Exploring Frameworks for Tropical Forest Conservation

Integrating Natural and Cultural Diversity for Sustainability, a Global Perspective
Conservation
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Conservation Exploring Frameworks for Integrating Natural and Cultural Diversity for Sustainability. A Global Perspective

EDITOR Nuria Sanz

Exploring Frameworks for Tropical Forest Conservation Integrating Natural and Cultural Diversity for Sustainability. A Global Perspective
The Ifugao agro-cultural system: bridging culture and nature to enhance tropical biodiversity
Abstract

The Ifugao agrocultural system offers a means to better understand the sustainability of indigenous agricultural ecology and promises to contribute to successful practices in the maintenance of biodiversity in the tropics. Similar to other agricultural systems in Southeast Asia, the complexity of Ifugao agriculture can be considered an agroecosystem, where agricultural, ecological, and cultural institutions are intertwined. Recent archaeological work in the region suggests a more recent origin of wet-rice cultivation, as late as ca. 300 BP, which coincided with the arrival of the Spanish. Forest management and wet-taro cultivation, however, appear to have been practiced by the Ifugao as early as ca. 600 BP. Microbotanical and macrobotanical analyses indicate that Ifugao have been utilizing forest resources and clearing forest cover long before the adaptation of wet-rice cultivation. Investigating the Ifugao agrocultural practices provides an opportunity to look into a living agricultural system where components are interrelated and integrated into economic, political, and religious spheres. Moreover, the Ifugao system presents a case study to address agricultural problems, economic and ecological sustainability of current farming systems, and their implications on state agricultural policies.

Introduction

Rice terraces dominate the landscape in Ifugao, Philippines (Figure 1). However, the success and maintenance of the Ifugao agricultural system is based on the complementarity of paddy-field rice cultivation with swidden fields and managed forests (Acabado 2012a). Customarily, the Ifugao agricultural system is guided by integrated patterns of mixed farming that include the management of private forests (muyung), communal forests (hinuob), swidden (uma) cultivation of sweet potatoes, pond-field cultivation of rice, inter-cropping of many secondary domesticates (i.e. sweet potatoes, potatoes, cabbage, and other cash crops), and the raising of pigs, chickens, and other livestock (Conklin 1980, p. 36). As such, although rice terraces dominate the Ifugao landscape, their agricultural system is considered as complementary system (Rambo 1996) since swiddening, agroforestry, and irrigated rice pond fields are interlinked by ecological and cultural facets.

An illustration of Ifugao agricultural strategies is presented in Figure 2: within a particular watershed, several types of land use categories make up the agricultural system (Table 1). Two types of forest cover: hinuob: upslope public forest often composed of open access communal areas; muyung: privately owned woodlots and managed with definite boundaries; uma (swidden): unirrigated slopeland, cultivated with root crops (usually, sweet potatoes); latangan (house terrace): residential site; na-ilid (drained field): levelled terraced area for cultivation and drainage of dry crops such as sweet potatoes and legumes; and, payoh (irrigated rice field): levelled, terraced farmland, bunded to retain water.
The Ifugao agrocultural system: bridging culture and nature to enhance tropical biodiversity

Figure 1. Map of the northern Philippines.
In Ifugao society, rice is both economically and ritually valued. In fact, the amount of rice land holdings is one of the bases for an individual’s social standing (wealth and prestige). The Ifugao also prefer to eat rice than sweet potatoes, which grown on swidden fields. Harold Conklin (1980) and Peter Brosius (1988) observed that sweet potato provides more than half of the starch requirements of the Ifugao during the period of their studies (between 1960 and 1980) (Conklin 1967, 1980). This explains the prestige value of rice in Ifugao culture. With this in mind, we would expect that the distribution of swidden fields in the Ifugao environment would be inversely correlated to the distribution of rice terraces (under the assumption that Ifugaos reserve their more productive/irrigable agricultural lands for rice production), but spatial data and ethnographic (Acabado 2012b) suggest otherwise. We argue that since rice and its associated cultural materials are prestige-based; swidden fields provide more carbohydrate than rice produced in the terraces (Acabado 2015). The existence of managed forests also augments the system by providing forest products that serve as alternative source of livelihood – in addition to its role in the Ifugao ecology.

The uniqueness of the Ifugao rice terracing tradition rice terraces became the basis for its listing in the UNESCO’s List of World Heritage in 1995. This listing recognizes the “…absolute blending of the physical, socio-cultural, economic, religious, and political environments… indeed, it is a living cultural landscape of unparalleled beauty” (UNESCO N.D.). Not only are the rice terraces a testimony to the ingenuity and intelligence of the Ifugao in their transformation of this mountainous landscape, but they also represent an enduring balance of the environment and the cooperative ability of the entire Ifugao community to develop and sustain the terraces. The terraces are not just productive habitats for village sustenance, they are also the sites for ritual practice that integrates and sustains the social fabric of the Ifugao. Moreover, they are the anchor for a diverse and productive environment that involves communal forest lands, taro and other wetland crops, and a complex agro-ecosystem that includes multiple cropping of herbs, a finely tuned annual cycle, zoning and
The Ifugao agrocultural system: bridging culture and nature to enhance tropical biodiversity

planning, and livestock production as part of a system regulated by religious rituals and cooperative social organization.

The Ifugao Rice Terraces was included on the World Heritage List in recognition of its Outstanding Universal Value under criteria (iii), (iv), and (v) (Table 2). The terraces were considered cultural landscapes that “…are illustrative of the evolution of human society and settlement over time, under the influence of physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal” (Operational Guidelines of the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage).

In this paper, we present the importance of understanding subsistence patterns to better manage tropical biodiversity. Intensive cultivation systems are known to contribute to the reduction of biodiversity, but the Ifugao agricultural system appear to enhance species diversity by providing various ecological niches, even in the paddy-fields. Particularly, we focus on the role of the Ifugao agrocultural system in the maintenance of the Ifugao landscape, cultural identity, and biodiversity.

<table>
<thead>
<tr>
<th>Local Term</th>
<th>Land Usage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magulon</td>
<td>Grassland</td>
<td>exposed ridge and slope land; untilled; with low herbaceous grasses; public (in any given region); unmanaged; minimal value; source of roof thatch, game; not cultivated without new irrigation sources; usually far from densely inhabited areas</td>
</tr>
<tr>
<td>'Inalāhan</td>
<td>Forest</td>
<td>slopeland; undisturbed soil, naturally woody cover; public (for residents of same watershed region); unmanaged; source of firewood, forest products, game.</td>
</tr>
<tr>
<td>Mabilāu</td>
<td>Caneland</td>
<td>(high grassland, cane grassland, secondary growth Miscanthus association): mostly slopeland, unworked soil, covered with various stages of second-growth herbaceous and ligneous vegetation dominated by dense clumps of tall canegrass; some protection and management (canegrass much used for construction, fencing, etc.).</td>
</tr>
<tr>
<td>Muyung</td>
<td>Woodlot</td>
<td>slopeland; unturned soil; covered with high tree growth (timber and fruit trees, climbing rattans, etc.); privately owned and managed (some planting of tree, vine, and bamboo types), with definite boundaries; valued for timber, other products, and protection of lower farmland from runoff and erosion.</td>
</tr>
<tr>
<td>Uma</td>
<td>Swidden</td>
<td>slopeland, cultivated and often “contour-ridges” heavily planted with sweet potatoes; moderately intercropped (including rice below 600-700 m); discrete temporary boundaries for cultivation period of several years.</td>
</tr>
<tr>
<td>Latāngan</td>
<td>House Terrace</td>
<td>leveled terrace land; surface smooth or paved but not tilled; primarily house and granary yards; workspace for grain drying, and so forth; discrete, often fenced or walled.</td>
</tr>
<tr>
<td>Na'llid</td>
<td>Drained Field</td>
<td>leveled terrace land, surface ditched and mounded (usually in cross-contoured fashion) for cultivation and drainage of dry crops such as sweet potatoes, legumes; discrete boundaries, privately owned; kept in this temporary state for a minimum number of seasons before shifting to permanent form of terrace use.</td>
</tr>
<tr>
<td>Payoh</td>
<td>Pond Field</td>
<td>leveled, terraced farmland, bunded to retain water for shallow inundation of artificial soil; carefully maintained for cultivation of wet-field rice, taro, and other crops; privately owned, discrete units, permanent stone markers.</td>
</tr>
</tbody>
</table>

Table 1. Land use categories in Ifugao, Philippines (from Acabado 2015)
A number of scholars (e.g. Butic and Ngidlo 2003; Camacho et al. 2012; Camacho et al. 2016) have argued for the active application of indigenous knowledge in biodiversity conservation. All of these cited references have referred to the Ifugao muyung as the classic example of how local knowledge can contribute to sustainable conservation programs. Undeniably, the Ifugao agroforestry management has become the symbol for an effective ecological conservation.

As a case study that highlights the success of the Ifugao agroecological system, particularly, the practice of muyung agroforestry management, we re-analyze and present survey data obtained by the Project Management Office, Globally Important Agricultural Heritage Systems, Department of Environment and Natural Resources, Cordillera Administrative Region, Philippines from the Municipality of Hungduan, in the Province of Ifugao (GIAHS 2011). Data presented in this paper is part of a larger research program that aimed to provide quantitative assessment of the biodiversity index of the Ifugao agicultural system. In this paper, we only focused on three Ifugao land use categories: muyung (privately-owned woodlots), uma (swidden fields), and payoh (rice terraces).

The Ifugao

The term Ifugao refers both to the province and the ethnolinguistic group who traditionally inhabit the region. There are five main Ifugao groups: Ayan-gan, Tuwali, Yattuka, Kalanguya, and Keley-i. They are separated by social and political boundaries, each trying to be distinct from the other yet bound by a common identity, that of being Ifugao - people of Pugaw or the Earthworld, a realm in their cosmos inhabited by mortal beings. These different Ifugao groups may have slight differences in language and practices but such variations are more exceptions than the general rule.

The Ifugao, as a group, are one of the most studied ethnolinguistic group in the Philippines mainly because pioneer American anthropologists focused their work among the Ifugao. At the turn of the twentieth century

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(iii)</td>
<td>The rice terraces are a dramatic testimony to a community’s sustainable and primarily communal system of rice production, based on harvesting water from the forest clad mountain tops and creating stone terraces and ponds, a system that has survived for two millennia.</td>
</tr>
<tr>
<td>(iv)</td>
<td>The rice terraces are a memorial to the history and labour of more than a thousand generations of small-scale farmers who, working together as a community, have created a landscape based on a delicate and sustainable use of natural resources.</td>
</tr>
<tr>
<td>(v)</td>
<td>The rice terraces are an outstanding example of land-use resulting from a harmonious interaction between people and their environment which has produced a steep terraced landscape of great aesthetic beauty, now vulnerable to social and economic changes.</td>
</tr>
</tbody>
</table>

Table 2. UNESCO criteria for the inclusion of the Ifugao Rice Terraces into the World Heritage List.
two prominent figures in Philippine anthropology, Roy Barton and Henry Otley Beyer, began their decades long investigation of the Ifugao. It is these two scholars who initially proposed the 2000-3000-year old origin for the Ifugao rice terraces, using observations and qualitative speculations on how long it would have taken the Ifugao to modify the rugged topography of the area (Barton 1919; Beyer 1955). This 'long history' has become the dominant narrative that found its way into textbooks and national histories. On the other hand, several scholars have proposed a more recent origin of the Ifugao rice terraces (i.e. Keesing 1962; Lambrecht 1967; Acabado 2009, 2012a). Using evidence from lexical information, ethno-historic documents, and archaeological data, these studies suggest that the terraced landscapes of the Ifugao are the end-result of population expansion into the Cordillera highlands in response to Spanish colonization. Lowland-mountain contacts even before the Spanish arrival might have facilitated the movement of lowland peoples to the highlands when the Spanish established bases in their locales.

Previously thought to be at least 2,000 years old, archaeological work has now established that the rice terraces were a response to the incursion of Spanish colonization in the Magat Valley lowlands to the northeast in the 17th century (Keesing 1962; Acabado 2009, 2010, 2012a). The rice terraces may have been developed in already pre-adapted pond fields originally developed for taro and other wetland farming (Acabado 2012a). Other components of this complex community farming system include the maintenance of communal forests in the highlands, common lands for other highly bio-diverse plantings of forbs, and integration of swine and water buffalo into the subsistence and ritual patterns of the community.

Radiocarbon dates from terrace studies indicate the antiquity of rice farming in the terraces no earlier than the late 16th century (Acabado 2009, 2010a, 2010b, 2012a, 2012b, 2012c, 2015, 2017) and that fields in the early settlement of Kiyyangan (Kiyangan, Ifugao) were most likely wetland agricultural pondfields for the cultivation of taro. These pondfield systems nonetheless prepared terrain and waterways for the development of rice terraces as accommodation and resistance to Spanish control of the people and resources of the region by escaping into mountain refugia. Macro-botanical data have shown that the Ifugao who settled the Old Kiyyangan Village were exploiting timber resources for house construction and source firewood as early as 1350 CE. We surmise that forest clearance also started during this period, but intensified soon after Spanish colonization. Ifugao agroforestry management would have develop after the shift to wet-rice cultivation.

As opposed to other upland areas in the Philippines, the Cordillera Region has not experienced massive settlement by migrant lowland populations (for discussions, refer to Cruz et al. 1986; Kerkvliet 1979). Ifugao Province, in particular, is still dominated by Ifugao themselves. This population composition is one of the main reasons why deforestation is not a big problem in Ifugao. Whereas population movements in other parts of the Philippines were related to lowland farmers being pushed to the uplands (Eder 2006; Fujisaka 1986; Olofson 1983, 1985), the long history of resistance against outsiders allowed the Ifugao to endure the flow
of non-Ifugao migrants. The culture of resistance also provided the impetus for the Ifugao to continue practicing their indigenous agroecological system.

Muyung: Forest Management Practice of the Ifugao

An important aspect of Ifugao agricultural terrace ecology and maintenance is the land use category of *muyung/pinugo*, or privately owned woodlots. These woodlots serve as the watershed of a particular terrace system and are invaluable for terraces whose primary source of water are the springs located in these woodlots. Although hydrologic studies (Hamilton and King 1983) in the last three decades suggest that heavy forest cover would actually result in more usage of groundwater, these woodlots protect low-lying fields from runoffs and erosion, and maintain supply of surface and irrigation water (through cloud-intercept), stabilizes relative humidity, improve soil’s nutrients and physical and chemical properties (Bruijnzeel 1990; Saberwal 1997). Indeed, increases in logging activities in the vicinity of Banaue in the early 1980s accelerated runoffs and evapotranspiration, intensifying Ifugao’s water shortage during the dry season (Eder 1982).

The addition of carving industry in the Ifugao economic base after the 2nd World War and intervention of the national government in forest conservation negatively affected the management of the *muyung/pinugo* system (Sajor 1999). These carvings are sold locally, especially in the tourist town of Banaue. Although the carving industry itself was not a problem, Philippine national policies on logging disrupted the local Ifugao forest management system. Previously, the Ifugao were able to access and obtain logs from their community’s *muyung/pinugo*, whilst properly observing indigenous regulations on logging. The total log ban imposed by the Philippine national government, however, prevented them from accessing their wood supply. Since woodcarving became a lucrative economic alternative for the Ifugao, and with the lack of access to an easily available wood supply, the carving industry became an impetus for illegal logging activities in the *muyung/pinugo* system. The uncontrolled logging in the *muyung/pinugo* system has devastated some of the terrace systems in Ifugao. Undeniably, agroforestry and agricultural ecological issues stand out in discussion of the Ifugao landscape.

The Ifugao’s *muyung* system stands out among indigenous silviculture, horticulture and soil and water conservation methods. To ensure sustainable water supply for the rice fields, the Ifugao manages forestlands as watersheds and agro-forests through an efficient assisted natural regeneration (ANR) system. They successfully practiced ANR long before its recognition in the forestry sector as a strategy for forest regeneration. The Ifugao attributes value to the forest on the basis of their cultural ways and practices (Butic and Ngidlo, 2003).

Adopting agroforestry in woodlots and multiple cropping in swidden farms, the Ifugao ensured another economic source in case of crop failure in the terraces. Fruit bearing trees, coffee trees, bananas, rattan for handicrafts, wood
for carving, medicinal herbs and mushrooms, bamboos of different kinds are just a few of the assortments found in the muyung. Edible rattan (*Calamus manillensis*) is also included in almost all woodlots. Rattan is integrated in woodlots for its edible fruits and poles/canes for handicraft (Rondolo, 2001). The Ifugao have been using ANR quite successfully without professional intervention for many years. Activities in the muyung include thinning, cleaning, pruning and salvage cutting (Camacho et al. 2012). These activities are done to enhance the growth and development of natural stands. In addition, harvesting of timber crops is highly selective by nature. Selection is based on the muyung owner’s extensive knowledge of the various tree species and their uses. According to Rondolo (2001), the Ifugao have their own plant classification system. Plants are classified based on taxo-morphological characteristics and according to use. The Ifugao’s knowledge of rattan classification is more detailed and accurate than most formally trained botanists.

### Muyung and the Rice Terraces

Not much has been written about the interdependence of the terraces and its surrounding forests yet the Ifugao know that one cannot exist without the other. The local concept of forests being “tudung di payo” (literally translates to “shield of the rice fields”) connotes a very wide synergy of the Ifugao’s natural environment and his rice terracing culture. In both ritual and practical day-to-day activities, the forest plays a significant role in the sustainable cultivation of the fields below it. Among the landed *kadangyan* or the local nobility, the transfer of terraced fields necessitates the transfer of its mandatory accessories including heirloom jars, rice granaries and its very own muyung. These accessories are called *unnud di payo*, that which follows the rice field. By custom law, the muyung, being *unnud di payo*, can only be inherited by the heir to whom the principal rice field is bequeathed.

The muyung serves as a buffer zone for the terraces in more aspects than one. The mountainous topography of the rice terraces makes it very vulnerable to even uneventful climatic conditions. During summer when water is scarce, the thick muyung canopy provides shade that minimize the drying up of the numerous fresh water springs that the terraces depend on for irrigation. During the wet season, sufficient forest cover is effective in preventing soil run-off that could otherwise cause silation of pond fields and rivers. Soil nutrients from decaying foliage in the underbrush constantly fertilize low-lying terraces when brought down the slopes during downpours, minimizing the need for synthetic fertilizer inputs. Other than that, the muyung harbors diverse flora relied upon by Ifugao for their biological pest-control methods, dye sources, medicine and others.

Before the onset of modern construction materials and even today, the muyung are a reliable source of housing and other construction materials. The wood carving industry of the Ifugao on the other hand has been sustained by the muyung since the tourism boom in the 1970s without causing irreversible damage to the integrity of the forest as a fine example of managed biodiversity. In fact, the national government
through the Department of Environment and Natural Resources’ Memorandum Circular No. 96-02 exempts muyungs from the coverage of the total log ban being implemented in the country, thereby recognizing the sustainability of this indigenous forest management system. In case of failure of crops in the terraces, muyung resources are a reliable source of alternative income for terrace farmers.

Ifugao Indigenous Forest Management

While the term muyung refers generally to woodlots, Ifugaos identify two kinds of forests based on management and property rights. The first type of Ifugao forest is the muyung or pinugu, owned and managed by a single family, passed down from earlier generations or purchased from other families based on strict rules of custom law. The second type is the Inalahan or communal forest owned and managed by a village (boble). This second type of forest usually defines boundaries and hunting grounds of neighboring villages where propriety rights are exclusive to the village to whom stewardship has been vested since time immemorial. The inalahan cannot be subjected to sale or any form of encumbrance by anyone. Both types of forests are in their nature, private properties under Ifugao custom law; a conflict point given national laws of the Philippine following the antiquated Regalian Doctrine where it states that all lands belong to the State – public property. At this point, we would like to emphasize that indigenous peoples’ concept of communal lands is not the same as public property.

The muyung system is the only indigenous forest management practices that government recognized; thus owners can acquire a Muyung Resources Permit (MRP) from the Department of Environment and Natural Resources (DENR) through the issuance of Memorandum Circular No.96-02. Through this permit, Ifugao communities can lay claim over the trees they planted in their muyung, thus encouraging them to manage, conserve, protect and preserve their muyung or forest.

Biodiversity in the Ifugao Agroecological System

The Ifugao agroecological system illustrates how indigenous knowledge contributes to the maintenance of biodiversity. Among the Ifugao, the various land-use (Table 2) categories exhibit varying degrees of floral and faunal species densities. As mentioned above, intensive agricultural systems tend to reduce species diversity since such systems, by definition, favors single-cropping. To understand the relationships between the different land use categories and the role of managed forests in Ifugao, a survey conducted by the Project Management Office, Globally Important Agricultural Heritage Systems, Department of Environment and Natural Resources, Cordillera Administrative Region, Philippines, provided a baseline data on the success of Ifugao agroecological system. Combining a bottom-up approach (focus group discussions) and pedestrian survey, the project provided qualitative and quantitative indices
of biodiversity in the town of Hungduan, Ifugao. The GIAHS-DENR survey team conducted a larger study, but we are only using small segment of their datasets, which are enough to highlight the importance of indigenous/local ecological management systems.

To determine the floral diversity in the Ifugao agroecological system, the GIAHS survey team obtained data from multiple land use categories in the municipality of Hungduan in Ifugao Province. Data from two muyung systems, three uma fields, and two payoh systems were obtained to establish biodiversity levels in the respective land use categories. Standard biodiversity indices were used in the investigations: Species Richness (R), Number of Individuals (N), Shannon-wiener Diversity Index (H'), Simpson's Index (D), Shannon's Equitability Index, and Sørensen's Similarity Index (IS).

**Muyung flora assessment**

As mentioned above, muyung are privately-owned woodlots by families who are also the owners of nearby rice terraces. The muyung tree-cover, which is located on top of a terraced slope, provide protection against run-off and are sources of wood for fuel, timber for house construction, traditional medicine, and wood for carving. Most farmers consider the muyung as a watershed that provides water for the terraces, and it is now widely understood that the forest cover actually uses more water (Bruijnzeel 1990; Saberwal 1997). In the Poblacion muyung, 10 indigenous tree species were identified and recorded. Talanak (*Alstronea candolleana*), Tabangawon (*Weinmania hutchinsonii*), Umug (*Clethra canascens*), Dulnuan (*Glochidion sp.*) and Amumuhong were the dominant tree species, with Importance Values of 86.7265, 33.9198, 28.2997, 16.0557 and 15.7004, respectively (Table 3) (GIAHS 2011, p. 17). It also has a diverse understorey vegetation, with 24 documented species. The dominant species with their respective summed dominance ratio values as shown in Table 4 are

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>DENSITY</th>
<th>RELATIVE DENSITY (%)</th>
<th>RELATIVE DOMINANCE</th>
<th>IMPORTANCE VALUE</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talanak (<em>Alstronea candolleana</em>)</td>
<td>21</td>
<td>32.3077</td>
<td>54.4188</td>
<td>86.7265</td>
<td>1</td>
</tr>
<tr>
<td>Tabangawon (<em>Weinmania hutchinsonii</em>)</td>
<td>12</td>
<td>18.4615</td>
<td>15.4583</td>
<td>33.9198</td>
<td>2</td>
</tr>
<tr>
<td>Umug (<em>Clethra canascens</em>)</td>
<td>13</td>
<td>20.0000</td>
<td>8.2997</td>
<td>28.2997</td>
<td>3</td>
</tr>
<tr>
<td>Dulnuan (<em>Glochidion sp.</em>)</td>
<td>6</td>
<td>9.2308</td>
<td>6.8249</td>
<td>16.0557</td>
<td>4</td>
</tr>
<tr>
<td>Amumuhong*</td>
<td>6</td>
<td>9.2308</td>
<td>6.4696</td>
<td>15.7004</td>
<td>5</td>
</tr>
<tr>
<td>Gutmo (<em>Syzygium sp.</em>)</td>
<td>2</td>
<td>3.0769</td>
<td>3.2940</td>
<td>6.3710</td>
<td>6</td>
</tr>
<tr>
<td>Hauilli (<em>Ficus septica</em>)</td>
<td>2</td>
<td>3.0769</td>
<td>2.0776</td>
<td>5.1545</td>
<td>7</td>
</tr>
<tr>
<td>Halinghingon (<em>Eurya amplexicaulis</em>)</td>
<td>1</td>
<td>1.5385</td>
<td>2.0776</td>
<td>3.6161</td>
<td>8</td>
</tr>
<tr>
<td>Tibig (<em>Ficus nota</em>)</td>
<td>1</td>
<td>1.5385</td>
<td>0.6889</td>
<td>2.2724</td>
<td>9</td>
</tr>
<tr>
<td>Gahatan (<em>Cryptocarya sp.</em>)</td>
<td>1</td>
<td>1.5385</td>
<td>0.3875</td>
<td>1.9260</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 3. Muyung timber Inventory within the GIAHS Project Site at Barangay Poblacion, Hungduan, Ifugao (* Local name) (adapted from GIAHS 2011, p. 18).
<table>
<thead>
<tr>
<th>SPECIES</th>
<th>RELATIVE DENSITY</th>
<th>RELATIVE FREQUENCY</th>
<th>SUMMED DOMINANCE RATIO</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyperus sp</td>
<td>14.4737</td>
<td>9.7561</td>
<td>19.3517</td>
<td>1</td>
</tr>
<tr>
<td>Baksi (Melastoma malabathricum)</td>
<td>14.4737</td>
<td>7.3171</td>
<td>18.1322</td>
<td>2</td>
</tr>
<tr>
<td>Umug (Clethra canascens)</td>
<td>11.8421</td>
<td>9.7561</td>
<td>16.7202</td>
<td>3</td>
</tr>
<tr>
<td>Sword fern (Nephrolepis hirsutula)</td>
<td>13.8158</td>
<td>4.8780</td>
<td>16.2548</td>
<td>4</td>
</tr>
<tr>
<td>Fern-Kilob (Dicranopteris linearis)</td>
<td>5.9211</td>
<td>4.8780</td>
<td>8.3601</td>
<td>5</td>
</tr>
<tr>
<td>Halinghingon (Eurya amplexicaulis)</td>
<td>5.9211</td>
<td>2.4390</td>
<td>3.7548</td>
<td>6</td>
</tr>
<tr>
<td>Atilba (Viburnum luzonicum)</td>
<td>3.2895</td>
<td>4.8780</td>
<td>5.7285</td>
<td>7</td>
</tr>
<tr>
<td>Betel nut (Areca catechu)</td>
<td>1.9737</td>
<td>7.3171</td>
<td>5.6322</td>
<td>8</td>
</tr>
<tr>
<td>Fern (Sticherus sp.)</td>
<td>1.9737</td>
<td>7.3171</td>
<td>5.6322</td>
<td>9</td>
</tr>
<tr>
<td>Rono (Miscanthus sinensis)</td>
<td>3.2895</td>
<td>2.4390</td>
<td>4.5090</td>
<td>10</td>
</tr>
<tr>
<td>Malatabako (Elephantopus mollis)</td>
<td>3.2895</td>
<td>2.4390</td>
<td>4.5090</td>
<td>11</td>
</tr>
<tr>
<td>Musa sp.</td>
<td>3.2895</td>
<td>2.4390</td>
<td>4.5090</td>
<td>12</td>
</tr>
<tr>
<td>Macaranga dipterocaprifolia</td>
<td>1.9737</td>
<td>4.8780</td>
<td>4.4127</td>
<td>13</td>
</tr>
<tr>
<td>Binung (Macaranga tanarius)</td>
<td>2.6316</td>
<td>2.4390</td>
<td>3.8511</td>
<td>14</td>
</tr>
<tr>
<td>Fern (Blechnum orientales)</td>
<td>1.3158</td>
<td>4.8780</td>
<td>3.7548</td>
<td>15</td>
</tr>
<tr>
<td>Fern (Sphenomeris sp.)</td>
<td>1.3158</td>
<td>2.4390</td>
<td>2.5353</td>
<td>16</td>
</tr>
<tr>
<td>Acorus calamus</td>
<td>1.3158</td>
<td>2.4390</td>
<td>2.5353</td>
<td>17</td>
</tr>
<tr>
<td>Poa sp.</td>
<td>1.3158</td>
<td>2.4390</td>
<td>2.5353</td>
<td>18</td>
</tr>
<tr>
<td>Wikstromea sp.</td>
<td>1.3158</td>
<td>2.4390</td>
<td>2.5353</td>
<td>19</td>
</tr>
<tr>
<td>Tree fern (Cyathea ontaminans)</td>
<td>1.3158</td>
<td>2.4390</td>
<td>2.5353</td>
<td>20</td>
</tr>
<tr>
<td>Kulo-kulot (Urena lobata)</td>
<td>1.3158</td>
<td>2.4390</td>
<td>2.5353</td>
<td>21</td>
</tr>
<tr>
<td>Balangbang (Medinilla speciosa)</td>
<td>1.3158</td>
<td>2.4390</td>
<td>2.5353</td>
<td>22</td>
</tr>
<tr>
<td>Vine</td>
<td>0.6579</td>
<td>2.4390</td>
<td>1.8774</td>
<td>23</td>
</tr>
<tr>
<td>Hawili (Elaearpus pendulus)</td>
<td>0.6579</td>
<td>2.4390</td>
<td>1.8774</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 4. Understorey Vegetational Analysis of Muyung with GIAHS sites at Poblacion, Hungduan, Ifugao (adapted from GIAHS 2011, p. 18).

Cyperus sp. (19.3157), Melastoma malabathricum (18.1322), Clethra canascens (16.7202), Nephrolepis hirsutula (16.2548) and Dicranopteris linearis (8.3601) (GIAHS 2011, p. 17).

The muyung in Brgy. Nungulunan, on the other hand, provided fifteen (15) tree species (Table 5). Similar to the Poblacion muyung, the Brgy. Nungulunan muyung has a diverse understorey vegetation with 38 recorded species (Table 6). The dominant species with their respective Summed Dominance Ratio (SDR) values are Gepas or Paniki tea (18.2147), ferns species namely: Leather leaf fern (17.5203), Kilob (6.5799), sword fern (3.8806) and Balangbang (3.6499) (GIAHS 2011, p. 19).
### Table 5. Result of Timber Inventory for Muyung within the GIAHS Project Site at Barangay Nungulunan, Hungduan, Ifugao (* Local name).

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>DENSITY</th>
<th>FREQUENCY</th>
<th>SUMMED DOMINANCE RATIO</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gepas/Paniki tea (<em>Sacandra glabra</em>)</td>
<td>355</td>
<td>100</td>
<td>18.2147</td>
<td>1</td>
</tr>
<tr>
<td>Leatherleaf fern (<em>Selaginella sp.</em>)</td>
<td>355</td>
<td>80</td>
<td>17.5203</td>
<td>2</td>
</tr>
<tr>
<td>Kilob (<em>Dicranopteris linearis</em>)</td>
<td>125</td>
<td>40</td>
<td>6.5799</td>
<td>3</td>
</tr>
<tr>
<td>Alolokdo/Sword fern (<em>Nephrolepis cordifolia</em>)</td>
<td>60</td>
<td>40</td>
<td>3.8806</td>
<td>4</td>
</tr>
<tr>
<td>Balangbang (<em>Medinilla speciosa</em>)</td>
<td>21</td>
<td>80</td>
<td>3.6499</td>
<td>5</td>
</tr>
<tr>
<td>Wild strawberry (<em>Rubus niveus</em>)</td>
<td>15</td>
<td>80</td>
<td>3.4007</td>
<td>6</td>
</tr>
<tr>
<td>Coleus sp.</td>
<td>25</td>
<td>60</td>
<td>3.1215</td>
<td>7</td>
</tr>
<tr>
<td>Gutmo (<em>Vaccinium whitfordii</em>)</td>
<td>14</td>
<td>60</td>
<td>2.6647</td>
<td>8</td>
</tr>
<tr>
<td>Rono (<em>Mischantus sinensis</em>)</td>
<td>30</td>
<td>40</td>
<td>2.6347</td>
<td>9</td>
</tr>
<tr>
<td>Tungor*</td>
<td>7</td>
<td>60</td>
<td>2.3740</td>
<td>10</td>
</tr>
<tr>
<td>Palm grass (<em>Curculigo palmifolia</em>)</td>
<td>23</td>
<td>40</td>
<td>2.3440</td>
<td>11</td>
</tr>
<tr>
<td>Ivy plant (<em>Pholidendron sp.</em>)</td>
<td>5</td>
<td>60</td>
<td>2.2910</td>
<td>12</td>
</tr>
<tr>
<td>Galiwgiwen (<em>Antidesma leptocladum</em>)</td>
<td>18</td>
<td>40</td>
<td>2.1364</td>
<td>13</td>
</tr>
<tr>
<td>Fern (<em>Pteris sp.</em>)</td>
<td>16</td>
<td>40</td>
<td>2.0533</td>
<td>14</td>
</tr>
<tr>
<td>Atilba (<em>Viburnum luzonicum</em>)</td>
<td>8</td>
<td>40</td>
<td>1.7211</td>
<td>15</td>
</tr>
<tr>
<td>Bini*</td>
<td>8</td>
<td>40</td>
<td>1.7211</td>
<td>16</td>
</tr>
<tr>
<td>(Clethra kanscens)</td>
<td>7</td>
<td>40</td>
<td>1.6796</td>
<td>17</td>
</tr>
<tr>
<td>Payong-payong (<em>Cyperus iria</em>)</td>
<td>7</td>
<td>40</td>
<td>1.6796</td>
<td>18</td>
</tr>
<tr>
<td>Dalingdingan (<em>Hopea foxworthyi</em>)</td>
<td>7</td>
<td>40</td>
<td>1.6796</td>
<td>19</td>
</tr>
<tr>
<td>Cyperus sp.</td>
<td>5</td>
<td>40</td>
<td>1.5965</td>
<td>20</td>
</tr>
<tr>
<td>Macaranga sp.</td>
<td>5</td>
<td>40</td>
<td>1.5965</td>
<td>21</td>
</tr>
<tr>
<td>Grass (<em>Brachiaria sp.</em>)</td>
<td>4</td>
<td>40</td>
<td>1.5550</td>
<td>22</td>
</tr>
</tbody>
</table>
Table 6. Understorey Vegetational Analysis of Muyung with GIAHS sites at Nungulungan, Hungduan, Ifugao (*Local names) (adapted from GIAHS 2011, p. 20).

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Frequency</th>
<th>Cover</th>
<th>Dominance</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown (moss-like)</td>
<td>15</td>
<td>20</td>
<td>1.3174</td>
<td>23</td>
</tr>
<tr>
<td>Orchid (Bulbophyllum sp.)</td>
<td>15</td>
<td>20</td>
<td>1.3174</td>
<td>24</td>
</tr>
<tr>
<td>Pugad lawin (Asplenium nidus)</td>
<td>13</td>
<td>20</td>
<td>1.2343</td>
<td>25</td>
</tr>
<tr>
<td>Anablon (Macaranga sinensis)</td>
<td>7</td>
<td>20</td>
<td>0.9851</td>
<td>26</td>
</tr>
<tr>
<td>Tabangawon (Weinmania hutchinsonii)</td>
<td>6</td>
<td>20</td>
<td>0.9436</td>
<td>28</td>
</tr>
<tr>
<td>Hapon (Crassocephalum crepidioides)</td>
<td>5</td>
<td>20</td>
<td>0.9021</td>
<td>29</td>
</tr>
<tr>
<td>Fern (Araioestegia davalloides)</td>
<td>5</td>
<td>20</td>
<td>0.9021</td>
<td>30</td>
</tr>
<tr>
<td>Binakal*</td>
<td>4</td>
<td>20</td>
<td>0.8606</td>
<td>31</td>
</tr>
<tr>
<td>White orchid (Orchis purpurea)</td>
<td>3</td>
<td>20</td>
<td>0.8190</td>
<td>32</td>
</tr>
<tr>
<td>Malagawed (Piper sp.)</td>
<td>2</td>
<td>20</td>
<td>0.7775</td>
<td>33</td>
</tr>
<tr>
<td>Higop (Hoya sp.)</td>
<td>2</td>
<td>20</td>
<td>0.7775</td>
<td>34</td>
</tr>
<tr>
<td>Orchid (Bulbophyllum sp.)</td>
<td>2</td>
<td>20</td>
<td>0.7775</td>
<td>35</td>
</tr>
<tr>
<td>Galamay bakes (Schefflera odorata)</td>
<td>2</td>
<td>20</td>
<td>0.7775</td>
<td>36</td>
</tr>
<tr>
<td>Balanti (Homolanthus sp.)</td>
<td>2</td>
<td>20</td>
<td>0.7775</td>
<td>37</td>
</tr>
<tr>
<td>Gabi-gabi (Alocasia sp.)</td>
<td>1</td>
<td>20</td>
<td>0.7360</td>
<td>38</td>
</tr>
</tbody>
</table>

Swidden fields (uma)

For most of the inhabitants of upland areas, shifting cultivation has been an integral part of their way of life. Its practice involves the rotation of fields between short periods of cropping and longer periods of falling. Although it has many forms (Thrupp et al. 1997; Spencer 1966; Conklin 1957), burning seems to be one of its unifying and indispensable aspects (Conklin 1959; Peters and Neunschwander 1988).

Shifting cultivation is also referred to as swidden cultivation especially in the anthropological literature. In many popular literatures, “slash-and-burn,” which is a derogatory term, describes tropical subsistence systems practiced by indigenous populations and is assumed to be a primitive subsistence strategy. Studies, however, show that peoples who engage in this type of farming are not primitive either in technology or in culture (Peters and Neunschwander 1988), and their geographic distribution is not historically limited to the tropics. Although most of swiddeners today are located in the tropics, the term swiddening is an Old English term that means “burned clearing” (Ekwall 1955; Izikowitz 1951; Conklin 1957).

In Ifugao, swiddening is an essential part of their way of life. As described by Conklin (1980, p. 24) and Acabado (2012b, 2015), shifting cultivation is a form of complementary partial swidden farming. All of the Ifugao villages have access to swidden land and no community relies solely on swidden cultivation. Uma fields are established in burned clearings on hillsides, usually too steep or unsuited for irrigated terracing. Fields are cropped for about three years and then fallowed for two or three times that period.
The GIAHS survey sampled three: Sitio Hubot, Poblacion, Hungduan; Barangay Abatan, Hungduan; and, Nungulunan, Hungduan. The third site was on fallow (*ublag*) while the first two were actively cultivated. The swidden field in Sitio Hubot, Poblacion, had twenty-eight (28) plants species within the transect lines (Table 7). Sweet potato or camote (*Ipomea batatas*) predominated the field; this was followed by *Samanea saman*, *Leukosyke capitellata*, *Mikania cordata* and *Artocarpus heterophylla*. (GIAHS 2011, p. 26).

The site at Brgy. Abatan had 42 diverse species of forest trees saplings, weeds, and agro-crops (Table 8). During the survey, the field was under crop rotation and was being prepared for the next cropping season. Five species dominated the field, namely, Anablon Rono, Gutmo, Tanghad, and Cassava (GIAHS 2011, p. 27).

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>Relative Cover</th>
<th>RELATIVE HEIGHT</th>
<th>RELATIVE FREQUENCY</th>
<th>SUMMED DOMINANCE RATIO</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camote (<em>Ipomea batatas</em>)</td>
<td>355</td>
<td>100</td>
<td>18.2147</td>
<td>15.1157</td>
<td>1</td>
</tr>
<tr>
<td>Raintree (<em>Samanea saman</em>)</td>
<td>355</td>
<td>80</td>
<td>17.5203</td>
<td>7.5911</td>
<td>2</td>
</tr>
<tr>
<td>Alagacy (<em>Leuocosyke capitellata</em>)</td>
<td>125</td>
<td>40</td>
<td>6.5799</td>
<td>5.5056</td>
<td>3</td>
</tr>
<tr>
<td>Uoko (<em>Mikania cordata</em>)</td>
<td>60</td>
<td>40</td>
<td>3.8806</td>
<td>5.4101</td>
<td>4</td>
</tr>
<tr>
<td>Jackfruit (<em>Artocarpus heterophylla</em>)</td>
<td>21</td>
<td>80</td>
<td>3.6499</td>
<td>5.0082</td>
<td>5</td>
</tr>
<tr>
<td>Puriket (<em>Bidens pilosa</em>)</td>
<td>15</td>
<td>80</td>
<td>3.4007</td>
<td>4.6341</td>
<td>6</td>
</tr>
<tr>
<td>Pallang (<em>Psophocarpus tetragonolobus</em>)</td>
<td>25</td>
<td>60</td>
<td>3.1215</td>
<td>4.2515</td>
<td>7</td>
</tr>
<tr>
<td>Atelba (<em>Viburnum luzonicum</em>)</td>
<td>14</td>
<td>60</td>
<td>2.6647</td>
<td>4.0967</td>
<td>8</td>
</tr>
<tr>
<td>Pegion pea (<em>Cajanus cajan</em>)</td>
<td>30</td>
<td>40</td>
<td>2.6347</td>
<td>3.7602</td>
<td>9</td>
</tr>
<tr>
<td>Buntot pusa (<em>Pennisetum polystachyon</em>)</td>
<td>7</td>
<td>60</td>
<td>2.3740</td>
<td>3.7602</td>
<td>10</td>
</tr>
<tr>
<td>Siteo (<em>Phaseolus sp.</em>)</td>
<td>23</td>
<td>40</td>
<td>2.3440</td>
<td>3.7168</td>
<td>11</td>
</tr>
<tr>
<td>Anablo* (<em>Wikstroemia sp.</em>)</td>
<td>5</td>
<td>60</td>
<td>2.2910</td>
<td>3.4332</td>
<td>12</td>
</tr>
<tr>
<td>Bulakmanok (<em>Ageratum conyzoides</em>)</td>
<td>18</td>
<td>40</td>
<td>2.1364</td>
<td>3.3450</td>
<td>13</td>
</tr>
<tr>
<td>Rono (<em>Mischantus sinensis</em>)</td>
<td>16</td>
<td>40</td>
<td>2.0533</td>
<td>3.2871</td>
<td>14</td>
</tr>
<tr>
<td>Braken fern (<em>Pteridium aquilinum</em>)</td>
<td>8</td>
<td>40</td>
<td>1.7211</td>
<td>3.0715</td>
<td>15</td>
</tr>
<tr>
<td>Pineapple (<em>Ananas comosus</em>)</td>
<td>8</td>
<td>40</td>
<td>1.7211</td>
<td>2.8219</td>
<td>16</td>
</tr>
<tr>
<td>Piwis (<em>Ficus benguetensis</em>)</td>
<td>7</td>
<td>40</td>
<td>1.6796</td>
<td>2.8139</td>
<td>17</td>
</tr>
<tr>
<td>Perpon (<em>Acalypha wilkesiana</em>)</td>
<td>7</td>
<td>40</td>
<td>1.6796</td>
<td>2.7338</td>
<td>18</td>
</tr>
<tr>
<td>Conyza Canadensis</td>
<td>7</td>
<td>40</td>
<td>1.6796</td>
<td>2.0822</td>
<td>19</td>
</tr>
<tr>
<td>Sword fern (<em>Nephrolepis cordifolia</em>)</td>
<td>5</td>
<td>40</td>
<td>1.5965</td>
<td>1.8495</td>
<td>20</td>
</tr>
<tr>
<td>Hapon (<em>Crassocephalum crepidioides</em>)</td>
<td>5</td>
<td>40</td>
<td>1.5965</td>
<td>1.6950</td>
<td>21</td>
</tr>
<tr>
<td>Wild orchids (<em>Orchis purpurea</em>)</td>
<td>4</td>
<td>40</td>
<td>1.5550</td>
<td>1.6947</td>
<td>22</td>
</tr>
<tr>
<td>Mutha (<em>Cyperus rotundus</em>)</td>
<td>15</td>
<td>20</td>
<td>1.3174</td>
<td>1.5399</td>
<td>23</td>
</tr>
<tr>
<td>Hulape (<em>Paspalum conjugatum</em>)</td>
<td>15</td>
<td>20</td>
<td>1.3174</td>
<td>1.5225</td>
<td>24</td>
</tr>
<tr>
<td>Saluyot (<em>Corchorus olitorius</em>)</td>
<td>13</td>
<td>20</td>
<td>1.2343</td>
<td>1.5176</td>
<td>25</td>
</tr>
<tr>
<td>Makahiya lalaki (<em>Mimosa invisa</em>)</td>
<td>7</td>
<td>20</td>
<td>0.9851</td>
<td>1.2990</td>
<td>26</td>
</tr>
<tr>
<td>Vines</td>
<td>6</td>
<td>20</td>
<td>0.9436</td>
<td>1.2816</td>
<td>27</td>
</tr>
<tr>
<td>Gatas-gatas (<em>Euphorbia hirta</em>)</td>
<td>5</td>
<td>20</td>
<td>0.9021</td>
<td>1.1612</td>
<td>28</td>
</tr>
</tbody>
</table>

Table 7. Vegetational analysis for the Habal area in Sitio Hubot, Hungduan, Ifugao. (*Local name*) (adapted from GIAHS 2011, p. 27).

The GIAHS survey sampled three: Sitio Hubot, Poblacion, Hungduan; Barangay Abatan, Hungduan; and, Nungulunan, Hungduan. The third site was on fallow (*ublag*) while the first two were actively cultivated. The swidden field in Sitio Hubot, Poblacion, had twenty-eight (28) plants species within the transect lines (Table 7). Sweet potato or camote (*Ipomea batatas*) predominated the field; this was followed by *Samanea saman*, *Leuocosyke capitellata*, *Mikania cordata* and *Artocarpus heterophylla*. (GIAHS 2011, p. 26).

The site at Brgy. Abatan had 42 diverse species of forest trees saplings, weeds, and agro-crops (Table 8). During the survey, the field was under crop rotation and was being prepared for the next cropping season. Five species dominated the field, namely, Anablon Rono, Gutmo, Tanghad, and Cassava (GIAHS 2011, p. 27).
<table>
<thead>
<tr>
<th>SPECIES</th>
<th>RELATIVE COVER</th>
<th>RELATIVE HEIGHT</th>
<th>RELATIVE FREQUENCY</th>
<th>SUMMED DOMINANCE RATIO</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anablon (<em>Macaranga sinensis</em>)</td>
<td>12.4660</td>
<td>23.6821</td>
<td>4.5977</td>
<td>13.5819</td>
<td>1</td>
</tr>
<tr>
<td>Rono (<em>Mischants sinensis</em>)</td>
<td>10.7661</td>
<td>18.5016</td>
<td>6.8966</td>
<td>12.0548</td>
<td>2</td>
</tr>
<tr>
<td>Gutmo (<em>Vaccinium whitfordii</em>)</td>
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<td>15.0381</td>
<td>3.4483</td>
<td>8.5042</td>
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</tr>
<tr>
<td>Cassava (<em>Manihot esculenta</em>)</td>
<td>4.9864</td>
<td>11.8410</td>
<td>4.5977</td>
<td>7.1417</td>
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<td>Palayen (<em>Lihtocarpoc sulitii</em>)</td>
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<td>2.2989</td>
<td>6.9644</td>
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<td>Braken fern (<em>Pteridium aquillinum</em>)</td>
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<td>6.5126</td>
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<td>4.9576</td>
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<td>Alnus (<em>Alnus maritima</em>)</td>
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<td>7.4006</td>
<td>1.1494</td>
<td>4.3611</td>
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<tr>
<td>Wild strawberry (<em>Rubus fraxinifolius</em>)</td>
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<td>7.2526</td>
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<td>4.3171</td>
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<tr>
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<td>Tabangawen*</td>
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<td>Alolokdo/Sword fern (<em>Nephelepis hirsutula</em>)</td>
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<td>1.1494</td>
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<td>Atilba (<em>Virburnum luzonicum</em>)</td>
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<td>5.0324</td>
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<td>Camote (<em>Ipomea batatas</em>)</td>
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<td>0.9769</td>
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<tr>
<td>Aguingay (<em>Rottboelia exaltata</em>)</td>
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<td>3.5523</td>
<td>1.1494</td>
<td>2.2472</td>
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</tr>
<tr>
<td>Hagonoy (<em>Chromolaena odorata</em>)</td>
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<td>1.9757</td>
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</tr>
<tr>
<td>Hulape (<em>Paspalum conjugatum</em>)</td>
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<td>0.6217</td>
<td>3.4483</td>
<td>1.8855</td>
<td>22</td>
</tr>
<tr>
<td>Bulakmanok (<em>Ageratum conyzoides</em>)</td>
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<td>1.5689</td>
<td>3.4483</td>
<td>1.8839</td>
<td>23</td>
</tr>
<tr>
<td>Baguio beans (<em>Phaseolus vulgaris</em>)</td>
<td>0.4533</td>
<td>3.5523</td>
<td>1.1494</td>
<td>1.7183</td>
<td>24</td>
</tr>
<tr>
<td>Uuko (<em>Mikania cordata</em>)</td>
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<td>0.8289</td>
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<td>1.6222</td>
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</tr>
<tr>
<td>Conyza Canadensis</td>
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<td>1.5393</td>
<td>2.2989</td>
<td>1.5514</td>
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<tr>
<td>Hapon (<em>Crassocephalum crepidioides</em>)</td>
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<td>1.6281</td>
<td>2.2989</td>
<td>1.4903</td>
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</tr>
<tr>
<td>Kulo-kulot (<em>Urena lobata</em>)</td>
<td>0.6800</td>
<td>1.4801</td>
<td>2.2989</td>
<td>1.4863</td>
<td>28</td>
</tr>
<tr>
<td>Balbas kalabao (<em>Spororobolus indicus</em>)</td>
<td>1.1333</td>
<td>1.9242</td>
<td>1.1494</td>
<td>1.4023</td>
<td>30</td>
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<tr>
<td>Mimosa sp.</td>
<td>0.4080</td>
<td>0.7993</td>
<td>2.2989</td>
<td>1.1687</td>
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<tr>
<td>Grass (<em>Brachiaria sp.</em>)</td>
<td>0.3853</td>
<td>0.6513</td>
<td>2.2989</td>
<td>1.1118</td>
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<tr>
<td>Violet flower</td>
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<td>0.6513</td>
<td>2.2989</td>
<td>1.0967</td>
<td>33</td>
</tr>
<tr>
<td>Unknown (violet flower)</td>
<td>0.3400</td>
<td>0.6513</td>
<td>2.2989</td>
<td>1.0967</td>
<td>34</td>
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<tr>
<td>Bayabang/Sword fern</td>
<td>0.2040</td>
<td>0.7401</td>
<td>2.2989</td>
<td>1.0810</td>
<td>35</td>
</tr>
<tr>
<td>Fern (<em>Sphenomeris sp.</em>)</td>
<td>0.6800</td>
<td>0.7401</td>
<td>1.1494</td>
<td>0.8565</td>
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<tr>
<td>Ageratina adenophora</td>
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<td>1.1494</td>
<td>0.7652</td>
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<td>Gallingsoga parviflora</td>
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<td>0.4736</td>
<td>1.1494</td>
<td>0.6770</td>
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<tr>
<td>Pilea sp.</td>
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<td>0.3552</td>
<td>1.1494</td>
<td>0.5469</td>
<td>39</td>
</tr>
<tr>
<td>Takim baka (<em>Sida acuta</em>)</td>
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<td>0.2368</td>
<td>1.1494</td>
<td>0.5074</td>
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<tr>
<td>Tridax procumbens</td>
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<td>1.1494</td>
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<td>Payong-payong (<em>Cyperus iria</em>)</td>
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<td>0.2368</td>
<td>1.1494</td>
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</table>

Table 8. Vegetational analysis for habal/umah (swidden farm) at Brgy. Abatan, Hungduan, Ifugao (* Local name)
(adapted from GIAHS 2011, p. 28).
<table>
<thead>
<tr>
<th>SPECIES</th>
<th>RELATIVE COVER</th>
<th>RELATIVE HEIGHT</th>
<th>RELATIVE FREQUENCY</th>
<th>SUMMED DOMINANCE RATIO</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dumduma/Wisak (Neonauclea media)</td>
<td>9.9114</td>
<td>16.4855</td>
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<td>Tuai (Bischofia javanica)</td>
<td>9.3284</td>
<td>15.1521</td>
<td>3.1746</td>
<td>9.2184</td>
<td>2</td>
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<td>Hagonoy (Chromolaena odorata)</td>
<td>7.8125</td>
<td>12.2672</td>
<td>6.3492</td>
<td>8.8096</td>
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</tr>
<tr>
<td>Alagaw (Prema odorata)</td>
<td>6.9963</td>
<td>15.7582</td>
<td>3.1746</td>
<td>8.6430</td>
<td>4</td>
</tr>
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<td>Buhuit/Wild strawberry (Rubus sp spp fraxinifolius)</td>
<td>6.9963</td>
<td>13.6975</td>
<td>4.7619</td>
<td>8.4852</td>
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<td>Talahib (Saccharum spontaneum)</td>
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<td>9.0913</td>
<td>3.1746</td>
<td>5.7988</td>
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<td>Cogon (Imperata cylindrica)</td>
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<td>6.4245</td>
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<td>Balete (Ficus benjamina)</td>
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<td>7.2730</td>
<td>1.5873</td>
<td>4.5082</td>
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<tr>
<td>Baksi/Botgui (Melastoma sp malabathricum)</td>
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<td>6.6669</td>
<td>3.1746</td>
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</tr>
<tr>
<td>Lapteng (Ficus sp.)</td>
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<td>6.0609</td>
<td>1.5873</td>
<td>4.0652</td>
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<tr>
<td>Hauli (Ficus septica)</td>
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<td>4.8487</td>
<td>3.1746</td>
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<td>Rono (Miscanthus sinensis)</td>
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<td>1.5873</td>
<td>3.7481</td>
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<td>Malatabako (Elephantopus mollis)</td>
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<td>3.2244</td>
<td>4.7619</td>
<td>3.2607</td>
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<td>Ipil-ipil (Leucaena leucocephala)</td>
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<td>4.8487</td>
<td>1.5873</td>
<td>3.1948</td>
<td>14</td>
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<tr>
<td>Guava (Psidium guajava)</td>
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<td>6.0609</td>
<td>1.5873</td>
<td>2.9381</td>
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<td>4.4850</td>
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<td>2.8015</td>
<td>16</td>
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<td>0.3394</td>
<td>4.7619</td>
<td>2.7343</td>
<td>17</td>
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<td>1.5873</td>
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<td>2.6716</td>
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<td>Botbotones (Hyptis capitata)</td>
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<td>3.5153</td>
<td>3.1746</td>
<td>2.4632</td>
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<tr>
<td>Balbas kalabaw (Sphorobolus sp)</td>
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<td>2.4243</td>
<td>1.5873</td>
<td>2.2700</td>
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<tr>
<td>Balanti (Mallotus mollissimus)</td>
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<td>2.9092</td>
<td>1.5873</td>
<td>2.2373</td>
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<tr>
<td>Hapon (Crassocephalum crepidoides)</td>
<td>0.4431</td>
<td>1.1152</td>
<td>3.1746</td>
<td>1.5776</td>
<td>23</td>
</tr>
<tr>
<td>Coconut orchid (Spathoglottis sp)</td>
<td>1.2826</td>
<td>1.8183</td>
<td>1.5873</td>
<td>1.5627</td>
<td>24</td>
</tr>
<tr>
<td>Takim baka (Sida acuta)</td>
<td>0.4664</td>
<td>1.0182</td>
<td>3.1746</td>
<td>1.5531</td>
<td>25</td>
</tr>
<tr>
<td>Fern (Sphenomeris sp)</td>
<td>1.0494</td>
<td>1.9395</td>
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<tr>
<td>Lantana (Lantana camara)</td>
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<td>1.0910</td>
<td>1.5873</td>
<td>0.9860</td>
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<td>Puriket (Bidens pilosa)</td>
<td>0.3498</td>
<td>0.6061</td>
<td>1.5873</td>
<td>0.8477</td>
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<td>Makahiya lalaki (Momosa sp)</td>
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<td>1.5873</td>
<td>0.7685</td>
<td>31</td>
</tr>
<tr>
<td>Bulakmanok (Ageratum conyzoides)</td>
<td>0.1399</td>
<td>0.3394</td>
<td>1.5873</td>
<td>0.6889</td>
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<td>Botbotones (Cyperus kyllingia)</td>
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<td>0.1939</td>
<td>1.5873</td>
<td>0.6870</td>
<td>33</td>
</tr>
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<td>Bayabang (Nepheirops codifolia)</td>
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<td>0.2424</td>
<td>1.5873</td>
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<td>0.2424</td>
<td>1.5873</td>
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<td>0.1939</td>
<td>1.5873</td>
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</tr>
<tr>
<td>Payong payong (Cyperus iria)</td>
<td>0.1866</td>
<td>0.1212</td>
<td>1.5873</td>
<td>0.6317</td>
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</tr>
<tr>
<td>Martial law vine (Mikania cordata)</td>
<td>0.1866</td>
<td>0.1212</td>
<td>1.5873</td>
<td>0.6317</td>
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<tr>
<td>Amoroko (Chrysopogon aciculatus)</td>
<td>0.2332</td>
<td>0.0727</td>
<td>1.5873</td>
<td>0.6311</td>
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</tr>
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</table>

Table 9. Vegetational analysis for habal/umah (swidden farm) at Brgy. Nungulunan, Hungduan, Ifugao (* Local name) (adapted from GIAHS 2011, p. 29).
The third site, which was on fallow, had 40 documented species (Table 9) dominated by *Neonauclea media* saplings with SDR of 10.3863. *Bichofoia javanica, Chromolaena odorata, Prema odorata* and *Rubus faxinfolius* were the other dominant species (GIAHS 2011, p. 29).

**Rice Terraces (payoh)**

Rice terraces dominate the Ifugao landscape but are interdependent ecologically and socially with the muyung and the uma systems. The rice paddies are privately-owned and are one of the main measures of an individual’s prestige in the community. The payoh is constructed mainly for wet-rice, but other crops are also cultivated on and around the paddy field (e.g. taro). Since paddy fields are essentially intensified systems, they tend to focus on a single crop but also provide the ecology for weeds that have the same environmental needs as wet-rice varieties. Thus, we expect to find various grasses in the irrigated terraces.

The GIAHS survey team obtained their samples from two sites: rice terraces at Poblacion, Hungduan and at Brgy. Hapao, Hungduan. As expected, both of the sites were dominated by *Oryza sativa* (Tables 10 and 11).

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>RELATIVE DENSITY</th>
<th>RELATIVE FREQUENCY</th>
<th>SUMMED DOMINANCE RATIO</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice (<em>Oryza sativa</em>)</td>
<td>43.5746</td>
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<td>Payong-payong (<em>Cyperus iria</em>)</td>
<td>8.5672</td>
<td>6.9444</td>
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<tr>
<td>Puriket (<em>Bidens pilosa</em>)</td>
<td>9.3058</td>
<td>5.5556</td>
<td>7.4307</td>
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</tr>
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<td>Put-putod (<em>Equisetum ramosissimum</em>)</td>
<td>4.4313</td>
<td>4.1667</td>
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</tr>
<tr>
<td>Marapagay (<em>Echinochloa crusgalli</em>)</td>
<td>2.9542</td>
<td>5.5556</td>
<td>4.2549</td>
<td>5</td>
</tr>
<tr>
<td>Balakbak (<em>Ludwigia octovalis</em>)</td>
<td>2.6588</td>
<td>5.5556</td>
<td>4.1072</td>
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</tr>
<tr>
<td>Fern (<em>Christella sp.</em>)</td>
<td>2.8065</td>
<td>4.1667</td>
<td>3.4866</td>
<td>7</td>
</tr>
<tr>
<td>Bulakmanok (<em>Ageratum conyzoides</em>)</td>
<td>2.2157</td>
<td>4.1667</td>
<td>3.1912</td>
<td>8</td>
</tr>
<tr>
<td>Sedges (<em>Scirpus grossus</em>)</td>
<td>2.6588</td>
<td>2.7778</td>
<td>2.7183</td>
<td>9</td>
</tr>
<tr>
<td>Cogon (<em>Imperata cylindrica</em>)</td>
<td>2.2157</td>
<td>2.7778</td>
<td>2.4967</td>
<td>10</td>
</tr>
<tr>
<td>Gabi (<em>Colocasia esculenta</em>)</td>
<td>1.1817</td>
<td>2.7778</td>
<td>1.9797</td>
<td>11</td>
</tr>
<tr>
<td>Maiden hair fern (<em>Adiantum caudatum</em>)</td>
<td>1.1817</td>
<td>2.7778</td>
<td>1.9797</td>
<td>12</td>
</tr>
<tr>
<td>Botones (<em>Hyptis brevipes</em>)</td>
<td>1.1817</td>
<td>2.7778</td>
<td>1.9797</td>
<td>13</td>
</tr>
<tr>
<td>Bonga-bonga (<em>Alternanthera sessilis</em>)</td>
<td>1.0340</td>
<td>2.7778</td>
<td>1.9059</td>
<td>14</td>
</tr>
<tr>
<td>Takip kuhol (<em>Centella asiatica</em>)</td>
<td>1.0340</td>
<td>2.7778</td>
<td>1.9059</td>
<td>15</td>
</tr>
<tr>
<td>Palang (<em>Psophocarpus tetragonolobus</em>)</td>
<td>0.4431</td>
<td>2.7778</td>
<td>1.6105</td>
<td>16</td>
</tr>
<tr>
<td>Galliang (<em>Cryptosperma merkusii</em>)</td>
<td>1.4771</td>
<td>1.3889</td>
<td>1.4330</td>
<td>17</td>
</tr>
<tr>
<td>Mutha (<em>Cyperus rotundus</em>)</td>
<td>0.7386</td>
<td>1.3889</td>
<td>1.0637</td>
<td>18</td>
</tr>
<tr>
<td>Samsamon (<em>Themeda triandra</em>)</td>
<td>0.7386</td>
<td>1.3889</td>
<td>1.0637</td>
<td>19</td>
</tr>
<tr>
<td>Kamama (<em>Drynaria cordata</em>)</td>
<td>0.7386</td>
<td>1.3889</td>
<td>1.0637</td>
<td>20</td>
</tr>
<tr>
<td><em>Pilea melastomoides</em></td>
<td>0.7386</td>
<td>1.3889</td>
<td>1.0637</td>
<td>21</td>
</tr>
<tr>
<td>Camote (<em>Ipomea batatas</em>)</td>
<td>0.7386</td>
<td>1.3889</td>
<td>1.0637</td>
<td>22</td>
</tr>
<tr>
<td>Hulape (<em>Paspalum conjugatum</em>)</td>
<td>0.7386</td>
<td>1.3889</td>
<td>1.0637</td>
<td>23</td>
</tr>
<tr>
<td>Boto-botones (<em>Hyptis capitata</em>)</td>
<td>0.7386</td>
<td>1.3889</td>
<td>1.0637</td>
<td>24</td>
</tr>
</tbody>
</table>
### The Ifugao agrcultural system: bridging culture and nature to enhance tropical biodiversity

Table 10. Payoh vegetational Analysis for in Poblacion, Hungduan, Ifugao (from GIAHS 2011, p. 31).

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>RELATIVE DENSITY</th>
<th>RELATIVE FREQUENCY</th>
<th>SUMMED DOMINANCE RATIO</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulakmanok (Ageratum coyzoides)</td>
<td>12.5604</td>
<td>9.2593</td>
<td>10.9098</td>
<td>1</td>
</tr>
<tr>
<td>Puriket (Bidens pilosa)</td>
<td>10.8696</td>
<td>5.5556</td>
<td>8.2126</td>
<td>2</td>
</tr>
<tr>
<td>Cogon (Imperata cylindrica)</td>
<td>9.6618</td>
<td>5.5556</td>
<td>7.6087</td>
<td>3</td>
</tr>
<tr>
<td>Marapagay (Echinochloa cruzgalli)</td>
<td>9.1787</td>
<td>5.5556</td>
<td>7.3671</td>
<td>4</td>
</tr>
<tr>
<td>Hulape Paspalum conjugatum</td>
<td>8.4541</td>
<td>3.7037</td>
<td>6.0789</td>
<td>5</td>
</tr>
<tr>
<td>Balabak (Ludwigia octovalis)</td>
<td>4.5894</td>
<td>5.5556</td>
<td>5.0725</td>
<td>6</td>
</tr>
<tr>
<td>Pilea melastomoides</td>
<td>4.3478</td>
<td>3.7037</td>
<td>4.0258</td>
<td>7</td>
</tr>
<tr>
<td>Kamama (Drynaria cordata)</td>
<td>3.1401</td>
<td>3.7037</td>
<td>3.4219</td>
<td>8</td>
</tr>
<tr>
<td>Gabling uwak (Monochoria vaginalis)</td>
<td>3.1401</td>
<td>3.7037</td>
<td>3.4219</td>
<td>9</td>
</tr>
<tr>
<td>Siksik parang (Borreria ocyymoides)</td>
<td>4.8309</td>
<td>1.8519</td>
<td>3.3414</td>
<td>10</td>
</tr>
<tr>
<td>Conya canadensis</td>
<td>2.4155</td>
<td>3.7037</td>
<td>3.0596</td>
<td>11</td>
</tr>
<tr>
<td>Payong-payong (Cyperus iria)</td>
<td>1.9324</td>
<td>3.7037</td>
<td>2.8180</td>
<td>12</td>
</tr>
<tr>
<td>Fern (Pteris vitata)</td>
<td>1.6908</td>
<td>3.7037</td>
<td>2.6973</td>
<td>13</td>
</tr>
<tr>
<td>Uoko (Mikania cordata)</td>
<td>0.9662</td>
<td>3.7037</td>
<td>2.3349</td>
<td>14</td>
</tr>
<tr>
<td>Unknown sp.</td>
<td>0.7246</td>
<td>3.7037</td>
<td>2.1422</td>
<td>15</td>
</tr>
<tr>
<td>Rice seedlings (Oryza sativa)</td>
<td>2.4155</td>
<td>1.8519</td>
<td>2.1337</td>
<td>16</td>
</tr>
<tr>
<td>Poa sp</td>
<td>2.4155</td>
<td>1.8519</td>
<td>2.1337</td>
<td>17</td>
</tr>
<tr>
<td>Kamote (Ipomea batatas)</td>
<td>3.1401</td>
<td>1.8519</td>
<td>2.4960</td>
<td>18</td>
</tr>
<tr>
<td>Hapon (Crassocephalum crepidioides)</td>
<td>2.4155</td>
<td>1.8519</td>
<td>2.1337</td>
<td>19</td>
</tr>
<tr>
<td>Tibig (Ficus nota)</td>
<td>0.4831</td>
<td>3.7037</td>
<td>2.0934</td>
<td>20</td>
</tr>
<tr>
<td>Galliang (Cryptosperma merkusii)</td>
<td>1.9324</td>
<td>1.8519</td>
<td>1.8921</td>
<td>21</td>
</tr>
<tr>
<td>Lupo-lupo (Alternanthera sp.)</td>
<td>1.2077</td>
<td>1.8519</td>
<td>1.5298</td>
<td>22</td>
</tr>
<tr>
<td>Fern (Christella dentata)</td>
<td>1.2077</td>
<td>1.8519</td>
<td>1.5298</td>
<td>23</td>
</tr>
<tr>
<td>Malacelery (Allium sp.)</td>
<td>1.2077</td>
<td>1.8519</td>
<td>1.5298</td>
<td>24</td>
</tr>
</tbody>
</table>
Table 11. Post harvest vegetational analysis of a payoh in Hapao, Hungduan, Ifugao (from GIAHS 2011, p. 32).

<table>
<thead>
<tr>
<th>Species</th>
<th>Coverage</th>
<th>Abundance</th>
<th>Biomass</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabi (Colocacia esculenta)</td>
<td>1.2077</td>
<td>1.8519</td>
<td>1.5298</td>
<td>25</td>
</tr>
<tr>
<td>Poa annua</td>
<td>0.7246</td>
<td>1.8519</td>
<td>1.2882</td>
<td>26</td>
</tr>
<tr>
<td>Digitaria sp</td>
<td>0.7246</td>
<td>1.8519</td>
<td>1.2882</td>
<td>27</td>
</tr>
<tr>
<td>Hyptis sp.</td>
<td>0.4831</td>
<td>1.8519</td>
<td>1.1675</td>
<td>28</td>
</tr>
<tr>
<td>Onion leeks (Allium sp)</td>
<td>0.4831</td>
<td>1.8519</td>
<td>1.1675</td>
<td>29</td>
</tr>
<tr>
<td>Takip kuhol (Centella asiatica)</td>
<td>0.4831</td>
<td>1.8519</td>
<td>1.1675</td>
<td>30</td>
</tr>
<tr>
<td>Cassava (Manihot esculenta)</td>
<td>0.4831</td>
<td>1.8519</td>
<td>1.1675</td>
<td>31</td>
</tr>
<tr>
<td>Marapait (Tithonia diversifolia)</td>
<td>0.4831</td>
<td>1.8519</td>
<td>1.1675</td>
<td>32</td>
</tr>
</tbody>
</table>

Concluding Remarks

The Ifugao agroecological system provides an excellent case where intensified agricultural system enhances biodiversity. Data from the GIAHS survey show that the Ifugao agroecological system tends to increase biodiversity because of indigenous ecological landscape management (Table 12). The survey also shows that the muyung contains most of the indigenous tree species in the region. As a managed forest, owners who are responsible for the upkeep of the forest patches favors native species as part of cultural norms and traditional ecological knowledge.

Similar to previous work that argued for the sustainability – and high biodiversity – of swidden fields (Anderson 1993; Conklin 1957; Dove 1985; Spencer 1966), the Ifugao uma has also exhibited the highest biodiversity index in the Ifugao agrocultural system. Although cultivars have changed due to market demands and cultural preference, swidden fields in Ifugao have hosted a diverse set of species, and have been demonstrated to be a sustainable practice. The Ifugao swiddening tradition counteracts the government’s official policy that describes swiddening as destructive, thus prohibiting the practice.

Data presented in this article contribute to the now established thought that local knowledge systems should be tapped to maintain or enhance biodiversity. Although political and economic pressures persist, local communities are able to make decisions that matter to them – socially and ecologically. Rice terraces, and in general, the Ifugao agroecological system is maintained because of its cultural value rather than their economic returns. The main threat to biodiversity in the region is the burden to produce cash crops, which would covert forest cover into cultivable areas. Introduction of invasive species has also contributed to the threat vulnerability of the ecosystem (Castonguay 2014). Conservation programs that do not include local realities to the plans further add to the deterioration of biodiversity and heritage. As a case in point, conservation programs in Ifugao are heavily focused on infrastructure repair (irrigation canals, collapsed terrace walls) and recently, developing markets for tinawon varieties. The cultural foundation of agricultural production has been
largely ignored, and the unintended consequences to Ifugao customary culture have been magnified (Acabado and Martin 2015).

In recent decades, the National Irrigation Administration (NIA), a state agency, has taken the lead in the maintenance of irrigation systems in Ifugao. This activity is associated with funds provided by the national government. Although it is still the farmers who carry out the repairs and maintenance of the system, they are paid monetarily by the project. This has immense implications in the sustainability of the Ifugao agricultural system as the basic socio-political dynamic that has regulated the social and ecological fabric of the Ifugao has been eroded. NIA sponsored a project to convert the Ifugao irrigation system into concrete structures in Hapao, Hungduan in 2003. The principle behind the structural change was conceived by engineers who thought that concrete irrigation channels require less maintenance than earthen structures. Most of the workers who were hired to help with the constructions were local farmers. They were paid monetarily, based on the prevailing wage standards. However, a few weeks after the completion of the project, a typhoon caused several small landslides that buried segments of the system. The local farmers could not muster enough workers as farmers were waiting for the national government to pay them to repair the damaged portions of the system. In the summer of 2012, the system is still inoperable.

Conservation programs in Ifugao, and elsewhere, should give primacy to Traditional Ecological Knowledge. As reinforced by the data provided in this essay, local knowledge and perceptions are invaluable in developing and implementing sustainable programs. As the nature of production in the region is increasingly leaning towards the market economy, the need for a bottom up approach to biodiversity

<table>
<thead>
<tr>
<th>LAND-USE</th>
<th>Sampling Sites</th>
<th>No. of Individuals (N)</th>
<th>Species Richness (SR)</th>
<th>Shannon's Diversity Index (H')</th>
<th>Shannon's Equitability Index (EH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muyung/Forest (Timber)</td>
<td>Poblacion</td>
<td>65</td>
<td>10</td>
<td>1.7136</td>
<td>0.7442</td>
</tr>
<tr>
<td></td>
<td>Nungulunan</td>
<td>67</td>
<td>15</td>
<td>1.9103</td>
<td>0.7044</td>
</tr>
<tr>
<td></td>
<td>Abatan</td>
<td>28</td>
<td>18</td>
<td>2.755</td>
<td>0.9533</td>
</tr>
<tr>
<td>Muyung/Forest (Understorey)</td>
<td>Poblacion</td>
<td>152</td>
<td>24</td>
<td>2.8805</td>
<td>0.9064</td>
</tr>
<tr>
<td></td>
<td>Nungulunan</td>
<td>1204</td>
<td>38</td>
<td>3.0728</td>
<td>0.8447</td>
</tr>
<tr>
<td></td>
<td>Abatan</td>
<td>963</td>
<td>32</td>
<td>2.8719</td>
<td>0.8287</td>
</tr>
<tr>
<td></td>
<td>Abatan Falls</td>
<td>38</td>
<td>38</td>
<td>3.221</td>
<td>0.8758</td>
</tr>
<tr>
<td>Habal/Ublag (Swidden Farm)</td>
<td>Poblacion</td>
<td>28</td>
<td>28</td>
<td>3.1217</td>
<td>0.9360</td>
</tr>
<tr>
<td></td>
<td>Abatan</td>
<td>42</td>
<td>42</td>
<td>3.3785</td>
<td>0.8982</td>
</tr>
<tr>
<td></td>
<td>Nungulunan (Ublag)</td>
<td>40</td>
<td>40</td>
<td>3.3477</td>
<td>0.9075</td>
</tr>
<tr>
<td>Payoh (Rice Terraces)</td>
<td>Poblacion</td>
<td>677</td>
<td>41</td>
<td>3.1064</td>
<td>0.8365</td>
</tr>
<tr>
<td></td>
<td>Hapao</td>
<td>414</td>
<td>32</td>
<td>3.2293</td>
<td>0.9318</td>
</tr>
</tbody>
</table>

Table 12. Biodiversity indices for various Ifugao land use categories from GIAHS sampled areas in Hungduan, Ifugao (adapted from GIAHS 2011, p. 36).
conservation has never been more crucial. The recognition by the national government of effective indigenous forest management systems and customary practices on natural resources management needs to be translated into policies that would effectively integrate age-old knowledge in contemporary environmental conservation initiatives.

References


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