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Most models that explain the development of agricultural systems suggest evolutionary relationships between extensive (e.g. swidden cultivation) and intensive (e.g. wet-rice cultivation) forms of production. Recent information from highland Southeast Asian farming systems questions the validity of this assumption. As a case in point, this article presents the results of a combined ethnographic study and spatial analysis of the Ifugao agricultural system in the northern Philippines, focusing in particular on the relationships among intensive rice terracing, swidden farming and agroforestry (Ifugao forest management). Informed by the Ifugao example, this article suggests that extensive and intensive systems are often concurrent and compatible components of a broad-spectrum lifeway.

Introduction

The Ifugao agricultural terraces offer a means to better understand agricultural ecology and relationships between the landscape and human organisation. Similar to other agricultural systems in Southeast Asia, the complexity of Ifugao agriculture can be considered an 'agro-cultural complex'.[1] The concurrent existence of intensive agriculture, swidden and agroforestry in the region 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 agricultural system presents a case study for addressing issues of economic and ecological sustainability of current farming systems, and the implications of state agricultural policies.

Using an historical ecological approach,[2] this article discusses the links between agricultural intensification and ecological and social factors. Dominant models on the

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1 Richard O'Connor, 'Agricultural change and ethnic succession in Southeast Asian states: A case for regional anthropology', *Journal of Asian Studies*, 54, 4 (1995): 968–96.

2 Carol Crumley, 'Historical ecology: A multidimensional ecological approach', in *Historical ecology: Cultural knowledge and changing landscapes*, ed. Carol L. Crumley (Santa Fe, NM: School of

intensification of agricultural production suggest an evolutionary relationship between extensive and intensive systems. Previous archaeological models for agricultural intensification assumed that there was a direct link between population and production system[3] and levels or stages of change.[4] These models, however, focused on lowland (i.e. Egypt, Mesopotamia, China) or island populations (i.e. the Pacific), whose evolution suggests that population increase and ecological factors may have influenced production intensification, making swiddening and gardening less suitable. In highland Southeast Asia, however, the relationship between extensive and intensive systems differs. The simultaneous presence of both farming systems suggests that a risk-minimisation strategy is an important aspect of how populations choose a specific subsistence system. Thus, ethnographic[5] and archaeological[6] studies in montane Southeast Asia challenge dominant intensification models.

This work re-evaluates the existing models using ecological parameters, as exemplified by the distribution of agricultural fields in the North Central Cordillera in the Philippines (see Figure 1), a region famous for the Ifugao rice terraces. Statistical analysis was used to determine the relationship between the distribution of cultural features, in this case, terraced rice fields and swidden plots, with ecological parameters that include elevation, slope, aspect, distance to water source and distance to hamlets. The ecological–distributional relationships were then integrated with ethnographic and ethnohistoric data to establish the suite of ecological and social considerations that the Ifugao have in making decisions about their subsistence strategies.

In Ifugao, swiddening, intensive cultivation and agroforestry are part of a sustainable system. Swiddening has been blamed for upland deforestation and desertification elsewhere; however, the Ifugao agricultural system sustains significant forest cover in the upland terrain. I argue that populations practising a combination of swiddening and intensive forms of cultivation demonstrate a risk-minimisation strategy.

American Research and Advanced Seminar Series, 1994), pp. 1–13; William Balée, 'The research program of historical ecology', *Annual Review of Anthropology*, 35, 2 (2006): 75–98; Ted Gragson, 'Time in service to historical ecology', *Ecological and Environmental Anthropology*, 1, 1 (2005): 1–9.

3 Ester Boserup, *Population and technological change: Study of long term trends* (Chicago: University of Chicago Press, 1981).

4 Patrick V. Kirch, *The wet and the dry: Irrigation and agricultural intensification in Polynesia* (Chicago: University of Chicago Press, 1994); Kathleen Morrison, 'The intensification of production: Archaeological approaches', *Journal of Archaeological Method and Theory*, 1, 2 (June 1994): 111–59.

5 See, for example, Terry Rambo, 'The composite swiddening agroecosystem of the Tay ethnic minority of the northwestern mountains of Vietnam', in *Montane mainland Southeast Asia in Transition*, ed. Benjavan Rerkasem, Deanna G. Donovan and Kirk Talbott (Chiang Mai: Chiang Mai University Consortium, 1996), pp. 69–89; Harold C. Conklin, Pugguwon Lupaih, Miklos Pinther and American Geographical Society of New York, *Ethnographic atlas of the Ifugao: A study of environment, culture and society in Northern Luzon* (London and New Haven: Yale University Press, 1980); J. Stephen Lansing, *Priests and programmers: Technologies of power in the engineered landscape of Bali* (Princeton, NJ: Princeton University Press, 1993).

6 Vernon L. Scarborough, John W. Schoenfelder and J. Stephen Lansing, 'Early statecraft on Bali: The water temple complex and the decentralization of the political economy', in *Research in Economic Anthropology*, vol. 20, ed. Barry L. Isaac (Greenwich, CT: JAI Press, 1999); Vernon Scarborough, John W. Schoenfelder and J. Stephen Lansing, 'Ancient water management and landscape transformation at Sebatu, Bali', *Indo-Pacific Prehistory Association Bulletin*, 20, 4 (2000): 79–92; John Schoenfelder, 'The co-evolution of agriculture and sociopolitical systems in Bali', *Indo-Pacific Prehistory Association Bulletin*, 20, 4 (2000): 35–47.

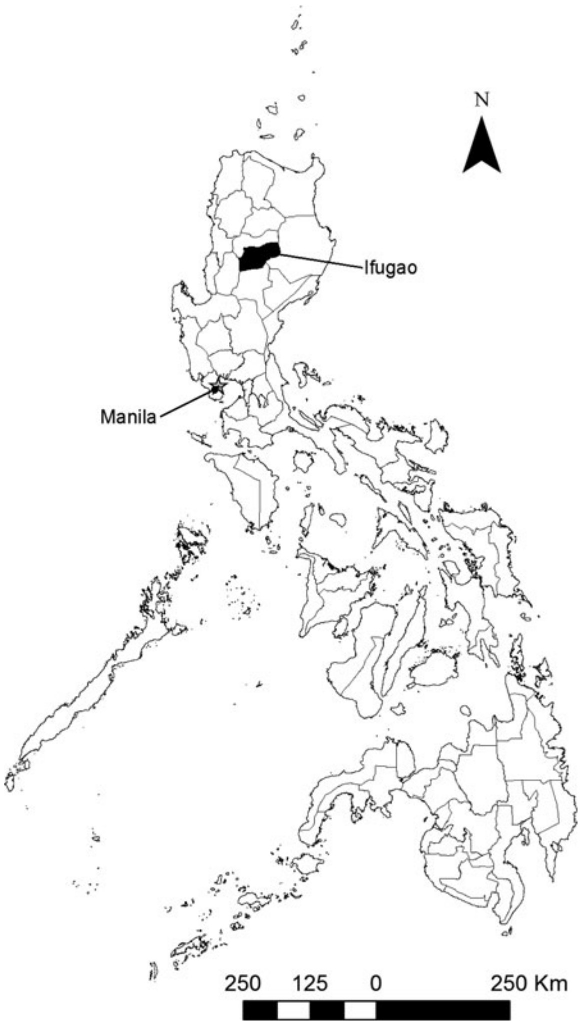

Figure 1. Location map of Ifugao Province, Northern Philippines

In discussing agrarian ecological issues, I start with a description of the distribution of agricultural systems in the North Central Cordillera relative to environmental parameters. The Ifugao agricultural system (especially, terraced rice pond-fields) is a unique opportunity for long-term study by archaeologists and ecologists; the terraces are still being used after more than four centuries.[7] As opposed to other agricultural systems of archaeological interest (i.e. Mimbres Valley, Mexico, the Andean raised fields, and Kohala field in Hawai'i), the Ifugao study provides us with both ethnographic and archaeological evidence for understanding human–environment interactions.

7 Stephen Acabado, 'A Bayesian approach to dating agricultural terraces: A case from the Philippines', *Antiquity*, 83 (2009): 801–14.

To balance the dataset (information obtained in the 1960s)[8] I focused on the present-day distribution of Ifugao agricultural systems. Where I use the term 'traditional', it refers to practices not influenced by the Green Revolution and its methods and that are 'indigenous' to the Ifugao, as explained by local farmers. Currently, a number of Ifugao farmers employ both traditional and modern methods (i.e. use of synthetic fertilisers, pesticides, and International Rice Research Institute [IRRI] rice varieties) of farming introduced after the 1960s.

The distribution of terraces and swidden fields in the Ifugao landscape shows that the difficult terrain of the North Central Cordillera did not prevent the cultivation of domesticated rice — a crop that is more adapted to levelled and well-watered areas. The existence of swiddening of non-rice crops in the Ifugao agricultural suite also shows exploitation of less productive (marginal) soils or locations. Therefore, the Ifugao provides another study where intensive and extensive production systems coexist, thus contesting the suggestion that swiddening is an inferior subsistence strategy; rather, it is a complementary system.

Agricultural strategies and land tenure

As a result of the American colonial government's successful 'pacification' of Cordillera cultural communities at the turn of the twentieth century, the Ifugao were drawn into the Philippine's market economy, increasing their need for monetary income. Thus, the Ifugao agricultural system experienced a transition from subsistence to simple commodity production after the 1930s.[9] Hence, where previously, agricultural products, especially rice, were solely for household consumption (including feasts), Ifugao agricultural products began to be sold. Small-scale agriculture and small animal husbandry are still dominant livelihood sources for most Ifugao, however.

After the Second World War, the growing need for monetary income compelled the Ifugao to begin to migrate to the lowlands and abroad in search of paid work. Remittances from Ifugao working abroad and in Philippine cities combined with the perception of farming as a low-status occupation greatly diminished the prestige of Ifugao farming technologies.[10] The past decade, however, has seen the re-emergence of an Ifugao identity in the midst of integration into wider Philippine society (and globalisation), with a revival of both tangible and intangible heritage. This is evident in the resurgent importance given to the terraces and rituals associated with Ifugao farming. Today, both intensive (irrigated terraces, cultivated with rice and vegetables) and extensive (swidden fields, cultivated with root crops) agriculture is practised. Arboriculture (with the introduction of mangos, avocados and coffee) and garden horticulture (vegetables) have also been added to the suite of Ifugao agricultural strategies.

A cross-section of a typical area is presented in Figure 2, demonstrating some Ifugao agricultural strategies. Within a particular watershed, several types of land-use categories make up the agricultural system: two types of forest cover – *'inalāhan*

8 That is, data from the study by Conklin *et al.*, *Ethnographic atlas of the Ifugao*.

9 Deirdre McCay, 'Cultivating new local futures: Remittance economies and land-use patterns in Ifugao, Philippines', *Journal of Southeast Asian Studies*, 48, 2 (2003): 285–306.

10 Ibid., p. 288.

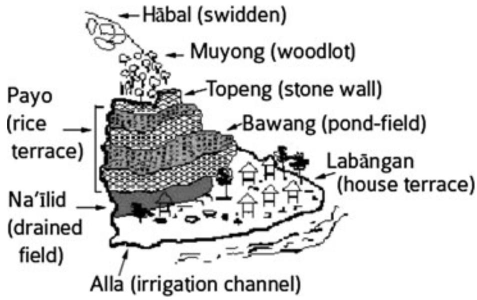

Figure 2. Profile of an Ifugao terrace system. Stephen Acabado, 'The archaeology of Ifugao agricultural terraces: Antiquity and social organization' (Ph.D. diss, University of Hawai'i, 2010), p. 83

(upslope public forests often composed of open-access communal areas) and *muyong* (privately owned woodlots managed with definite boundaries); *hābal* (swidden; unirrigated slopeland, cultivated with root crops, usually, sweet potatoes); *labangan* (house terraces; residential sites); *na'īlid* (drained fields; levelled terraced areas for cultivation and drainage of dry crops such as sweet potatoes and legumes); and *payo* (irrigated rice fields; levelled, terraced farmland, bunded to retain water).

An important aspect of Ifugao agricultural terrace ecology and maintenance is the land-use category of *muyong/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[11] in the last three decades suggest that heavy forest cover actually results in more groundwater usage, these woodlots protect low-lying fields from runoff and erosion, and maintain the supply of surface and irrigation water (through cloud-intercept), stabilise relative humidity, and improve the soil's nutrients and physical and chemical properties.[12] Indeed, more logging in the vicinity of Banaue in the early 1980s accelerated runoff and evapotranspiration, exacerbating Ifugao's water shortages during the dry season.[13]

The advent of a woodcarving industry in the Ifugao economy after the Second World War combined with the intervention of national forest conservation measures negatively affected the management of the *muyong/pinugo* system.[14] These carvings are sold locally, especially in the tourist town of Banaue. Although the carving industry itself was not a problem, national policies on logging disrupted the Ifugao forest

11 Lawrence Hamilton and Peter King, *Tropical forested watersheds: Hydrologic and soils response to major uses of conversion* (Boulder, CO: Westview, 1983); Leendert A. Bruijnzeel, *Hydrology of moist tropical forests and effects of conversion: A state of knowledge review* (Paris: UNESCO International Hydrological Programme, 1990); Vasant Saberwal, 'Science and dessicationist discourse of the 20th century', *Environment and History*, 4 (1998): 309–43.

12 Conklin *et al.*, *Ethnographic atlas of the Ifugao*, p. 8.

13 James Eder, 'No water in the terraces: Agricultural stagnation and social change at Banaue, Ifugao', *Philippine Quarterly of Culture and Society*, 10 (1982): 101–16.

14 Edsel E. Sajor, 'Cutting trees and dynamics of social change: The case of the Ifugao *Muyong* in the Philippine uplands', *Institute of Social Studies* (Netherlands) Working Paper no. 294 (The Hague: Institute of Social Studies, 1999).

management system. Previously, the Ifugao were able to access and obtain logs from their community's *muyong/pinugo*, while properly observing indigenous regulations on logging. The total log ban imposed by the national government, however, prevented them from accessing their wood supply. Since woodcarving had become a lucrative source of income for the Ifugao, the carving industry became an impetus for illegal, uncontrolled logging in the *muyong/pinugo* system, which has devastated some of the terrace systems in Ifugao.

Wet-rice cultivation

Anthropologists who have studied subsistence patterns in relation to social complexity have largely focused on intensive systems of cultivation.[15] The centralised management of large irrigation systems (and the intensification associated with these systems) has been seen as the stimulus for the emergence of social complexity. However, there are still a significant number of irrigation systems being run by local community organisations in Southeast Asia and very little attention has been paid to these systems.[16]

In the Philippines, examples of these community-based irrigation systems are found in the densely populated lowland areas of Ilocos and the less densely populated province of Isabela that practise the *zanjera* system. *Zanjera* is a cooperative system of agricultural management developed in the north.[17] It involves the organisation of water allocation, maintenance of common agricultural structures (i.e. irrigation channels and ditches), as well as a conflict resolution system. In other words, a *zanjera* is a large, participatory and communal irrigation system without major state intervention. Currently, the National Irrigation Administration of the Philippines manages dams and water reservoirs; the *zanjeras* operate canals and local water distribution.

In the early 1970s Henry Lewis described the *zanjera* irrigation societies in the northern Philippine provinces of Ilocos and Isabela.[18] The *zanjera* system developed in Ilocos, historically a densely populated region. After the Second World War, the government sponsored migration to less densely populated areas in the country — similar to Indonesia's *transmigrasi* programme. Ilocano migrants who had been members of *zanjeras* settled in the province of Isabela, but did not form local *zanjeras*, which Lewis suggested was because of the different resource bases of the two provinces. Water was then readily available in Isabela (via the Cagayan River and its tributaries), and this, along with the lower population density, eliminated the need

15 Morrison, 'The intensification of production'; Kathleen Morrison, 'Typological schemes and agricultural change: Beyond Boserup in South India', *Current Anthropology*, 37 (1996): 583–608; Eva Hunt and Robert C. Hunt, 'Irrigation, conflict, and politics: A Mexican case', in *Irrigation's impact on society*, ed. Theodore E. Downing and McGuire Gibson (Tucson: University of Arizona Press, 1971), pp. 129–58; Robert McC. Adams, *The evolution of urban society: Early Mesopotamia and Prehispanic Mexico* (Chicago: Aldine, 1966).

16 Randolph Barker and François Molle, 'Perspectives on Asian irrigation', Paper presented at the Conference on Asian Irrigation in Transition: Responding to the Challenges Ahead, Asian Institute of Technology, Bangkok, 22–23 Apr. 2002.

17 Walter Coward Jr, 'Principles of social organization in an indigenous irrigation system', *Human Organization*, 38, 1 (1979): 28–36.

18 Henry Lewis, *Ilocano rice farmers: A comparative study of two Philippine barrios* (Honolulu: University of Hawai'i Press, 1971).

for community resource management. Rapid population growth in Isabela in the last four decades, however, has necessitated the establishment of irrigation cooperatives in the province, albeit under the direct supervision of the Department of Agriculture.

In Ifugao, there is no formal irrigation organisation such as the *zanjera*, although there is a customary cooperative system of reciprocal labour (*uggbu* or *baddang*). Cooperation among those whose fields have to share a water source — common in the area — is apparent. The need for this cooperation is emphasised in areas of intense population pressure or limited water supplies, or both, where the organisation of community labour and management is essential to gaining access to and sharing water, in order to minimise conflicts.[19] Similar to the *zanjeras*, the Ifugao study provides an illustration of a communal cooperative system, as necessitated by topographic/environmental limitations.

Intensification models

Agricultural intensification models are ultimately linked to demographic changes, although the nature of this causal relationship is debated (as in Boserup versus Malthus). The Boserupian linear model of intensification provided archaeologists (and anthropologists) with an empirical way of studying this process. In Boserupian terms, population growth forces the intensification of production via increasing capital inputs (labour, machinery, fertilisers).[20] Greater output (crop yields) is achieved through a linear progression of successive stages in the reduction of fallow length accompanied by progressive improvements in technology, the use of fertilisers, and a steady increase in labour inputs. This theory, however, fails to define 'intensification' clearly,[21] and the resulting models considered the relationship between simple subsistence strategy (swiddening) and intensive agricultural production (irrigated paddy fields) as evolutionary.

Similarly, Harold Brookfield's perspective on intensification rested on increases in labour inputs and other investments used to raise production significantly per unit of land or labour. His definition of intensification was tighter and shifted the focus away from levels or stages of intensity to the process itself. In Brookfield's view, 'intensification of production describes the addition of inputs up to the economic margin, and is logically linked to the concept of efficiency through consideration of marginal and average productivity obtained by such additional inputs'.[22] In other words, there are a number of ways to increase productivity, but all of them involve additional inputs of time and energy. In foraging societies, an increase in gathering is almost synonymous to an increase in labour inputs per unit of land in food-producing societies, as well as an increase in the efficiency of production in craft-producing

19 Tan Shui Yan, *Institutions and collective action: Self-governance in irrigation* (San Francisco: ICS Press, 1992); Elinor Ostrom, *Crafting institutions for self-governing irrigation systems* (San Francisco: ICS Press, 1992).

20 Ester Boserup, *The conditions of agricultural growth: The economics of agrarian change under population pressure* (London: G. Allen & Unwin, 1965).

21 Patrick Kirch, 'Agricultural intensification: A Polynesian perspective', in *Agricultural strategies*, ed. Joyce Marcus and Charles Stanish (Los Angeles: Cotsen Institute of Archaeology, UCLA, 2006).

22 Harold Brookfield, 'Intensification and disintensification in Pacific agriculture: A theoretical approach', *Pacific Viewpoint*, 13 (1972): 211–38.

groups.[23] There are three significant aspects here: spatial, energy capitalisation, and technological. Examples of these are foragers who increase the spatial extent and duration of their food gathering; farmers who raise production by increasing labour input and the use of better technology; and specialists who develop more efficient equipment and skills.

Brookfield developed, with Piers Blaikie, the concept of *landesque capital*,[24] wherein labour inputs are focused on agricultural infrastructure (i.e. construction of terraces and irrigation channels), with the goal of making permanent modifications that will provide a long-term increase in production, while requiring minimal maintenance. *Landesque capital* also creates artificial microecosystems that are more efficient and suitable for longer and sustainable production.[25]

Intensification then cannot be viewed through a single lens: its multidimensional character should serve to distinguish it from simple expansion or increase, and innovation.[26] In the archaeological concept of intensification, time is an inherent part of the process. Agricultural practices happen in a precise cycle within a given time-span. Thus, archaeologists can look at the long-term trends in strategies of intensification and view it as a process rather than as a series of single events. This implies multiple paths to intensification rather than a single route from long to short fallows.[27]

The three perspectives discussed in this section point to labour as the major variable in agricultural intensification. As Vernon Scarborough noted, agricultural labour organisation probably led to greater social complexity.[28] Labour is difficult to archaeologically quantify compared with other aspects of technology, however. One way to shed some light on the historical role and impact of agricultural labour is the use of contemporary observations and landscape analysis and to compare them with archaeological information, given the antiquity of the terraces.

Water management systems and managerial requirements

The relationship between complex irrigation systems and social complexity has generated models of how anthropologists represent long-term culture change. Indeed, when Karl Wittfogel proposed the idea of 'hydraulic civilisation',[29] anthropologists were quick to apply his perspective to socio-organisational change, both in ancient and contemporary societies, but soon discovered that complex hydraulic systems do not necessarily lead to social complexity. Anthropologists generally agree that water systems of a certain scale entail some form of management, although the degree of organisational complexity varies.[30] The prevention of conflicts and disruption of

23 Morrison, 'The intensification of production', p. 115.

24 Piers Blaikie and Harold Brookfield, *Land degradation and society* (London: Methuen, 1987).

25 Kirch, 'Agricultural intensification', p. 194.

26 Morrison, 'The intensification of production', p. 114; Harold Brookfield, 'Intensification revisited', *Pacific Viewpoint*, 25, 1 (1984): 15–44.

27 Morrison, 'The intensification of production', p. 115.

28 Vernon Scarborough, *The flow of power: Ancient water systems and landscapes* (Santa Fe: School of American Research, 2003).

29 Karl Wittfogel, 'Developmental aspects of hydraulic societies', in *Irrigation civilizations: A comparative study*, ed. Julian Steward (Washington, DC: Pan American Union, Social Science Monograph, 1955), pp. 43–53.

30 See Stephen Lansing, 'Complex adaptive systems', *Annual Review of Anthropology*, 32 (2003): 183–204; Clark Erickson, 'The social organization of pre-Hispanic raised field agriculture in the Lake Titicaca Basin', in *Economic aspects of water management in the pre-Hispanic New World, Research in Economic*

societal dynamics is probably the most important task of water system organisation, but the degree of organisational complexity will determine how conflicts are resolved.

Water management systems develop from the interplay between the physical and cultural environments and emphasise cooperation. These result in the equitable sharing of water through a consensus often sanctioned by formality and law. As in religious systems, the more flexible and encompassing the rules of access and usage, the more lasting and resilient the water management system.[31] Stated differently, the systems with the best chance of uninterrupted longevity have slowly evolved on highly variable landscapes from which people make a living. Even under appreciable stress, water management systems tend to persevere because of their adaptability and dynamism. This dynamism can be seen in materially visible changes in settlement patterns and landscape transformation in the archaeological record over time.

Distribution of rice terraces in the North Central Cordillera of Luzon

This section presents results of the Ifugao Geographic Information System (GIS) project, and reports the author's previous research.[32] It also illustrates the distribution of agricultural fields across the Ifugao landscape. A specific rice terrace or swidden field's location depends on ecological, social and cultural factors, including the knowledge of how these elements are interrelated and effectively utilised.[33] Present-day Ifugao terrace systems are a manifestation of these interrelated factors. They are also linked to land-use categories recognised by the Ifugao (Table 1).

As mentioned, the Ifugao environment is generally considered marginal for intensive wet-rice systems. The region is located in the interior of the Cordillera mountain range, with a rugged topography. The average slope where irrigated pondfields are located is 18°.[34] In contrast to lowland intensive systems located on gentler gradients, it is apparent that in Ifugao, wet-rice cultivation requires a high investment in energy and environmental modification.

Rice agricultural land use and the environment

The value of permanent agricultural property among the Ifugao, with rice fields as a primary example, rests on several factors other than the size or land area of the field.[35] These factors include: water sources; water loss (due to seepage, earthworms); distance from residence; immediate surroundings; shape of valley (e.g. deep concave); shape of bench-terraced surface; conditions of embankment (walling); quality of soil; type of fill; and protection from floods and avalanches.[36] Assuming that ethnographic models are a starting point for understanding long-term development of agricultural strategies and landscape use, spatial and ethnographic analysis provides us with

Anthropology, ed. Vernon Scarborough and Barry Isaac (Greenwich, CT: JAI Press, 1993), pp. 369–426; compare with Allan Kolata, 'The agricultural foundations of the Tiwanaku State: A view from the heartland', *American Antiquity*, 51 (1986): 748–62.

31 Scarborough, *The flow of power*, p. 3.

32 Stephen Acabado, 'Land use and agricultural intensification: A GIS-based analysis of the Ifugao landscape, Ifugao, Philippines' (M.A. thesis, University of Hawai'i, Mānoa, 2003).

33 Conklin *et al.*, *Ethnographic atlas of the Ifugao*, p. 7.

34 Acabado, 'Land use and agricultural intensification', p. 56.

35 Conklin *et al.*, *Ethnographic atlas of the Ifugao*, p. 32.

36 Ibid.

Table 1: Land use categories of the Ifugao

Local term	Land usage	Description
Mapulun	Grassland	Exposed ridge and slopeland; 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.
'Inalāhan	Forest	Slopeland; undisturbed soil, naturally woody cover; public (for residents of same watershed region); unmanaged; source of firewood, forest products, game.
Mabilāu	Caneland	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.).
Muyong	Woodlot	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.
Hābal	Swidden	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.
Labāngan	House terrace	Levelled 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.
Na'īlid	Drained field	Levelled 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.
Payo	Pond-field	Levelled, terraced farm land, 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.

Source: Adapted from Harold C. Conklin, Pugguwon Lupaih, Miklos Pinther, and American Geographical Society of New York, *Ethnographic atlas of the Ifugao: A study of environment, culture and society in Northern Luzon* (London and New Haven: Yale University Press, 1980), pp. 7–8.

information on landscape transformation and subsequent production intensification in the region.

The GIS database developed in this investigation includes distance from water sources and hamlets. In addition, several environmental factors were analysed to describe the distribution of rice terraces. These include elevation, slope and aspect.

Linking environmental characteristics to the distribution of the terraced fields in the Cordillera provides insights on optimal areas for agricultural production, based on the assumption that areas that were optimal for farming would have been the first to be exploited. Moreover, this section offers insights regarding factors that come into play in Ifugao decision-making about agricultural strategies.

For this research, Harold Conklin's[37] land-use maps of North Central Ifugao were digitised and incorporated in a GIS. Specific environmental parameters (elevation, slope, aspect, and distance to water and hamlet) were used to determine the range of environmental characteristics that the Ifugao use in deciding where to construct agricultural terraces. Table 2 summarises terrace feature for 13 agricultural districts (see also Figure 3).

It is apparent that environmental parameters play a significant part in the Ifugao's choice of terrain to be cultivated. Statistical analyses[38] suggest that the environment directly influences the size of each individual rice terrace in Ifugao (*P* value[39]). However, the strength of the relationship (coefficient of determination or *R*-squared[40]) is not strong enough, suggesting that there are other aspects acting on the distribution (Table 3).[41] These aspects include social and cultural factors that are not readily available on two-dimensional land-use maps.

Through the course of the author's fieldwork in Ifugao, the research informants mentioned availability of labour sources, proximity to kin hamlets (which is directly related to the former), and stories of ancestral and other spirits in the area (which would require special rituals to appease the spirits and, thus, would be more expensive) as examples of social and cultural considerations in selecting a field for terrace construction. The author, while understanding that these are present-day decisions, finds these useful for this study, with the assumption that ethnographic data inform the past.

Distribution of rice terraces

The average elevation of the rice fields or terraces in North Central Ifugao is 1,049 metres above sea level. However, the frequency distribution of the elevation of the rice fields was between 720–1515 metres above sea level, with 860 metres

37 Harold Conklin, *Land use in North Central Ifugao,* A set of eight large-scale (1: 5,000) sheet maps (New York: American Geographical Society, 1972).

38 Simple regression analysis was used to measure the effects of ecological parameters on the distribution and/or sizes of individual agricultural plots.

39 *P* value refers to the probability that the results of the sample being tested were arrived at by chance. In this study the *P* value is placed at 0.05.

40 *R*-squared refers to the coefficient of determination, a descriptive measure between 0 and 1 indicating the strength of relationship between variables (the higher the number is, the stronger the relationship).

41 Stephen Acabado, 'The archaeology of Ifugao agricultural terraces: Antiquity and social organisation' (Ph.D. diss, University of Hawai'i, 2010).

Table 2: Summary of terrace features from individual agricultural districts

Agricultural district	Agricultural district land area (m^2)	Rice terrace total area (m^2)	Average rice terrace area (m^2)	Rice terrace average elevation (m)	Rice terrace average slope (°)	Rice terrace modal aspect	Rice terrace average distance to hamlets (m)	Rice terrace average distance to water source (m)
Amganad	1,396,391.84	451,891.40	545.76	1087.26	9.1	East	99.4	80.71
Bannawol	14,740,766.56	1,920,254	240.24	1190.94	22.39	Southeast	161.1	61.97
Bayninan	3,148,382.44	281,382	305.85	965.37	15.84	Southeast	215.69	112.52
Hengyon	3,946,415.27	931,944.44	361.49	915.75	15.26	Southeast	174.72	112.1
Kababuyan	9,236,065.89	2,135,471.48	308.23	1051.62	16.36	Southeast	146.81	91.83
Kinnakin	10,517,644.28	80,266	255.92	1018.47	20.27	Southeast	231.09	80.64
Lugu	1,318,099.38	339,176.80	454.66	1176.68	14.13	East	114.01	76.53
Nabyun	1,243,466.56	129,308.60	278.08	957.58	19.58	East	118.48	55.4
Nunggawa	1,097,366.80	400,726.30	453.31	880.88	13.46	Southeast	173.47	49.29
Ogwag	4,381,036.86	406,547.50	321.63	834.41	14.48	Southeast	219.63	43.81
Pugo	1,859,161.52	497,748.50	437.77	1098.08	16.28	East	165.97	62.99
Puitan	4,512,982.28	1,084,772.50	266.006	959.31	18.79	Southeast	181.39	69.09
Tam'an	1,449,110.59	248,394.80	286.42	1050.12	20.46	Southeast	222.26	45.91
All terraces	58,846,890.27	9622384	302.5431	1049.23	17.93	Southeast	163.01	62.07

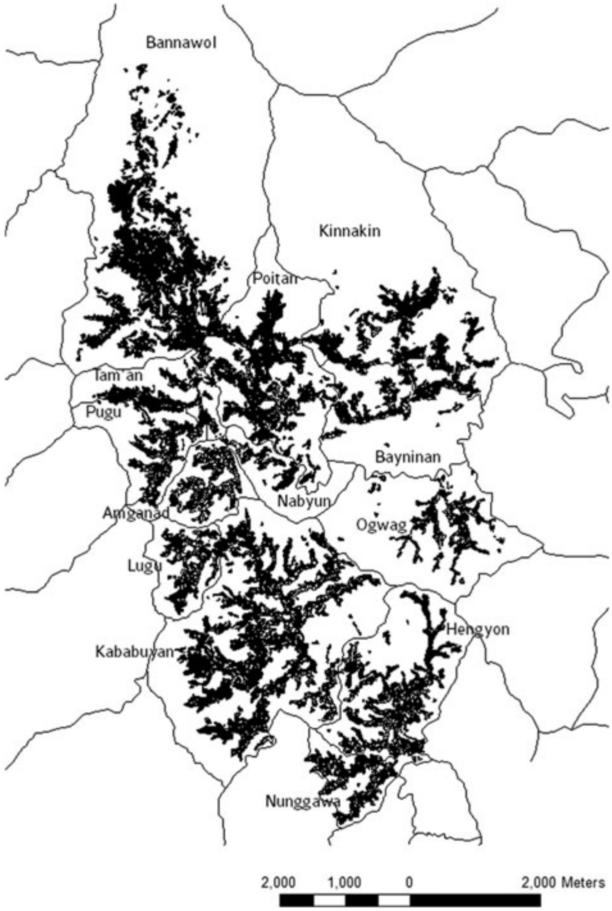

Figure 3. Distribution of rice terraces and swidden fields across the 13 agricultural districts of North Central Cordillera

above sea level as the mode. Conklin *et al.* list the highest terraces as being 1600 metres above sea level.[42] Table 4 illustrates an inverse relationship between the sizes of individual terraces relative to elevation for most of the agricultural districts investigated. However, linear regression results indicate that elevation hardly affects the distribution of the terraces.

A strong relationship exists between terrace size and topographic slope. Terraces in larger agricultural districts are influenced by slope. As expected, there is an inverse relationship between the amounts of land used for rice agriculture and the slope of the topography. The average slope of the rice fields was 17.9°, while most of the fields were on slopes of between 11.59° to 25.11° (see Figure 4). To sum up, slope does not appear to be a determining factor of intensified rice production. Although it may have influenced land usage, other factors might have had stronger effects on the amount of land converted to rice agriculture.

42 Conklin *et al.*, *Ethnographic atlas of the Ifugao*, pp. 4–5.

Table 3: Correlation matrix between land area of individual rice terrace and elevation, slope, aspect, distance to hamlets, and distance to water source in each agricultural district

	Correlation					
Agricultural district	Elevation	Slope	Aspect	Distance to hamlets	Distance to water	Observations
Amganad	0.009	–0.13578	0.002344	0.028295	–0.0633	828
Bannawol	–0.015	–0.10946	0.0136	–0.01762	0.051286	7993
Bayninan	–0.049	–0.222	0.018	0.00498	–0.03614	920
Hengyon	–0.20	–0.178	–0.006	–0.15449	0.01696	2578
Kababuyan	–0.17	–0.144	0.03	–0.09014	0.00646	6928
Kinnakin	0.07	–0.14	0.03	–0.04284	–0.03645	3127
Lugu	–0.017	–0.206	0.001	–0.03729	–0.01072	746
Nabyun	0.177	–0.269	–0.006	–0.11946	0.133212	465
Nunggawa	0.009	–0.073	–0.047	–0.06043	0.036331	884
Ogwag	–0.097	–0.213	–0.012	–0.12612	0.138637	1264
Puitan	0.005	–0.140	–0.006	–0.07701	0.110398	4078
Pugo	0.006	–0.153	0.017	–0.05654	0.039211	1137
Tam'an	0.037	–0.063	0.096	0.032305	0.041189	867

Table 4: Results of linear regressions between size of individual rice terrace and elevation

District	Correlation	Correlation coefficient (R-squared)	Elevation coefficient	P value	n
All terraces	−0.063052965	0.003976	−0.22711	2.1735E-29	31804
Amganad	0.009953	9.91E-05	0.318612	0.774899	828
Bannawol	−0.01525	0.000233	−0.04318	0.172738	7993
Bayninan	−0.04908	0.002409	−0.49334	0.136866	920
Hengyon	−0.20074	0.040298	−1.95934	7.61E-25	2578
Kababuyan	−0.17144	0.029391	−1.15567	7.59E-47	6928
Kinnakin	0.072241	0.005219	0.211505	5.27E-05	3128
Lugu	−0.01779	0.000317	−0.35595	0.627502	746
Nabyun	0.177481	0.031499	1.864391	0.000119	465
Nunggawa	0.009777	9.56E-05	0.276106	0.771587	884
Ogwag	−0.09743	0.009492	−0.88732	0.000523	1264
Poitan	0.005372	2.89E-05	0.027069	0.731633	4078
Pugu	0.006484	4.2E-05	0.096899	0.827107	1137
Tam'an	0.037097	0.001376	0.25883	0.275225	867

Most of the rice fields in this study are facing the east, the southeast, and south (see Figure 5). The direction of the rice fields is consistent with Conklin's findings that the south- and east-facing slopes are greener than other directions. North- and northwest-facing terraces are minimal, probably due to the relatively small amount of sunlight received in these locations.

Nearly 75 per cent of the terraced rice fields are within 125 metres of a water source (irrigation channel) (see Figure 6). It is interesting to note that in seven

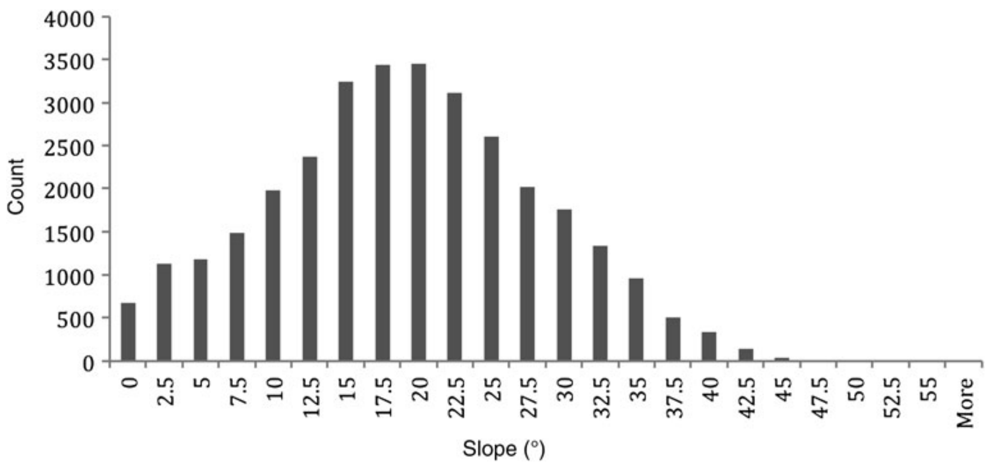

Figure 4. Frequency distribution of the average slope of rice fields (y values = number of terraced rice fields)

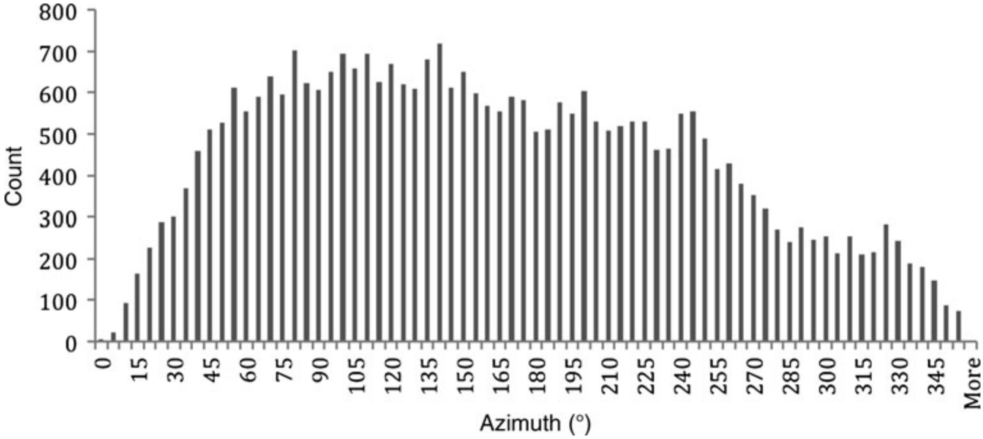

Figure 5. Frequency distribution of the aspect of terraced rice fields

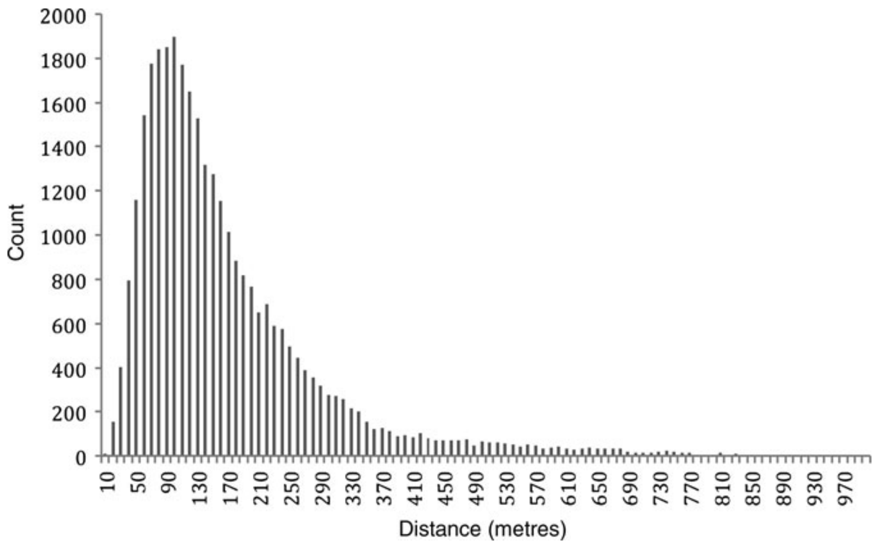

Figure 6. Frequency distribution of the minimum distance of rice fields from villages (y values = number of terraced rice fields)

agricultural districts there is no statistically significant relationship between the amount of land used for rice agriculture and the proximity to drainage. This might mean that these areas have springs or are rain-fed.

The distribution of terraces in relation to their proximity to hamlets is not very strong. Only 30 per cent of the terraces are located within 110 metres of the nearest hamlet (see Figure 6). The rest of the distribution (70 per cent) is located between 111 metres and 985 metres. Conklin listed the proximity to hamlets as an important factor for assessing the value of agricultural land. The results of the regression analysis of land used for rice agriculture and the minimum distance of the fields from hamlets suggest the same pattern, although 5 of the 13 agricultural districts showed a statistically insignificant relationship. This exception (rice-fields and distance to hamlet relationship) might be a function of the size of the agricultural district and the concentration of hamlets (as in the case of Hengyon and Kababuyan).

Swidden fields

Shifting cultivation has been an integral part of upland lifeways in Southeast Asia as well as an important means of subsistence. Although it has many forms,[43] burning seems to be one of its unifying and indispensable aspects. Shifting cultivation is characterised by a rotation of fields between short periods of cropping (generally, one to three years) and longer periods of fallow, some lasting up to 20 or more years.[44]

Shifting cultivation is also referred to as swiddening, a term that I will also use.[45] In popular literature, it is also referred to by the derogatory term ‘slash-and-burn’, which along with shifting cultivation, is reserved to describe tropical subsistence systems practised by ‘preliterate’ peoples. Peoples who engage in this type of farming are not primitive either in a technological or cultural sense,[46] nor is its geographic distribution historically limited to the tropics.

Harold Conklin pointed out that previous definitions of swiddening frequently and inaccurately implied an aimless, unplanned, nomadic movement or an abrupt change in location, either of which may refer to the cropping area, to the cultivator, or both. Conklin’s study among the Hanunóo Mangyan of Mindoro in the Philippines showed that swidden systems are not primitive, but are sustainable forms of agriculture — and more environmentally friendly than most intensive forms of farming.[47] He categorised two types of swiddening: partial and integral systems of cultivation. The former refers to those farmers who practise swidden cultivation for a purely economic end, while the latter describes those whose culture is strongly tied in with cultivation (religion, rituals and community dynamics are associated with the subsistence strategy). He also pointed out that partial systems are not environmentally viable due to the lack of social structures and cultural institutions to support the system. Partial systems are also referred to as incipient swiddening,[48] where the swiddener does not

43 Lori Thrupp *et al.*, *The diversity and dynamics of shifting cultivation: Myths, realities, and policy implications* (Washington, DC: World Resources Institute, 1997); J. Spencer, *Shifting cultivation in Southeastern Asia* (Berkeley: University of California Press, 1966); Harold Conklin, ‘An ethnoecological approach to the study of shifting agriculture’, *Transactions of the New York Academy of Sciences*, 2nd series, 17 (1954): 133–42.

44 Raymond Watters, ‘The nature of shifting cultivation: A review of recent research’, *Pacific Viewpoint*, 1, 1 (Mar. 1960): 59–99; Harold Conklin, *Hanunóo agriculture: A report on an integral system of shifting cultivation in the Philippines* (Rome: FAO, 1957).

45 Swiddening is an Old English term that means ‘burned clearing’. Eilert Ekwall, ‘“Slash-and-burn” cultivation: Contribution to anthropological terminology’, *Man* 55 (1955): 135–36; Karl Izikowitz, *Lamet: Hill peasants in French Indochina*, Etnologiska Studier 17, Göteborg: Etnografika Museet, 1951; Conklin, *Hanunóo agriculture*.

46 William Peters and Leon Neuenschwander, *Slash and burn: Farming in the Third World forest* (Moscow, ID: University of Idaho Press, 1988).

47 Conklin, *Hanunóo agriculture*.

48 Ibid., p. 3; Katherine Warner, ‘Local technical knowledge and natural resources management in the humid tropics’, *Community Forestry Note* 8 (Rome: FAO, 1991).

have (in most cases) the appropriate ecological knowledge to develop a sustainable system. This typology of swidden systems is insightful because of the general perception that swidden cultivators are to be blamed for forest degradation and deforestation. A better understanding of swiddening forms attributes deforestation to partial systems of shifting cultivation, rather than the whole system.

Clifford Geertz echoed Conklin's assertion that integral systems are sustainable. In his study of subsistence change in Java, he stated that, in ecological terms, the most distinctive positive characteristic of swidden agriculture, and the characteristic most in contrast with wet-rice agriculture, is that it is integrated into, and when genuinely adaptive, maintains the general structure of the pre-existing natural ecosystems into which it is projected.[49]

Ifugao swidden fields and the environment

In Ifugao society, rice, grown on terraces, is both economically and ritually valued over the other more abundant source of carbohydrates in their diet, sweet potatoes. The Ifugao prefer to eat rice than sweet potatoes. In fact, the amount of paddy landholdings is one of the bases for an individual's social standing (wealth). Both Harold Conklin and Peter Brosius observed that sweet potatoes grown in swidden fields provided more than half of the starch requirements of the Ifugao during the period of their respective studies (between 1960 and 1980).[50] 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 Ifugao reserved their more productive/irrigable agricultural lands for rice production).

The Ifugao practise a form of complementary swidden farming. All districts have access to swidden land, but no district relies solely on swidden cultivation. Burned clearings on hillsides, too steep or unsuited for irrigated terracing, are cropped for about three years and then fallowed for two or three times that period.[51] Similar to statistical tests I ran with the distribution of rice terraces, this section also tested the amount of land used for swidden cultivation against the same environmental parameters used to analyse rice fields.

Statistical analysis of environmental parameters suggests that Ifugao farmers are able to cultivate most marginal areas for dry-crop production. Compared with rice fields, swidden plots are located in less productive areas. This distribution, however, does not mean that swidden fields offer lower yields than rice fields. The summary of descriptive statistics of swidden fields is presented in Table 5.

Ethnographic information suggests that swidden fields are located at higher elevations than rice fields. As expected, there is a significant correlation (inverse) between elevation and the amount of land used for swidden fields (Table 6). The average elevation of the swidden fields in the study area was placed at 1,124 metres above

49 Clifford Geertz, *Agricultural involution: The process of agricultural change in Indonesia* (Berkeley: University of California Press, 1963).

50 Conklin, *et al.*, *Ethnographic atlas of the Ifugao*; Harold Conklin, 'Some aspects of ethnographic research in Ifugao', *Transactions of the New York Academy of Sciences*, series 2, 30, 1 (1967): 99–121; J. Peter Brosius, 'Significance and social being in Ifugao agricultural production', *Ethnology*, 27, 1 (1988): 97–110.

51 Conklin *et al.*, *Ethnographic atlas of the Ifugao*, p. 24.

Table 5: Summary of swidden field features from individual agricultural districts

District	District land area (m^2)	Total land area (m^2) (swidden)	Average land area (m^2) (swidden)	Average elevation (m above sea level) (swidden)	Average slope (swidden)	Modal aspect (swidden)	Average distance to hamlet (m)	Average distance to water (m)
Amganad	1,396,391.84	2654.38	1522.28	1124.83	28.84	Southeast	257.348	30.442
Bannawol	14,740,766.56	524144.6	2104.99	1317.69	29.754	Southeast	254.291	51.038
Bayninan	3,148,382.44	174473.9	2957.18	969.13	24.86	Southeast	372.881	155.526
Hengyon	3,946,415.27	249540.1	3465.83	993.84	30.07	South	292.379	117.886
Kababuyan	9,236,065.89	17528.2	2655.51	1141.44	27.57	East	261.654	70.475
Kinnakin	10,517,644.28	554276.6	5381.32	1064.22	32.52	South	249.816	69.047
Lugu	1,318,099.38	22192.8	1387.05	1177.2	21.09	South	152.045	57.091
Nabyun	1,243,466.56	75056.7	3752.83	976.51	25.38	Southeast	137.321	66.744
Nunggawa	1,097,366.80	19797.02	2199.66	947.45	23.82	East	277.880	72.582
Ogwag	4,381,036.86	319764.18	4503.72	930.95	28.89	East	508.787	50.638
Poitan	1,859,161.52	360002.72	3564.38	1042.61	29.5	South	222.616	80.158
Pugu	4,512,982.28	54242.01	3190.7	1228.05	29.4	Northeast	308.117	34.295
Taman	1,449,110.59	98893.14	2472.32	1159.18	30.23	Southeast	281.737	44.003

Table 6: Results of linear regression between size of individual swidden field and elevation

District	Correlation	Correlation coefficient (R-squared)	Elevation coefficient	P value	n
Amganad	0.468983	0.219945	5.045367	0.288417	7
Bannawol	0.037481	0.001405	1.218041	0.556087	249
Bayninan	−0.33779	0.114102	−16.8973	0.008884	59
Hengyon	0.254787	0.064917	50.9438	0.030781	72
Kababuyan	0.204918	0.041991	4.813197	0.024759	120
Kinnakin	0.191788	0.036783	17.55174	0.05229	103
Lugu	−0.55655	0.309744	−9.03653	0.025151	16
Nabyun	−0.04847	0.00235	−2.56657	0.839185	20
Nunggawa	0.759376	0.576652	27.38535	0.01762	9
Ogwag	0.109374	0.011963	8.197389	0.363892	71
Poitan	0.206665	0.042711	9.087778	0.038121	101
Pugu	0.739497	0.546856	107.1025	0.000692	17
Tam'an	0.301636	0.090985	9.803681	0.058552	40
All swidden fields	−0.02018	0.000407	−0.71892	0.546693	894

sea level — about 75 metres higher on average than rice fields. The distribution of the swidden fields across elevations was also uneven.

Relationship between the distribution of swidden fields and agricultural terraces

Recently, the evolutionary relationship between intensive and extensive cultivation systems has been questioned in light of ethnographic information that illustrates the importance of swiddening to highland populations. Similarly, this investigation supports the contention that intensive and extensive systems have complementary relationships rather than an evolutionary one. Furthermore, I argue that the presence of swidden fields among intensive cultivators is a risk-minimising strategy.

The prevalence of agroecosystems among upland Southeast Asian populations supports a different view of intensification. For instance, in the northwestern highlands of Vietnam, there are subsistence patterns that are similar to Ifugao strategies.[52] This suggests that the complementarity of swiddening, household gardening, animal husbandry and an intensive paddy rice system serves to buttress the seasonality of cropping as well as any climatic fluctuations that might affect annual growing cycles.

Among the Ifugao, this risk minimisation is supported by the distribution of swidden fields across the landscape. Of the swidden agricultural districts investigated, 13 show a significant distribution *vis-à-vis* the rice-growing area. Swidden fields are statistically in close proximity to rice fields but on steeper slopes and somewhat further away from hamlets.

52 Rambo, 'The composite swiddening agroecosystem of the Tay ethnic minority'.

The Ifugao agricultural system adds to the increasing data that refute an exclusively evolutionary relationship between swiddening (long-fallow) and intensive forms of production. The extant models under-represent the complementarity of upland tropical agrarian systems with intensive rice agriculture. As this study shows, the Ifugao (at least in Banaue) practise annual wet-rice cropping that involves short-fallow (4–6 months) and a single harvest per year. Given that the harvest is not sufficient to supply the carbohydrate needs of the population, this supports the observation that rice cultivated in irrigated terraces is more of a prestige good.

With regard to labour requirements, Conklin calculated that one hectare of highland pond-field surface area requires a minimum of 630 days of farm labour per year.[53] Direct swidden work requires 250 days of agricultural labour per hectare per year, and maintaining a hectare of woodlot requires an average of about 20 human-labour-hours a year. Although production estimates for swidden fields are non-existent, calculations on work hours provide an impression that this farming system supplies substantial subsistence resources for the Ifugao. Upland populations are able to farm both paddy and swidden fields because of the seasonality of labour demands (cropping cycles), and thus each system complements the other.

Summary: The Ifugao agricultural system

The topographic locations of terraced rice fields and swidden fields in the North Central Cordillera suggest that the two subsistence patterns are interrelated. Although wet-terraced fields are clustered along relatively gentler slopes and swidden fields are scattered on higher elevations and steeper gradients, production requirements, consumption needs and social factors (i.e. status and prestige) provide evidence of the complementarity of the two subsistence patterns. Thus, landscape as well as ethnographic information obtained for this study underscores the interrelatedness of the two production strategies in a single integrated system.

The primary goal of this article is determining the relationships between land use and environmental and social factors. Within intensification debates and Brookfield's definition of the intensification of production,[54] the landscape of the Ifugao can be categorised as marginal for full-scale agricultural production and especially marginal for wet-rice cultivation. Thus, tests used in this study provide empirical information on the energy needed for rice terracing in Ifugao (i.e. slope, distance to water source and hamlets) to support the concept of intensification through *landesque capital*.[55] There is a need to look at both ecological and social factors that might explain the Ifugao choice to engage in wet-rice cultivation, despite the unsuitability of the environment to such farming. The significance of multiple strategies that include swidden production bridges the instability presented by the terrain in intensive systems.

Slope was found to be a factor in determining types of land use, which is consistent with Conklin's findings regarding the effects of slope on rice terracing and swidden cultivation. Correlation and regression analyses values are statistically significant

53 Conklin *et al.*, *Ethnographic atlas of the Ifugao*, p. 37.

54 Brookfield, 'Intensification and disintensification in Pacific agriculture', pp. 43–4.

55 Blaikie and Brookfield, *Land degradation and society*.

and demonstrated that slope had the strongest effect on the amounts of land used for the types of studied features: terraced rice and swidden fields. Additionally, the results reveal a high correlation between the amounts of land devoted to farming and the size of villages such that the percentage of land used for rice agriculture and swidden cultivation seemed to be a function of population size. This relationship between larger agricultural districts and the amounts of land used for plant production can be viewed as an 'incentive factor' because the environment approaches optimality with more sources of water and land area available for cultivation, i.e. larger basins can attract and sustain larger populations.

The distribution of swidden fields was also affected by topographic factors examined in this study. This difference might be caused by the different types of technology employed by farmers using these types of plant cultivation. With rice agriculture, the intensive nature of production requires people to drastically modify their environment and thus offset the effects of marginal lands. In doing so, they are able to remain on particular land sites and do not need to continually move to less favourable fields. Swidden cultivation, however, represents agricultural extensification such that people cultivate a particular land area for only three years before moving to cultivate another area while allowing the original land area to remain fallow for six years before returning to it.[56] Thus, these different practices help to explain the location of swidden fields on relatively steeper slopes and more marginal lands.

Ethnographic information corroborates the results of the GIS analysis carried out in this study. Moreover, these datasets suggest the following patterns: (a) a diversified system usually uses both paddy and swidden; (b) the Ifugao started with paddy and then added swidden; and (c) Ifugao who do not have paddy fields use swidden. These features of Ifugao agroecology imply risk minimisation that combines two subsistence patterns. The interrelatedness of the strategies employed by the Ifugao (and other upland populations in Southeast Asia) challenges the unilineal model of agricultural intensification progressing from swidden to wetfield agriculture.

Although the model presented has produced statistically significant numbers in the regional analyses, this study focused explicitly on environmental–deterministic factors. The coefficients of determination reflect that less than half of the processes that have affected land usage in North Central Ifugao have been explained by these factors. Social aspects of intensification as well as of land use, as proposed by Harold Brookfield,[57] Barbara Bender[58] and Bennet Bronson,[59] might be among the other factors that played significant roles in the processes in Ifugao.

Foremost of these social factors is the status of rice as a symbol of wealth. As mentioned, rice-landholdings traditionally measure a person's wealth in Ifugao. As such, this aspect of Ifugao culture could be driving production intensification and

56 Conklin *et al.*, *Ethnographic atlas of the Ifugao*.

57 Brookfield, 'Intensification and disintensification in Pacific agriculture'; Brookfield, 'Intensification revisited'.

58 Barbara Bender, 'Gatherer–hunter to farmer: A social perspective', *World Archaeology*, 10, 2 (1978): 204–22.

59 Bennet Bronson, 'The earliest farming: Demography as cause and consequence', in *Population, ecology, and social evolution*, ed. Stephen Polgar (The Hague: Mouton, 1975), pp. 53–78.

expansion of terraced rice fields. Ethnographically, this is quantifiable, but it is impossible to investigate archaeologically.

In terms of ecological concerns, the apparent unpredictability of the terrain in terms of agricultural production in Ifugao leads to the importance of the commons (public woodlots available for swiddening). Although swidden fields become semi-private property because of the energy investment of the person/family who has cleared the area, common property serves as a buffer to the variability and limited access to rice fields. Furthermore, conversion to a permanent private landholding (rice field) is too expensive for an individual/family. Ifugao custom demands a series of rituals and feasts before a person of lower status can claim a plot of land. Thus, social norms restrict the conversion of common property to private landholding. Ethnographic information and agricultural practices also corroborate this assertion. Since the area cultivates a single-harvest-per-year rice variety, paddy landholdings and eating rice on a regular basis become status symbols. The more substantial produce from swidden fields, such as sweet potatoes, is considered common food, devoid of prestige.

Thus, identifying the social factors ethnographically would allow us to better understand subsistence strategies. Combining these datasets with ecological and archaeological components would provide a stronger comprehension of agricultural complexes. Such integration would allow us to reposition subsistence strategies away from unilineal and ambiguous concepts.

This investigation of Ifugao subsistence strategy provides an added dimension to debates about agrarian change. Although this is not a new perspective, empirical data obtained from the Ifugao landscape and ethnographic interviews further illustrate the limitation of unidirectional models for understanding complex and complementary systems.