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TRANSFORMING LIVES AND LANDSCAPES

Soil Fertility Matters

A Newsletter on Soil Fertility and Fallow Management in the Upland Tropics

This second issue of *Soil Fertility Matters* is produced under the project titled the *Interim Information Support for the Southeast Asian Regional Network on Soil Fertility and Improved Fallow Management*, based at the University of the Philippines Los Baños-Foundation, Inc. (UPLB-FI) and funded by the International Fund for Agricultural Development (IFAD) through the World Agroforestry Centre (ICRAF).

Inside this issue...

Soil fertility *is the capacity of soil to support the growth of plants on a sustained basis under given conditions of climate and other relevant properties of land.*

Practitioners Share Views on Soil Fertility and Fallow Management

D.B. Magcale-Macandog

More than 200 individuals from around the world, composed of development planners, project managers, scientists, researchers, and champions of soil fertility and fallow management in the tropical uplands, are actively participating in an electronic discussion on soil fertility and fallow management. This electronic discussion list, called *FallowNet*, is moderated by the UPLBFI-ICRAF-IFAD Information Support Project which is based at the University of the Philippines Los Baños.

FallowNet serves as an avenue for information exchange and facilitates dynamic exchange of ideas on different topics which include shifting cultivation, soil fertility management, green manure, cover crops, upland ponds, improved fallows, livestock, economics of upland farm management to globalization. This article features a synthesis of the FallowNet's on going discussion covering shifting cultivation, green manure and cover crops (GM/CCs), burning, phosphorus and improved fallows.

The exchange of ideas, experiences, and perspectives among the FallowNet discussion list members has pointed out that shifting cultivation systems should be looked at from

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Indigenous Knowledge in Northwestern Mindanao

V. J. Suminguit

A comparative study on intracultural variation of indigenous knowledge of agroforestry was conducted in two ethnic communities, the Visayan settlers and the Subanun indigenous group. The communities studied are located in the two adjacent municipalities of Don Victoriano, Misamis Occidental and Josefina, Zamboanga del Sur. The study has potential relevance to upland development work in both Western and Northen Mindanao. Highlights of this study was presented recently during the one-day Local Ecological Knowledge Seminar-Workshop held in Los Baños, Philippines on 19 August 2002.


Photograph courtesy of V.J. Suminguit

A multistorey agroforestry system of the Subanun tribe in Northwestern Mindanao.

The study attempted to document the local understanding of agroforestry; and understand how indigenous knowledge of agroforestry is differentially distributed according to age, gender, and ethnicity.

Agroforesters like Rocheleau (1987); Raintree (1990) and Budd, et al. (1990) have asserted the urgency of documenting indigenous agroforestry practices in the tropical regions to understand the contributions of these practices to the different agricultural systems. Because agroforestry appears to be the best land use alternative that will increase food production, while slowing down the rate of tropical deforestation, documenting indigenous agroforestry practices is needed. Further, the documentation task is important because this is where the anthropological concern for indigenous knowledge systems and the biological concern for agroforestry systems overlaps.

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An Integrated and Participatory Research Approach for the Stabilization of Shifting Cultivation in Lao PDR

B. Linquist and P. Sophrathilath

More than 80% of Lao PDR's total land area is mountainous. For centuries, many ethnic minorities living in the country's mountainous regions have practiced shifting cultivation. Even up to this time, they continue with this practice. However, due to increasing population, the fallow period is becoming shorter and shorter. The shortening of fallow periods contributes to the decrease in crop yield, increase in weed pressure, and increase in soil erosion. All these resulted in upland farmers' decreasing income and agricultural productivity, leading ultimately to poverty.

The Lao PDR government has exerted efforts to reduce shifting cultivation in the uplands through the enactment of a land allocation program that allots three to four upland fields to each farm household. Initially, this scheme led to a further decline in crop yields as fallow periods were shortened to only 2 or 3 years.

To address the above issues, the Lao PDR's National Agriculture and Forestry Research Institute (NAFRI) established the Integrated Upland Agricultural Research Project (IUARP) to provide an integrated approach to developing sustainable livelihood systems for these upland communities. IUARP works in eight mountain villages near Luang Prabang in northern Laos. These villages represent diversity in terms of ethnic groups, access to market and roads, and relative importance of livestock and lowland rice.

For funding and technical support, NAFRI has teamed up with several CGIAR centers, which include the World Agroforesty Centre (ICRAF), the International Rice Research Institute (IRRI), Centro Internacional de Agricultura Tropical (CIAT), and International Water Management Institute (IWMI); the Australian Centre for International Agricultural Research (ACIAR); the Potash and Phosphate Institute (PPI) and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). The number of research institutions involved was initially a challenge in coordinating activities at the village level. To address this problem a local implementation team (IT) was established. The IT is composed of district-level staff and locally based researchers, serves as the interface between the research institutions and the farmers. All research activities and field visits are conducted in coordination with this team.

Photograph courtesy of L.E. Mojica

Sale of charcoal is one of the major sources of income from agroforestry activities in Lao PDR.

The IUARP primarily seeks to address the problems and issues in upland farming through an integrated, participatory research approach. In the past, much of upland research addressed only a few, individual components of a complex and diverse system. As a result, outputs from these research programs did not have any significant impact. Furthermore, previous research has been conducted with minimal inputs from upland farmers. In this approach, farmer research groups are consulted and empowered to address particular issues in upland farming.

The research conducted by IUARP is demand-driven. The starting point is the farmer participatory problem diagnosis (PD). This village activity identifies problems and needs. As a follow-up to the PD, cross visits are organized to expose the farmers to other farmers or researchers who are working on the same problems. Through this process, farmers who want to experiment with new technologies are identified. Researchers initially work closely with these farmers to help them understand the technology being tried. Throughout the year, researchers visit farmers frequently to assess progress. During these visits, formal and informal analyses of farmer preferences are conducted to identify what farmers think about the technologies. These dialogue and information sharing form the basis for planning next year's research.

Having gone through this process for 2 years, other positive benefits of using this approach emerged. First, the PD helped establish trust between researchers and farmers. The farmers saw the sincerity of the researchers in trying to understand and address farm problems. Second, the whole village became aware of the research activities, even though not all participated. As a result, farmers were motivated to be involved. In the first year, 50 farmers participated; in the second year, more than 300 farmers were involved in various research activities.

The problems initially indicated by some (or all) of the village residents were (1) insufficient rice production, (2) poor nutrition of livestock, (3) limited opportunities for income generation, and (4) deterioration of forested areas. Some of the ongoing research to address these problems focus on improving rice varieties, improving fallows and soil conservation technologies, improving the productivity of limited lowland rice areas, pest control, forage evaluation, fish raising, and evaluation of alternative income activities (e.g. growing fruits, non-timber forest products).

During the first year of the project, most of the activities concentrated on research. It was necessary for farmers and researchers to identify the types of research work that are suited in the area. This strategy was also a confidence-building exercise that allowed farmers and researchers to trust each other. As research progresses, promising technologies that can be adapted emerge. These are then integrated into programs that promote more sustainable livelihood systems.

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Agricultural Development with Rainforest Conservation:
Methods for seeking best bet alternatives to slash-and-burn

T.P. Tomich, M. van Noordwijk, S.A. Vosti and J. Witcover

Local users of forests see them through a filter of private interest: as the means to earn a living either directly by extracting forest products or indirectly by clearing forests for agriculture, then burning forest biomass to create an initial injection of nutrients into soils that often are fragile and deficient in key nutrients.

It is inaccurate to equate all forms of slash-and-burn with permanent forest conversion and unsustainable land use. Traditional shifting cultivation of foodcrops, as practiced for generations by local people in the tropics, is sustainable as long as population densities were low enough to allow long fallow rotations. Although traditional shifting cultivation is disappearing as rural population densities increase, slash-and-burn as a technique of land clearing is used by virtually all actors (public and private, large- and small-scale), contributing to forest conversion, sometimes in systems that are unsustainable. Nearly all tropical deforestation uses 'slash-and-burn' techniques for land clearing. There is considerable confusion in the literature, however, on how much of this is part of a long-fallow rotational system ('shifting cultivation') and how much is intended forest conversion. Small-scale farmers focus on the private goods and services of rainforest use, which often involves deforestation.

Overall, a best bet is a way to manage tropical rainforests or a forest-derived land use that, when supported by necessary technological and institutional innovation and policy reform, somehow takes into consideration the local private and global public goods and services that tropical rainforests supply.

Local private concerns of the small-scale farmer

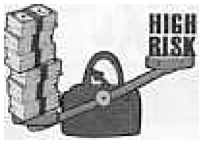
Since many of the small-scale farmers practicing slash-and-burn appear to do so because they lack feasible livelihood options that do not involve forest conversion, understanding farmer objectives and the social, economic, and biophysical constraints they face is critical. Fundamentally, for a land use or technological alternative to be a best-bet candidate, it must be feasible for small-scale farmers to adopt, perhaps on only a portion of their land.

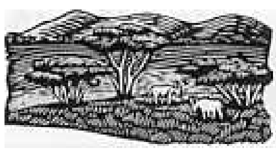
First, best bets must be profitable, and more profitable than alternative activities on- or off-farm. The time frame within which best bets would need to turn a profit depends on the financial situation of the household. Among small-scale farmers with few financial assets and little or no access to credit, this time frame could be quite short. Second, best bets must improve the food security situation of the farm household, the more so the closer the household lies to, or risks failing below, the threshold for minimum daily requirements. Third, these alternative activities must be compatible with labor constraints at the farm level, limited either by the human resource endowment of the farm household itself or by the rural labor market. Finally, best bets need to be agronomically sustainable; that is to say, alternative production systems must not degrade the underlying natural resource base in ways that undermine productivity and, as a result, destroy the profitability of these systems over time.

Some factors affecting attractiveness of investments in productive assets and for sustainable resource management also operate beyond the household level. These include security of rights of access to and use of the natural resource base.

Evaluation of best bets

To be regarded a best bet, an alternative would have to surpass unsustainable shifting cultivation. Agronomically degraded systems, such as grasslands and degraded pastures, provide another set of minimum standards to beat. Systems that make better use of, and enrich, forests should be considered candidates for best bets. Likewise, agroforestry and treecrop systems that improve productivity while conserving some biodiversity and sequestering carbon would also be good candidates. Finally, improvements in existing foodcrop and livestock production systems that boost productivity and extend the productive life of soils should also be considered since they may reduce demand for additional forest conversion under certain conditions.





Measuring smallholder concerns (indicators)

- *Private profitability:* the appropriate measure of private profitability is the expected net present value (NPV) of revenues less costs of purchased inputs and of domestic factors of production, all valued at market prices. In addition, the time to reach positive cash flow (at a level sufficient to make a substantial contribution to sustaining a farm household), is critical, as is the existence of any subsequent period of negative cash flow.
- *Household food security:* the appropriate food security indicator must incorporate both direct consumption of home-produced food as well as trade for food. This is especially important for land use systems that do not involve foodcrops, but it applies to food-producing systems as well. The measure used will be based on the concept of risk of food entitlement failure, which encompasses trade-based and production-based entitlements to food as well as security of property rights over productive assets (inheritance and transfer entitlements).
- *Household labor use:* a measure of labor requirements (person-days per year) of particular systems will be averaged over the land use cycle. This will be supplemented by a measure of cash flow to meet hired labor needs should family labor be insufficient, calibrated so as to capture discrete periods of peak labor demand in the system itself (taking into consideration

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labor demand in other household activities). It is also necessary to measure division of labor by gender and age for operations where those distinctions matter.

- *Agronomic sustainability:* this refers to the long-term production capacity of a land use system; like the 'indicators' above, it is itself multidimensional. The overall indicator of agronomic sustainability follows the law of the minimum: it will take a value of 1 (indicating the system is agronomically sustainable) if all components are above the minimum threshold for sustainable production, but 0 (unsustainable) if any component is below its threshold value at any time.

Panacea or Pandora's box?

However, several overriding caveats regarding technological change must be faced. First, best-bet technologies alone cannot arrest forest conversion. Many of the forces driving deforestation and natural resource degradation arise at the regional or national level and can overwhelm the mitigating effects of technological change. Second, financial profitability is a necessary condition for adoption of best bets by smallholders but is not sufficient by itself as a means to slow deforestation. Third, the relative profitability of forest conversion by smallholders is not determined solely by production technology; it is also tied to institutions and legal frameworks that establish, monitor, and enforce property rights; to policies regarding public investment in infrastructure and social services; and to macroeconomic policy. The institutional and policy environments sufficient for best-bet alternatives to reduce poverty and deforestation are not well understood yet; and this is top priority on ongoing research. However, it is a sure bet that deforestation will accelerate in developing countries if profitable innovations for rainfed land uses are introduced where there is open access to rainforests and within an economy-wide context of rapid population growth and declining economic opportunities.

This article was condensed by Dr. Damasa B. Magcale-Macandog from the original article of Dr. Thomas Tomich, et al. 1998, entitled, Agricultural development with rainforest conservation: methods for seeking best bet alternatives to slash-and-burn, with applications to Brazil and Indonesia, published in Agricultural Economics 19 (1998) pp. 159-174.

Nutrient Cycling in Ecosystems and Nutrient Flows in Agroecosystems

M. van Noordwijk

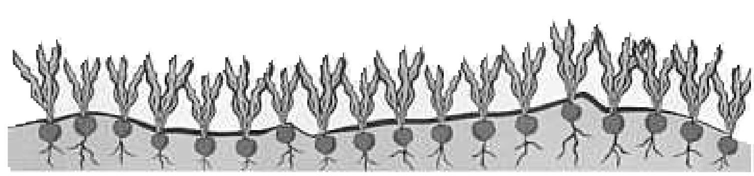
Nutrient cycling in natural ecosystems

The basic concept that natural ecosystems maintain closed nutrient cycles (Chapin, 1980; Jordan, 1985; Brown et al., 1994) depends on spatial and temporal scales. Nutrient cycles will be closed in situations where 'demand' for nutrients by the growing biomass exceeds current supply. In early and late successional stages, however, considerable nutrient losses may occur when a nutrient balance is made at patch scale. In early stages, aboveground demand and ability to capture belowground resources may be too small for making use of all (temporary) nutrient flushes available; in mature systems, nutrient demand may be less than current supply. Losses at patch scale can lead to lateral transfers between sites, via groundwater, surface runoff, or dust that can support a growing phase of vegetation elsewhere. Losses for one patch may provide opportunities for others and a patch-mosaic may therefore be more efficient in nutrient cycling than a summation of supposedly independent units would suggest. On a geological timescale, leaching and erosion on hill slopes dominate soil formation; a transfer occurs from nutrient-degrading sites to nutrient-building sedimentation zones and colluvial sites, with a net loss of nutrients into the oceans. This differentiation into rich and poor sites increases overall biodiversity.

Nutrient cycling differs between ecological zones and one should be careful with generalizations. Differences are due to climatic factors affecting loss rates by erosion and leaching, differences in soil type and in the effective buffering of nutrients in the root zone, and differences in the response of vegetation. In mixed vegetation, relatively deep-rooted components can provide a 'safety net' for nutrients leaching from topsoil (van Noordwijk et al., 1996). Soil zones with high physicochemical adsorption constants can, by analogy, be interpreted as chemical safety nets.

In the tropical rainforest zone, water availability may allow roots to focus on the surface layers where most nutrients are available. In fact, in nutrient-poor soils where plants resorb most nutrients from their leaves before litterfall (thus resulting in low litter quality and slow decomposition), a substantial part of the roots may be found in the 'root mats' within the surface layer, on top of the mineral soil. Under these circumstances, nutrient cycling can avoid the mineral with its strong chemical (aluminum [Al] and iron [Fe]) sinks for phosphorus (P) (Tiessen et al., 1994).

The nutrient cycle in natural ecosystems involves uptake by plant roots from (largely) mineral nutrient sources, utilization of these nutrients in plant biomass for a certain period of time, and return to the soil in organic or inorganic form with litterfall, as seeds or dead plants remain at the end of the plant's life cycle. A considerable part of the nutrients may pass through herbivores before they return to the soil. A fraction of the nutrients may pass through one or more carnivore steps, but eventually most of the nutrients brought above the soil surface by plants return to the soil surface in organic or inorganic form; the remainder may enter riverain and marine ecosystems and return to the soil only at a geological timescale, or (largely confined to nitrogen and sulphur) become part of atmospheric pools and return as wet and dry deposition or through nitrogen fixation. Most of the nutrients, however, may return to the soil within the direct vicinity of where they were taken up. Decomposition of organic inputs to the soil ecosystem returns the nutrients to the inorganic (mineral) form, but there can be considerable delays involved. Inorganic nutrients are part of physicochemical equilibria in the soil, governing their current concentration in soil solution. Transfers of nutrients between neighboring land units can occur, via movement of soil or in water-soluble form, but usually such transfers are small.



Nutrient cycles become nutrient flows in agroecosystems

All processes of the nutrient cycle described in the previous section can be recognized in agroecosystems as well, where farmer management is aimed at the nutrient uptake and associated plant productivity of one (or a limited number of) plant and/or herbivore species (Fig. 1). A major difference starts at harvest time, however, when products are removed from the field where they grew. In a subsistence economy, most nutrients still stay in the ecosystem from which they were derived in plant uptake and will be returned around the homestead. As long as culture is based on 'shifting homesteads,' human systems can stay part of the natural nutrient cycle, and spontaneous vegetation can reclaim the accumulated nutrient stocks from the soil. With increasing integration of agriculture into world markets, the distance traveled has increased enormously and in the vast majority of current farms, a return flow of nutrients in waste products is no longer feasible. The nutrient cycle has thus become a nutrient flow process based on mining, with substantial on-site losses in each cycle and accumulation in peri-urban areas (Fig. 2)

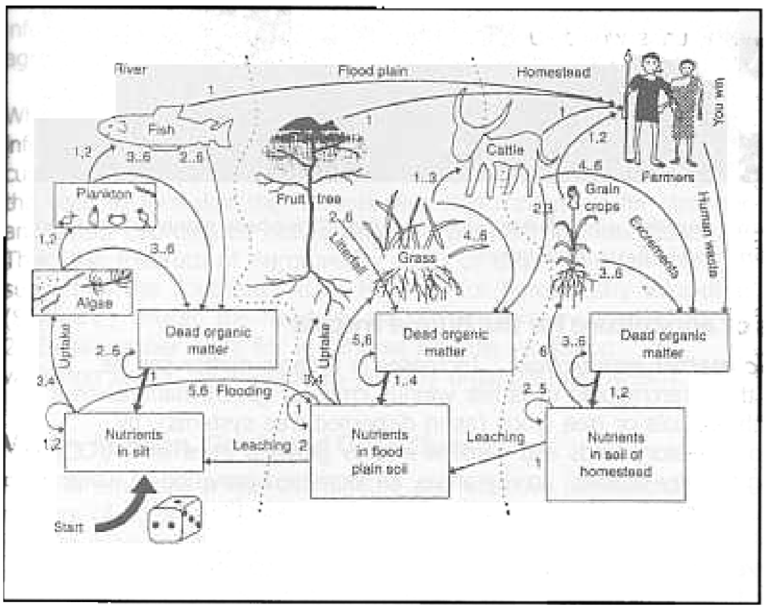


Fig. 1. Nutrient cycling in a traditional agricultural system.

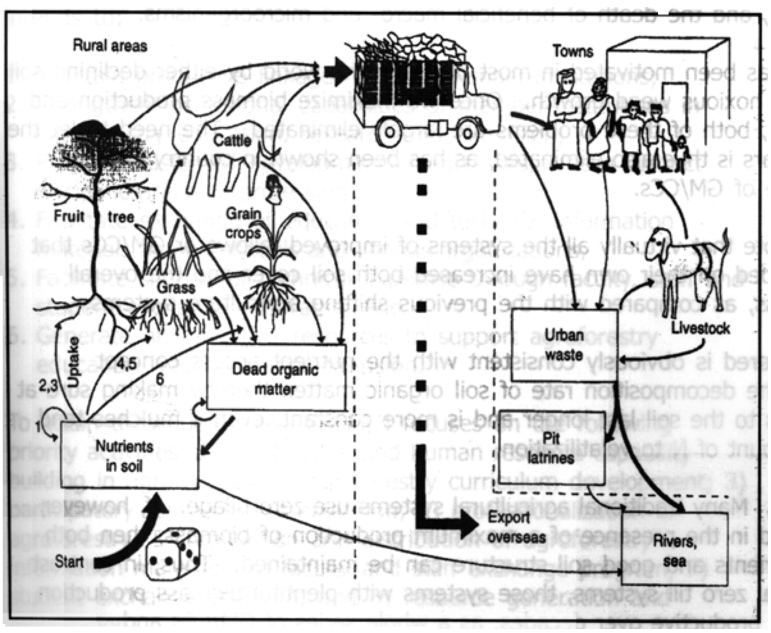


Fig. 2. Nutrient flow in an agricultural system that produces for urban or export markets.

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The Nutrient Access Concept of Tropical Soil Fertility

Roland Bunch

Crop growth above a certain extremely low concentration does not depend on the concentrations of nutrients. It depends, rather, on the constant access of plant roots to the nutrients, even when these nutrients exist in very low concentrations. As long as the plants enjoy the right conditions of nutrient balance, accessibility to nutrients, and a constant resupply of nutrients, the relationship between the concentration of nutrients in the soil and its productivity is either zero (i.e., there is no relationship) or negative (i.e., more concentrated nutrients reduce plant productivity).

This fact is very relevant to tropical soils and farmers than to temperate-zone soils and farmers because tropical soils tend to have fewer cation-exchange sites and, therefore, lower concentration of nutrients. Because of this paucity of CEC, it is also much more difficult and costly for farmers to raise those concentrations of nutrients over the medium to long term. Second, the ambient heat of the tropics makes it difficult or impossible for plants to create the osmotic pressure to be able to absorb nutrients from highly concentrated solutions. Therefore, plants in the lowland tropics often thrive better on more limited concentrations of nutrients, as long as the remaining conditions are fulfilled.

Thirdly, farmers who work by hand or animal traction can more easily micromanage their soils, creating varied microenvironments, in some of which nutrients are accessible, even if the total soil environment is deficient in accessible nutrients. And lastly, while northern farmers can often afford to fertilize their soils more heavily than what is needed for present purposes, resource-poor farmers in developing countries just cannot afford to overfertilize. Furthermore, more nutrients are lost in high-rainfall or steeply sloping lands.

The new concept of soil fertility emphasizes not the concentration of nutrients in the soil but rather the maximization of the access of plant roots to soil nutrients. Maximum plant growth can best and most cheaply be achieved in the tropics by the constant supply of soil nutrients, a healthy balance between the nutrients, and maximum access of plant roots to these nutrients (i.e., the maintenance of good soil structure and/or mulches).

Photograph courtesy of M. Stark

A staff of ICRAF-Visayas, together with a farmer, showing a plot of rice bean plants used as one of the GM/CCs for corn plots in Leyte, Philippines.

The five principles of agriculture for the humid tropics

1. ***Maximize organic matter production.*** Increases in organic matter can be achieved by using the intercropping of either various crops or green manure/cover crops (GM/CCs) with annuals or tree crops (as in dispersed tree systems), by establishing two- to four-story fields and gardens and by growing trees or GM/CCs on wasteland or during the dry season. In dry areas, an increased provision of water in whatever form can also result in greater levels of biomass production.

2. ***Keep the soil covered.*** Soil exposed to the tropical sun produces more weeds (which are another form of biomass, but may compete with crops and/or occasion a good deal of work). Unprotected soil also becomes very hot, causing a series of problems, including the more rapid rate of soil organic matter burnout, reduction in crop growth rates, and the death of beneficial macro- and microorganisms.

Shifting agriculture has been motivated in most places in the world by either declining soil fertility or increasing noxious weed growth. Once we maximize biomass production and keep the soil shaded, both of these problems are largely eliminated. The need to let the land lie fallow for years is thus also eliminated, as has been shown in country after country with the use of GM/CCs.

It is interesting to note that virtually all the systems of improved fallows or GM/CCs that farmers have developed on their own have increased both soil cover and the overall production of biomass, as compared with the previous shifting agriculture systems.

Keeping the soil covered is obviously consistent with the nutrient access concept because it reduces the decomposition rate of soil organic matter, thereby making sure at provision of nutrients to the soil last longer and is more constant, even if mulches tend to lose a certain amount of N to volatilization.

3. ***Use zero tillage.*** Many traditional agricultural systems use zero tillage. If, however, zero tillage is used in the presence of a maximum production of biomass, then both the supply of nutrients and good soil structure can be maintained. Thus, in contrast to many traditional zero till systems, those systems with plentiful biomass production can remain highly productive over decades, as a whole series of GM/CCs and agroforestry systems have proven.

Enhancing Agroforestry Education, Research and Development through the Philippine Agroforestry Education and Research Network (PAFERN)

L. D. Landicho and V. T. Villancio

The Conception of PAFERN

Four years back, a National Workshop on Agroforestry Education was held at the University of the Philippines Los Baños (UPLB). Attended by more than 40 participants, representing about 30 agroforestry schools, national government agencies including the Commission on Higher Education, and some non-government organizations (NGOs), the workshop resulted in the establishment of an informal coalition of agroforestry institutions to help strengthen the agroforestry education in the country. It was called the Philippine Agroforestry Education and Research Network (PAFERN). The participants drafted the vision, mission, goals and objectives of PAFERN. Since then, PAFERN has operated as an informal coalition of 31 state colleges and universities engaged in agroforestry education, research and development.

While the member-institutions appreciate the relevance of the informal coalition, specifically in terms of information exchange, curriculum development, institutional and staff capability building, the need to formalize the network was also recognized for stronger and better coordinated networking and program implementation. Thus, the Institute of Agroforestry (IAF) of UPLB, through the support of the Southeast Asian Network for Agroforestry Education (SEANAFE), invited the heads of the 31 agroforestry schools on 21-24 November 2001 for a National Meeting-Workshop. This workshop served as a venue to formally organize the PAFERN.

Vision, Mission, Goals and Objectives

PAFERN envisions a well-coordinated and effective institutional delivery of agroforestry education, research and extension. Its mission is to enhance and sustain the capabilities and commitment of member-institutions to quality agroforestry education, research and extension. Primarily, it aims to institutionalize strong links within and among schools and various organizations engaged in advancing agroforestry as a science and practice. Specifically, the network intends to:

1. Maintain productive linkages among member-institutions;
2. Strengthen institutional capabilities of member-institutions in agroforestry education, research and extension;
3. Promote sustained development of agroforestry as a distinct discipline and as a profession;
4. Facilitate exchange of education and technical information materials among schools and various organizations;
5. Facilitate sharing of technical expertise through faculty, staff and student exchange programs; and
6. Generate and mobilize resources to support agroforestry education, research and extension.

To attain these objectives, PAFERN focuses on the following priority activities: 1) institutional and human resource capability-building in agroforestry; 2) agroforestry curriculum development; 3) participatory research and extension; 4) professionalization of agroforestry; 5) production and distribution of agroforestry information materials; 6) faculty and staff exchange program; 7) student exchange program; and 8) resource generation and mobilization.

PAFERN
envisions a well-coordinated and effective institutional delivery of agroforestry education, research and extension.

The Modus Operandi of PAFERN

PAFERN is composed of three principal bodies - the Board, the General Assembly, and the Secretariat. The General Assembly is composed of the official representatives of the member-institutions. Currently, there are 31 member-institutions that are actively involved in the implementation of network activities. These include 19 in Luzon, 5 in the Visayas, and 7 in Mindanao. The members are expected to 1) link the network with various agencies, including funding institutions to sustain operation; 2) provide opportunities for human resource development in agroforestry; 3) conduct agroforestry education, research and extension activities; 4) produce and share agroforestry information materials; 5) share costs for participation in network activities; and 6) share resources with other member-institutions.

On the other hand, the Board, which facilitates and oversees the overall implementation of PAFERN, is composed of a Chairperson and three members representing the three island groups of the country - Luzon, Visayas and Mindanao. The members of the Board are selected through an election during the first general assembly meeting and every two years thereafter, during the annual general assembly meeting. The chairperson of the Board is elected by the General Assembly, while island representatives are elected by the member-institutions in each of the three island groups. The Philippine representative to the SEANAFE Board is also an ex-officio member of the Board. Meanwhile, IAF serves as the national secretariat of the network, which provides administrative and technical support services to effectively carry out its activities.

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The Need to Systematize Local Ecological Knowledge Systems in Benguet, Philippines

G. T. Bengwayan

The International Fund for Agricultural Development (IFAD) joins the upland development community in recognizing local ecological knowledge (LEK) as a major consideration in the planning and implementation of development undertakings. In this regard, IFAD co-sponsored a seminar workshop on Local Ecological Knowledge held at PCARRD, Los Baños, Laguna, on 19 August 2002. Case presentations on the state of LEK in specific upland communities covered by IFAD-assisted project sites were presented in the seminar.

This article is one of the papers presented during the LEK seminar-workshop and it highlights the existing LEK of an upland indigenous community at the Cordillera Administrative Region (CAR) in the northern part of the Philippines, site of the IFAD-assisted Cordillera Highland Agricultural and Resource Management (CHARM) Program. One of the collaborating institutions of CHARM is the Benguet State University, with which the author of this paper is currently affiliated.

Farmer's local ecological knowledge is documented and systematized for use of development planners and other stakeholders.

At the outset, LEK could be considered synonymous to indigenous knowledge systems and practices (IKSP), a knowledge system based on time-tested practices of indigenous peoples (IPs). According to the International Labor Organisation (1994), such local practices enable indigenous people to survive in fragile ecosystems (i.e., sloping uplands).

On the other hand, LEK is not only confined to IPs; it also includes the whole gamut of local folk in the countryside or in farming communities. The rationale of the LEK seminar-workshop points to the need to consider LEK (and/or IKSP) in rural development initiatives. The International Institute of Rural Reconstruction credo states these concepts succinctly:

Learn from the people.
Start with what they know.
Build on what they have.

In this light, documentation of these existing local practices is imperative. It is enlightening to know that work along this area is being fast-tracked. This is evident in studies conducted by state universities and colleges (SUCs), non-government organizations (NGOs), UNDP, ILO-INDISCO and many more. Even with the existence of on-going and completed documentation activities on LEK, there still remains a considerable area to work on. There is an urgent need to focus on data management including systematic storage and facilitating easy access and retrieval. This will make LEK information available to direct users such as LEK planners and policy makers.

The IKSP of the Ibalois and Kalanguyas of Benguet

The *Ibalois* and the *Kalanguyas* are among the major tribes of the province of Benguet. The Ibalois are residents of these Benguet municipalities: Itogon, Atok, Bokod, Kabayan, Tublay, Tuba, Kapangan, Sablan and La Trinidad. The *Kalanguyas* settled in Kabayan, Benguet. Both tribes have a wide range of IKSP in agriculture and resource management.

Indigenous Practices

Seed conservation practices

- *The Su-ulan system.* This is a structure constructed above the fire hearth where rice, corn, beans, pigeon peas (kardes), coffee bean, and squash seeds are stored. The smoke serves as a preservative and it repels insects and rodents. The structure is also used as a storage area for fuel wood.
- Use of ash for small-seeded crops. Seeds of food crops such as pechay and wild mustard are mixed with wood ash and stored in a bottle.

Soil conservation

Lusod folks employ the gen-gen, a hillside structure which combines terracing and composting. This practice prevents surface run-off and enriches the soil.

Farming practices

- *Fallowing.* After crops in a slash-and-burn plot or *kaingin* area are harvested, the area is given a "rest period" of 6-12 months. This enables the soil to regenerate.
- *Outplanting of sweet potato or camote (Ipomoea batatas).* This practice includes the selection of camote cuttings before harvesting. Cuttings are planted in a shady area with short distances in between plants. The cuttings serve as planting materials for the next cropping.
- *Mixed cropping.* This practice involves the cultivation of a variety of food crops and medicinal plants in one plot. A plot is cultivated with different crops such as squash, legumes, and other vegetables. Naturally occurring herbs are also allowed to grow in the same plot.

Forest Protection Practices

- *Establishment of fire lines.* This is done through the organization of an ug-ugbu group, a local version of a work group system (known as bayanihan in other areas of the Philippines).
- *Selective harvesting.* Only the needed parts of the forest or fruit trees are harvested. For instance, tree twigs and branches are used as fuel wood, fruits are

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The Need to Systematize

aten and the barks are used to make ropes. One of the key informants mentioned that "we don't have to cut the whole tree to get what we need. This means that sections of trees are enough to satisfy their basic household requiremen

Threats to the Sustainability of Indigenous Practices

The following factors threaten the continuous existence of indigenous practices.

Populatio Although population pressure as an indirect effect on the practic s, it has a be ing on land e. With the increase in populatic land use patterns may from farming to residential. With this, not only are the practices threatened but also the existing plant diversity.

Abuse of the kaingin system. The kaingin practice is related to population growth. More lands will be used for farming and its use may be frequent. Fallowing may no longer be practiced.

Disinterest among the young. As the younger generation gets exposed and is lured into commercial vegetable farming, concern over the preservation of plant species and the corresponding practices mentioned earlier may

Given this scenario, it is import that concerned agencies and loc units (LGUs), from the provi cial to community (barangay) level ook in these causes of diversity los erosion of LEK. There is a need to document LEK and IKSP, convert these collected data/information into a systematic or organized form, and then disseminate them to development planners, policymakers, researchers and staff of related institutions. A better understanding of the value of existing LEK, IKSP is essential before it can be integrated into the mains development planning.

utrient access.

Often, zero tillage cannot be practiced the first or second year of the transition, but as soil organic matter levels increase and the soil becomes covered, the populations of organisms that naturally till the soil increase rapidly, making further tillage by the farmer unnecessary. Zero tillage has an important relationship to the nutrient access concept because tillage both damages soil structure and increases the rate of soil organic matter burnout. Furthermore, tillage exposes the soil and removes or incorporates the mulch.

4. ***Maximize biodiversity.*** The main importance of increased biodiversity is in maintaining the system's long-term sustainability. It can also be very important in maintaining the balance of nutrients required by the nutrient access concept.

5. ***Feed the crops largely through the mulch.*** Many humid tropical soils, with their pH below 5.0, their aluminum toxicity, and compaction layers, are not very hospitable environments for crop roots. Thus, crops will often grow much better if they can also access nutrients from a thick layer or mulch. In fact, most, if not all, crops that grow in the humid tropics will spread the vast majority of their feeder roots immediately under or even up into a mulch layer as long as it remains fairly moist. That is, they will feed much more readily from inside and immediately below the litter layer than from the soil itself.

Even the impact of chemical fertilizers can sometimes be greatly increased by being applied to the mulch rather than the soil. Basically, feeding plants through the mulch helps compensate for less than ideal conditions of soil structure or root growth, providing a supplemental source of readily available nutrients in small but constant quantities right at the soil surface, thereby making it less necessary for crops to develo huge root systems that extend deep into the soil profile.

These five principles, apart from having proven themselves time and time again among small farmers around the world, are the self-same principles a humid tropical forest employs to maintain its high "productivity" during millennia, even on soils with very low CEC. A tropical rainforest maximizes biomass production and biodiversity, keeps the soil shaded at all times, and feeds its plants largely through the litter layer. And, of course, no human beings have to plow a forest to keep it growing lush and green, century after century.

Thus, the sustainability of forest ecology over the millennia provides important evidence that tropical agriculture following these five principles should also be sustainable over long periods of time. The small amou of scientific research done on this issu so far tends to support this conclusion

One major result of the nutrient access concept of soil fertility would be an increase in optimism about the plight of resource-poor farmers. A second impact would be that the world's agriculture will become a good deal more sustainable. Increased sustainability will come from the reduced use of chemical fertilizers (reducing groundwater and stream pollution, nutrient imbalances, and soil acidification), from the positive impacts on the environment of increased biomass production, soil cover, soil organic matter, and biodiversity, and from the decrease of farmer dependency on increasingly expensive fossil fuels.

nd Di sa B. Magca Macandog the article of Dr Roland B ntit ent Quantity Access: A New Unde H Maintain Fertility at http:/ thw3.cals t/RolandB.htm

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