community centered in the many Bogor based research institutions, including Indonesia's premier agricultural (and forestry) university (Institut Pertanian Bogor).

During the initial year of the program there has been opportunity for wide-ranging consultations with colleagues from national and international partner and client institutions throughout Asia. This has been accompanied by deliberate dialogue and introspection within ICRAF. Consequently, the strategy for ICRAFs work in the region has been evolving an ever-sharper focus.

Three events had particularly significant importance in the development of guiding ideas for the regional program. The first occurred in August, 1992, when a team of four ICRAF scientists joined 10 Indonesian colleagues from forestry anddd agricultural research institutions for a team site selection visit to prospective locations to make recommendations on an appropriate site at which to base research on the 'Alternatives to Slash and Burn' (ASB) project.

Second, a global workshop on research methodology was hosted by SARRP in February-March 1993 in Bogor, with field diagnostic work in central Sumatra. Third in April-May SEARRP conducted an international training course on 'Land Use Systems Research Methodology for the Humid Tropics of Asia'. Two prospective research sites were characterized in the course of the fieldwork (a bush-fallow rotation area on the boundary of Kerinci Seblat National Park, and a new transmigration site in Sitiung, both in Sumatra).

Defining ICRAFs Mandate in the Region

This paper reviews the current status of our vision for Southeast Asia, and how we intend to accomplish it. Although the recognized products that ICRAF can deliver are substantial, the prospective resources are modest. Therefore, SEARRP will focus on a few key objectives, and strive to accomplish these well.

We propose that our activities be limited to:

* Conducting strategic research on key hypothesis and

* Developing and disseminating more effective research methods.

It is our intention to identify and concentrate on the most important problems in agroforestry, and provide strategic leadership in developing the research base to solve them. This involves the selection of a small number of top priority projects.

The training and dissemination that we do would be directly targeted to enriching the capacity for strategic and applied research in the institutions with whom we collaborate.

The direct clients for our work are defined as those institutions and individuals who are conducting research, training, dissemination, or policy implementation, at the governmental or non-governmental levels.

The themes that place general bounds on the Program's activities are:

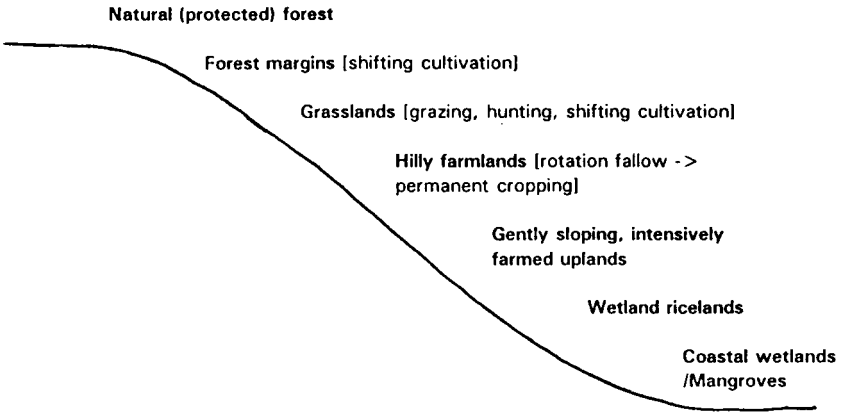
1) **the development of alternatives to slash and burn agriculture, and**

2) **the rehabilitation of degraded uplands.**

The following sections describe the rationale for the proposed activity structure within the scope of these themes.

Choosing an Ecosystem Focus

The landscape ecology of much of southeast Asia follows a broadly similar pattern along a decreasing elevational gradient. In a 'typical' watershed the land use pattern may be characterized as:



Although such a model is highly simplified, it has useful value in conceptualizing the ecosystems and their interactions for research and development planning.

The remnants of old growth forest are generally present only at the highest elevations (eg old growth is seldom observed at less than about 800 m elevation in the Philippines). The boundary of the forest margin is constantly moving upward due to forest conversion processes, accelerated by slash and burn. Behind the forest margins are extensive grasslands. They evolved following prior cultivation, and are maintained in a fire climax. These lands are used (depending on the area) for cattle grazing, hunting, or shifting cultivation.

At lower elevations closer to the roads, the hilly lands are more densely occupied. Here, rotation-fallow systems are gradually evolving into more permanent cropping systems. This zone grades into more gently sloping, intensively farmed uplands. Wetland rice is produced in the alluvial valleys from the uplands to the broad lowland river basins. Agroforestry is important in the rice-growing areas as home gardens and bund planting. The coastal wetlands include large areas of mangroves, which allow for unique forms of agroforestry.

Depending on the watershed size, geomorphology, and human settlement patterns, the various zones may be juxtaposed, or one or more might be missing. But the pattern repeats itself dependably enough to provide a landscape ecosystem model. This model helps isolate relationships among landscape components, and can be a useful basis to help clarify research needs.

Agroforestry is anticipated to have a major impact on the lowland rice and coastal ecosystems in the future. However, our priorities indicate that neither ecosystem be included in our prospective current workplan.

ICRAFs regional target ecosystems in the medium term will be limited to the uplands, and will encompass three ecosystems: **The forest margins, grasslands, and hilly farmlands.** Each of the prospective research sites for the 'alternatives to slash and burn initiative' have been selected to sample these landscape components.

Agroforestry Systems Hypotheses

We propose that the conceptual framework for our research in the target ecosystems be based on three agroforestry systems hypotheses. We have identified one over-arching hypothesis to guide our efforts in each ecosystem.

Systems Hypothesis 1. On the forest margins, complex agroforestry systems or 'agroforests' provide a superior alternative for small-scale farmers to either food crop systems or monoculture plantations of perennials. Complex agroforests increase production sustainability, increase biodiversity, reduce production risks, and increase returns to labor when compared to continuous food crops or monoculture plantation crops models as alternatives to slash and burn.

Two predominant models have been promoted for sustainable settlement of the forest margins in southeast Asia. The first might be termed the 'continuous food crops model'. It was based on the premise that with appropriate soil and crop management practices, continuous annual cropping could be practiced sustainably on humid, infertile Ultisols and Oxisols based. The Transmigration Program of Indonesia has widely employed this premise for the past two decades, and it continues to be a basis for new settlement in many locations. The record of research in support of this model has not been highly promising. Actual experience by both government-subsidized and spontaneous settlers and indigenous peoples has tended to strongly support the conclusion that this model for sustaining profitable small-scale food cropping on these soils not often feasible.

An alternative model, given particular emphasis during the past decade, is the 'monoculture estate crops model'. It has been given strong support from international development banks. This model involves the development of large estates to replace natural forest and/or slash and burn farming. Small-scale farmers receive 1-2 hectare parcels on the estate that are designated for monoculture rubber or oil palm, with a guaranteed market.

These tree-crop based schemes avoid some of the problems of earlier land development models, but they still lack the flexibility and crop diversity of traditional forest farming strategies. New concerns have arisen with these models, particularly the high degree of price risk farmers face because their source of livelihood is dependent on a single commodity. Other instabilities observed are the

loss of biodiversity in the production system, and the likelihood of increased pest infestation, threatening dependence on pesticide inputs.

A mounting body of studies on the agroecology of the farming systems of indigenous communities on the forest margins in Southeast Asia has now provided strong indications that there is a 'middle ground' between continuous annual cropping and monoculture plantations. We now recognize that solutions involving the development of agroforests, or complex agroforestry systems, have been quietly occurring in some of the rural communities on the forest margins.

Some cases of 'agroforest' models that exemplify these solutions include: The 2.5 million hectares of 'rubber agroforests' in Indonesia (which produce 75% of the country's rubber) the cultivation of dipterocarp timber trees in several types of agroforestry systems, (including the damar systems based on *Shorea Javanica* which produce commercial resins for export), the diverse array of fruit agroforest systems (eg. the durian forest gardens of West Kalimantan), and the cultivation of rattan in swidden fallows in East Kalimantan.

These systems have now been largely described and documented. What is now urgently needed is:

1) a more quantitative understanding of their agroecology,

2) the ability to predict the determinants their extrapolability,

3) agronomic improvements that will improve their productivity.

A scientific understanding of these solutions has only begun. The prospects for building upon knowledge of these systems is almost unrecognized by the wider scientific community, even within agroforestry. Their consideration by policymakers as options for public support toward a more intensive and sustainable agriculture and forestry is still unrealized.

In building a research program around the 'agroforest hypothesis' we seek to work vigorously to build a deeper empirical database and working models on the agroecology of these systems, to guide decisions on when, where, and how the development of complex agroforestry systems is preferable to other options. We are assembling a collaborative research team of international and national researchers to tackle the issues from the social, economic, agroecology, agronomic and silvicultural perspectives.

The team will strive to develop generalizable methods to guide the local research and development teams that are now forming in several countries. These local teams are striving to understand, promote, and improve agroforest models for their

specific agroecosystems. Better methods for doing this need to be developed. Practical guidelines and insights will be valuable, provided they are based on the solid experience of a research group that has done work with a view to methodology development. One example of possible spin-off for methodology development is the Bina Desa Program in Indonesia which requires every timber concession (of which there are approximately 500) to investigate ways by which local communities can build a more intensive, sustainable agricultural system.

In a more long-term context the ICRAF complex agroforest team will identify the technological constraints to improving the productivity of these systems. This will provide strategic direction to research that to develop better germplasm and management practices for agroforests.

One important question under debate is: "How relevant is the agroforestry experience of mature, indigenous communities (where many of the most promising prospective agroforestry solutions have developed) to the dramatically different circumstances of pioneer cultivators, who are responsible for most of the current pressure on the land?" One view is that in some cases complex agroforests are a transitional stage at low population density, and that as the imperative for intensification increases, system complexity will necessarily decrease. Conclusive answers are not known, but they are crucial. We see it as essential to target the research to two types of situations:

* Mature communities with promising agroforest solutions, and

* Pioneer communities facing the challenge of how to proceed toward sustainable systems.

The key field research area selected for our work on the agroforest hypothesis is the watershed of the Hari River in West Sumatra, Indonesia. The work will be focussed in two locations in the watershed: A pioneer settlement recently established in lowland rainforest on sloping Ultisols in Sitiung, and a mature Minangkabau settlement practicing annual cropping under bush fallow rotation on the boundary of the Kerinci-Seblat National Park in the upper watershed. The latter site will enable us to apply the hypothesis to buffer zone management in a major national park.

The research effort will be conducted by a consortium of institutions funded through the Alternatives to Slash and Burn Project. The consortium will include agroforestry development NGOs, universities and the national research centers for forestry (Forest Research and Development Centre , and for farming systems on acid soils (Central Research Institute for Food Crops) and International institutions (IRRI, CIFOR and ICRAF). We will employ a farmer-participatory land use systems research methodology, complemented by vigorous researcher-managed

investigations. The ICRAF team on this project would be composed of the social scientist, forest ecologist, agroecologist, systems agronomist, and soil fertility specialist, with germplasm contributions from the multipurpose tree specialist.

Systems Hypothesis 2. The rehabilitation of imperata grasslands through small-scale agroforestry systems will be superior to plantation reforestation in terms of production, equitability, and participation objectives.

The *Imperata cylindrica* grasslands of southeastern Asia represent a vast underutilized natural resource, covering an area exceeding 20 million hectares. Most grasslands (known as *alang-alang*, *cogon*, and *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. Plantation reforestation, particularly the many projects sponsored by national forest departments, have had a singularly disappointing history. Only a small proportion of the trees survive to maturity, either due to fire, poor site conditions, or lack of care. There is increasing interest in focusing on land use alternatives for these grasslands that feature the active participation of local people. The World Bank has estimated that the economic benefits to 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.

Little systematic knowledge exists concerning the rehabilitation of degraded grasslands. Largely ignored is the reality that the presence of imperata grasslands is symptomatic of a complex interaction of human and environmental factors. 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.

There are important examples of farmer rehabilitation of Imperata grasslands. Agroforestry systems have been notably effective in rehabilitating Imperata grasslands in eastern Indonesia. But the fundamental land tenure requirements for rehabilitation across the range of Imperata ecosystems must receive particular emphasis.

Timber prices are increasing rapidly in Southeast Asia. This is inducing small-scale farmers to grow trees for sale. Hundreds of farmers in the southern Philippines are widely planting such species as *Gmelina arborea, Peraserianthes falcataria*, and *Acacia mangium*. They are intercropping the trees in contour lines with their annual field crops.

Preliminary observations indicate that the establishment of timber trees by small-scale farmers has several unique advantages:

1) land preparation and weeding costs in the initial years are charged to the annual crops, making tree establishment and maintenance cheap and effective compared to large-scale plantation methods,

2) the cropped alleyways between trees provide fire breaks that drastically reduce wildfire damage, and

3) small farmers' more intensive field management better insures that the trees will make it to harvestable age.

The premise is that small-scale farmers may be effective agents for reforestation in the future, by integrating trees into their farming systems. Strategically designed tests of this hypothesis will provide a basis for further action. SEARRP proposes to attack this issue by combining a systems approach with development of quantitatively predictive models. We aim to:

1) Conduct a **systems analysis of the imperata ecosystems** in Indonesia to classify the grasslands into a limited number of contrasting ecosystems, appraise the current knowledge base on practical agroforestry systems to rehabilitate grasslands differing in ecology, and develop a framework for a long-term research effort in this area.

This work will be done through a 2-year collaborative research project funded by ACIAR. It is being implemented by a Working Group of ICRAF scientists, Australian scientists, and Indonesian scientists from several institutions. CIFOR'S social science team, and the Program on reforestation of degraded forest land will be participating also.

2) Develop a **model of annual-perennial interactions** that will guide the process of designing the geometry and management systems for various types of agroforestry systems.

All agroforestry is based on the premise that the advantages of combining agricultural and forest enterprises exceeds the value of either in isolation. This assertion needs better empirical analysis leading to efficient predictions of when the agroforestry advantages are positive, and how systems should optimally be designed.

This issue is complex because the mix of trees and crops usually varies in a time-dependent manner. The tree canopy coverage is not constant but varies, usually increasing with time. This time dependency in the evolution of agroforestry systems is crucial to evaluating their role for small-scale farms, where the imperative family staple food supply must be balanced against the opportunities for perennial cash crop production.

ICRAF cannot afford to invest in large numbers of ad-hoc trials to test how annuals and perennials interact in intercropping systems of various conformation. There are many such prospective systems. Rather, we will aim to develop a practical model of annual-perennial intercropping to provide insight into the separable and integrative aspects of the intercrop on system productivity and income.

We will initiate component interactions research to develop a capacity for process-oriented understanding and modeling of tree-crop interactions. Our three initial experimental approaches in this direction will be to:

* Quantify the terms of the ICRAF 'tree-crop interaction equation' for a number of contrasting situations where the overall effect is known to be positive or negative.

* Develop and test model descriptions for the equation's interaction terms which are based on tree, soil and crop parameters that are either 'constants' for a given species, or can be easily estimated.

* Develop and test a method for predicting tree root length and distribution from easily observable roots close to the main stem. (A cooperation with the Theoretical Biology Group, Utrecht University.)

The field research to build this knowledge base will build upon current work in northern Lampung with Brawijaya University and the Institute of Soil Fertility (Haren, Netherlands), and in northern Mindanao in collaboration with the Sustainable Agriculture and National Resources Management (SANREM) program involving several Philippines and American institutions, and supported by USAID.

The output of the biophysical interactions modeling will be integrated with the intercropping production frontier modeling approach. We will be refining and testing the model using datasets from ongoing and prospective experiments of ICRAF and other institutions. This modeling effort will have applications in testing all three systems hypotheses.

We anticipate that the practical outputs of our work will guide the efforts of governments and development banks in designing programs that support the efforts of small-scale farmers to produce trees for market and hillslope sustainability.

Systems Hypothesis 3. On <u>hillslope farmlands</u> there are several pathways to sustainable small-scale farming. Among these, contour hedgerow systems initiated through natural vegetative strips (NVS) provide distinct advantages as a superior, least cost foundation upon which to build agroforestry-based conservation farming.

Annual crop farming is common on millions of hectares of hilly land in nearly every country in southeastern Asia. Much of this land is on slopes that range from 15-90 %, with documented rates of soil erosion that typically range from 50-300 t/ha/yr. If urgent efforts to stabilize these soil resources are not successful, the resulting land degradation and wasted farms will further exacerbate settlement pressure on the forest margins.

Alley cropping based on contour hedgerows of pruned leguminous trees has been promoted for over a decade in several countries as a solution to the problem. Contour hedgerow systems have demonstrated an effective ability to reduce soil losses. But farmer adoption has not been widespread. The constraints to adoption include the intensive labor requirements to install and periodically prune and maintain the hedgerows, limited value-added to farm income, and unanticipated problems in soil fertility sustainability. The classic alley-cropping model is now being widely promoted, but ICRAF researchers recognize that it has serious limitations in some situations.

Grass strips have also received major attention in different parts of the world as contour vegetative barriers for erosion control. Two major problems have surfaced with their use. Often, their high biomass production leads to serious resource competition with the adjoining food crops, particularly since they are usually pruned for cut-and-carry fodder. Their nutrient yield is then removed from the field. Second, their tall stature often leads to shading of adjacent crops, or high labor expenditure in slashing.

New directions are urgently required. The constraints observed with both trees and forage frasses have stimulated an alternative concept of employing hedgerows that contain noncompetitive species. One approach that has received little attention is the installation of natural vegetative strips (NVS). These are narrow contour strips of field area left unplowed and allowed to vegetate naturally. These natural grasses may be suppressed by grazing, slashing, or mulching with crop residue.

After isolated observations were made of this practice among upland farmers, and their tendency to prefer this method of establishing contour vegetative barriers was confirmed, work began on the understanding the potential role of NVS. Recent data indicates that they provide excellent erosion control, with negligible installation and maintenance costs, or competition with the associated annual crops. As the strips capture sediment and develop into terraces they also provide a foundation for agroforestry. Income-generating cash perennials are planted on the risers along with fodder or green manure species.

We hypothesize that the strips are a convenient way to evolve toward more sustainable annual cropping, with a gradually increasing farm area in perennials.

We believe the concept deserves wider evaluation. But some important technical issues do require attention: how can soil fertility can be maintained in the upper alleyways as terraces form, and how does incorporation of cash perennials affect the food crop and overall system productivity ? Subsequent pathways to sustainable farming will involve management systems based on nutrient recycling, nutrient regeneration, or nutrient importation. These options have yet to be scientifically explored.

We will need to address the issue of how and where to extrapolate the natural strip concept. For this we are developing a decision support system in collaboration with a Philippine soil scientist, for use at the farm level. Farmer evaluation of natural strip technology will employ a participatory research methodology.

SEARRP will seek to develop collaborative research with other institutions to fully explore the strategic implications of natural vegetative strips as a foundation for agroforestry-based conservation farming on hillslope farms. Our partnerships in this area currently involve the Tropical Soils Program (TropSoils) at North Carolina State University, faculty and students at two Philippine universities. The work will be the major theme of our involvement in the SANREM consortium working at our key site in Mindanao.

The implications in terms of research locations, and their phased development, are addressed in the next section, which covers the eco-geographical implications of ICRAFs research in southeastern Asia.

Eco-Geographical Focus

The three systems hypotheses are each strongly related to a particular ecosystem. Each hypothesis also has geographic implications: Where the issue is prominent, and where the appropriate location(s) for its investigation (see table on next page).

As one proceeds north from the equator in southeast Asia the upland climate generally becomes progressively harsher with longer, more arid dry seasons, cooler winters, and a greater threat of tropical storms. Northward along this gradient are also ecological conditions that are associated with slower establishment of vegetation, lower primary productivity, and a greater tendency for upland soils tooo lack ground cover for substantial portions of the year. The respective eco-regions along the gradient may recognized as:

* Equatorial tropics (-5 to 5 degrees lat.)	Indonesia, Malaysia
* Mid-latitude wet-dry tropics (5 to 15 degrees lat)	Philippines, Southern Thailand & Southern Vietnam.
* Northern tropics (15 to 22 degrees lat.)	Northern Thailand, Vietnam, Myanmar, Laos and Southern China

The equatorial tropics is where the major remaining forests exist. These are particularly concentrated on the islands of Sumatra, Borneo, and New Guinea. Research to protect natural forestland by addressing the intensification of agroforestry systems on the forest margins will be targeted predominantly to the equatorial tropics. The strategic research site tentatively identified is the Hari river watershed in central Sumatra. The full ICRAF scientific team in Indonesia will be involved in research on hypothesis 1.

The northern tropics encompasses the huge east-west belt of hillylands in the interior of mainland southeast Asia, reaching from Assam to Vietnam and southern China. The climate is strongly monsoonal with long dry winters that are slightly cooler. The problem in this zone contrasts sharply with that of the equatorial tropics. Major land degradation in the upland watershed areas has resulted from agricultural intensification on steep terrain. The global Alternatives to Slash and Burn Project has selected northern Thailand as a key research site. It is in a central location vis-a-vis the uplands of four neighboring countries, and has the most favorable scientific infrastructure to support strategic research and training. Systems hypotheses 2 and 3 are particularly relevant for ICRAFs focus in the ASB research consortium based there. We propose to build a team of 2-3 scientists in northern Thailand to provide a critical mass of scientific effort for this ecosystem.

Research Strategy:
A Test of Three Systems Hypotheses

ECOSYSTEM	Forest Margins	Grasslands	Hillslope Farmlands
HYPOTHESIS	Agroforests superior to foodcrops or monoculture estate crops	Reforestation through Agroforestry	Natural strips as a foundation for agroforestry
RESEARCH LOCATION	Indigenous communities Pioneer communities	Pioneer communities	Permanent farms
KEY ECO GEOGRAPHIC RESEARCH			
Equatorial	Indonesia	Indonesia	
Midlatitude		Philippines	Philippines
Mainland		Thailand	Thailand

The mid-latitude tropics is a transitional zone. Research work in the Philippines builds upon the support of ICRAFs strong relationship with the Upland Ecosystem Program of IRRI and the SANREM CRSP, a long term initiative of USAID. The work will be conducted with these partners in the Manupali watershed in northern Mindanao. It will be managed as a subsidiary activity of the Bogor regional team.

Thus, our plan with respect to research sites focusses on two dominant locations: The equatorial tropics (Sitiung, Sumatra, Indonesia) and the northern tropical hill country (Chiangmai, Thailand), with a subsidiary site in the mid-latitude tropics (Mindanao).

The ecosystem continuum at each of the 3 research locations will enable ICRAF to employ a landscape approach in its research. Work in the forest margins, grasslands, and hillslope farmlands at one major site in each eco-geographic regions will enable us to engage in comparative analysis, and to better extrapolate our findings across the region.

We will phase the initiation of research activity at our key sites. During the first half of 1993 the Philippine site became fully operational, in collaboration with IRRI, and two site characterization activities were conducted at the Indonesian site. Field research in Indonesia will be initiated during the second half of 1993, as the ASB project obtains funding.

Research at the northern tropical hill country site in Thailand is scheduled to begin in late 1994.

Regional Research Linkages

The humid tropics of Southeast Asia is a huge geographical area. Attention needs to be given to how ICRAF will address the needs of countries and institutions outside the key ASB locations. We propose to manage our engagement outside of our strategic research locations primarily through the strength of the ASB research consortia.

Mainland Southeast Asia. ICRAFs strategy for research collaboration on the mainland of Southeast Asia will be focused on its partnership with the ASB consortium in northern Thailand. Here, particular leadership is anticipated from Chiangmai University.

The consortium should provide useful linkages and support to agroforestry research related to ASB objectives in southern China (eg Kunming), Myanmar (viz. Shan uplands) and Vietnam. In this model, ICRAFs support for agroforestry research in these countries would be handled through the ASB consortium. The collaborating

countries, would send researchers for training at the key sites. They will also be encouraged to develop national research projects on ASB with bilateral funding.

India is developing a country project on alternatives to slash and burn and has extensive research work on agroforestry for upland rehabilitation through the All-India Coordinated Research Project on Agroforestry. We will seek close linkages between these efforts and the global ASB initiative.

Training Initiatives

In training we will place emphasis on the training of PhD and MSc students as an integral part of the research work. We plan to conduct formal and informal short-term research methods training in support our partner institutions.

We are already building institutional partnerships with universities within the region and internationally. Our scientists will be involved in advising graduate thesis and dissertation research on strategic problems integral to our systems hypotheses and ecological focus in the region. We are currently involved in dissertation advisorship for students from the University of the Philippines, the Visayas State College of Agriculture and the Australian National University. Three Asian students conducting their PhDs at North Carolina State University are also in various stages of their dissertation research in collaboration with ICRAF Southeast Asia.

We are also developing a Southeast Asian Agroforestry Scholars Program to obtain funds to enable bright, ambitious students to do more challenging (and ultimately more costly) field research on our systems hypotheses. The Indonesian Ministry of Forestry is implementing a massive overseas graduate training program. ICRAF will work with selected Indonesian students completing their coursework at foreign universities, enabling them to conduct quality agroforestry dissertation research back in Indonesia.

Co-advising students in close collaboration with a university academic advisor builds strong ties with university staff in the region. It also pulls into the program the latest research methods from the more developed country university programs.

In short-term training we anticipate conducting an international course on land use and agroforestry research methodology annually. Our first such course was held in April-May 1993.

Multipurpose Tree Improvement

Improved germplasm is crucial to the sustainability of agroforestry systems in the three priority ecosystems. On the forest margins the immediate introduction of appropriate trees into the farming system after the forest has been opened, or the grasslands settled, enhances the probability of developing a stable production system. Tree cultivation to partially replace annual crops on sloping farmlands is a key pathway to arresting their degradation. Therefore, we will put strong emphasis on the selection, evaluation and management of selected indigenous and exotic trees and shrubs for fruit, fodder, wood, and industrial products.

A prospective vehicle through which SEARPP could help accelerate the genetic improvement of multipurpose trees would be to collaborate closely with the international MPT Network. This collaborative network of 10 countries is coordinated by the F/FRED Program in Bangkok. The network has several activities: Coordinated trials on a number of MPT species, an MPT database, and research projects on MPT marketing and propagation technology. Funding for F/FRED is phasing out in 1994. ICRAF has been invited to explore the possible integration of a few relevant aspects of the network into its Southeast Asia program. We are currently studying this prospect and developing a scientific and funding strategy to support such a linkage.

Building disciplinary strength

The program's objective in building a scientific team is to assemble the disciplinary strength and balance to rigorously test our systems hypotheses. The positions that have been programmed for Indonesia in ICRAFs Medium Term Plan, and the Programs to which they are connected are:

*	Social scientist	Program 1
*	Multipurpose tree specialist	Program 2
*	Soil fertility specialist	Program 3
*	Systems Agronomist	Program 4
*	Training and dissemination specialist	Program 5-7

The team may be further strengthened by seconded staff from partner institutions. In Indonesia the Bogor-based researchers will focus on Systems Hypotheses 1 and 2.

An ICRAF team for the mainland hill country will begin to be assembled in 1994 if funding for the expansion of the ASB Project is approved. Additional positions for this eco-geographic zone are also anticipated through complementary funding. This team will focus on Systems Hypotheses 2 and 3.