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# Towards a Practical Classification of Slash-and-Burn Agricultural Systems

*Sam Fujisaka and German Escobar*

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## Summary

Slash-and-burn agricultural systems have received a great deal of attention due to their observed or hypothesised role in tropical deforestation, biodiversity loss, and global warming. These agricultural systems are varied and their diversity has led to confusion in making cross-site comparisons. We reviewed 103 publications describing 136 cases in order to develop a scheme to classify slash-and-burn systems. Four variables – initial vegetative cover, type of user, final cover, and fallow length – were used to describe each case. Based on these descriptors, nine groups representing the same or similar combinations of values were identified. The method provides a way to establish similarities or differences among slash-and-burn cases (or representativeness of cases) to the extent that the available literature accurately represents what exists in the field. Researchers are invited to provide descriptors of additional cases, respective references, and case locations in order to improve and test the utility of the method and to simultaneously expand the resulting database.

## Introduction

Since 1992 the International Centre for Research on Agroforestry (ICRAF) has coordinated a global project seeking to develop technical and policy 'Alternatives to Slash-and-Burn' (ASB), where slash-and-burn is taken to include shifting cultivation and swidden agriculture. Studies conducted in Cameroon, Brazil, and Indonesia have addressed issues of tropical deforestation, biodiversity loss, global

[1]This paper is based on Fujisaka, S, Hurtado, L & Uribe, R (1996), 'A Working Classification of Slash-and-Burn Agricultural Systems', *Agroforestry Systems* (34) 151-169. The earlier paper includes references for the publications reviewed, tables grouping each of the 136 cases, and maps showing case locations.

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warming, forest conversion to other uses such as pasture, agricultural productivity and sustainability, and the fate of indigenous forest users (ASB, 1994). This research has led to questions regarding the representativeness and comparability of sites located in Africa, Asia, and Latin America. Important questions include: the extent to which slash-and-burn agriculture represents a conversion of primary forest as opposed to re-cultivation of secondary forest; whether farmers are members of traditional groups with stocks of adaptive indigenous knowledge or colonists with limited local agroecological knowledge; whether lands are left to fallow after slash-and-burn cultivation or are converted to uses such as pasture or plantations; whether fallows are relatively long, as reported for many traditional groups, or short, as is reported for most current practitioners; and the extent to which the different groups studied are integrated into the national cash economy.

Several classificatory systems have been proposed in the past. These can be described as:

- simple contrasts between culturally 'traditional' or 'integral', versus 'non-integral', 'new', or 'partial' systems (Conklin, 1954; Spencer, 1966; Watters, 1971);
- similarly simple typologies based on one or more usually biophysical factors, e.g. durations of cultivation and fallow (Kundstadter and Chapman, 1978); fallow length (Ruthenberg, 1980); migratory versus sedentary shifting cultivation patterns (Majid, 1983); and impacts on vegetation (Boerboom and Wiersum, 1983);
- several-stage evolutionary analyses and typologies (Grandstaff, 1978; Greenland, 1974; Margolis, 1977; Norgaard, 1981); and
- descriptions of the diversity of systems within particular localities or regions (ASB, 1994; Kartawinata *et al*, 1984; Miracle, 1967; Stocks, 1983).

Closely related to these classificatory schemes are lists of variables according to which slash-and-burn systems can be characterised. Conklin (1954), for example, suggested using principle crops, crop associations and successions, crop-fallow time ratios, livestock, tools and techniques, vegetative cover of cleared land, and climatic and edaphic conditions. More than 30 years later, Hecht *et al* (1995) suggested a similar list which included crop-fallow time ratios, cropping systems, clearance systems, level of technology, and the allocation and organisation of labour.

These approaches are useful in identifying factors which serve to describe slash-and-burn systems. Attempting to apply the criteria in order to classify systems, however, results largely in either manageable but limited, purpose-specific classifications based on one or two factors (e.g. identification of four types based on crop-fallow time ratios in order to analyse differences in biomass regeneration and soil nutrient dynamics), or hypothesized systems which consider a range of variables, which while important soon become too unwieldy to apply in the sense of distinguishing among and then grouping cases.

A simple working system to classify and then to broadly contrast and compare different forms of shifting cultivation is needed. The desired method should be neither unidimensional or purpose-specific nor consist simply of a long list of attributes. This paper therefore proposes an (admittedly *ad hoc*) method for classification and comparison based on four variables relevant to contemporary slash-and-burn systems. The choice of these variables is discussed in the following section. The system is intended to allow for the easy classification of additional cases into a not overly-complex typology or set of classes. Each case was coded and classified; and with associated maps locating each case, a simple but global database on slash-and-burn agriculture is provided.

# Methods

A review of 103 publications dealing with 136 cases of slash-and-burn agricultural systems was carried out in order to identify common variables which could be used to differentiate between such systems. An attempt was made to characterise each case by a range of variables and then to use cluster analysis to identify appropriate common variables. The attempt failed because of the subjective judgements required to deal with the differences in scales of the reviewed cases and the different scope of variables emphasized by each. Instead, an alternative approach was taken which involved making an initial survey of variables that were implicitly or explicitly distinguished in the literature, and then discussing potential key variables with both biophysical and social science researchers working with slash-and-burn agriculture.

Many variables were considered (e.g. crops grown, soil types, length of time cultivated, system productivity, land availability). The goal, however, was to

identify a small number of variables which would provide a classificatory system which was at the same time simple and easy to apply, and which would result in a relatively small number of useful groupings (in spite of the great variation globally in slash-and-burn agricultural systems). Based on a consensus of what researchers thought would be important and useful, four variables were finally selected: (i) initial vegetative cover, (ii) type of resource users, (iii) type of 'final' vegetative cover remaining after users shifted to other parcels or converted the land to other uses, and (iv) fallow length (if lands were fallowed).

## Initial vegetative cover

The type of initial vegetative cover is an important factor because it has implications for debates about the impact of slash-and-burn practices on deforestation and biodiversity loss. Although slash-and-burn farmers have been popularly associated with the cutting and burning of primary forest, most slash-and-burn today takes place in secondary forest (and even in grasslands). Three main types of initial vegetative cover were identified:

- primary forest;
- secondary regrowth, bush fallow, degraded forest, and agroforests; and
- grasslands, pastures, and savannas.

## Resource users

Most 'traditional' slash-and-burn groups described in the reviewed literature are indigenous forest dwellers. The present study suggests classification of resource users into three broad types:

- indigenous communities;
- government organized colonists, including participants in *taungya* systems; and
- self-sponsored or 'spontaneous' settlers or ranchers.

Although groups of the latter may become more 'indigenous' in character over time, the proposed system would maintain the distinction between 'indigenous' and 'colonist' because, in most cases, the differences tend to persist and it is difficult to determine convergence. Hmong settlers in Karen areas in northern Thailand and the longer settled *caboclos* of the Amazon, for example, do adopt some of the practices of the indigenous groups, but display substantially different land use patterns and remain much more tied to their respective national economies and

societies.

## Final vegetative cover

Four main types of 'final' vegetative cover were identified:

- fallows and secondary regrowth;
- pastures;
- perennial crops and agroforests; and
- plantation crops and *taungya*.

The most common 'traditional' practice is to fallow and shift to new fields. Other groups (e.g. in Indonesia) establish tree crops which can be harvested after annual cropping has ceased. Conversion to pasture has been common in Latin America; while the planting of plantation crops such as oil palm, rubber, and citrus is found throughout the tropical forest regions.

## Fallow length

Overall, the reviewed literature provided less information about fallow lengths, which were described as:

- no fallow or a non-cyclical system;
- short (1-2 years);
- medium (3-8 years); and
- long (more than eight years).

## Grouping of cases

Each of the reviewed cases was evaluated on the basis of the data presented about the four selected variables in the respective publication, and then placed into a group with similar cases. In this way nine groups were identified (together with a tenth 'other' group to cater for all those cases for which insufficient information was available).

It was not possible to create 'neat and clean' groupings in terms of inclusiveness-exclusiveness due to choices made to increase usefulness and decrease the number of groupings. In six groups, all cases within each group were largely the same in terms of initial cover, user, and final cover. Three groupings,

on the other hand, were formed predominantly on the basis of final vegetative cover while initial cover and users varied. As a result, for example, although most cases in which land users who exploited both primary and secondary forest were placed in a single group, all cases in which forest was converted to pasture were grouped together – including a few in which both primary and secondary growth were so converted.

The proposed method also coded each case as if it were relatively homogeneous. In cases in which different systems were encountered, the dominant one was described.

# Results

The nine identified groups are described in this section, each under a separate heading. Comments about the method, implications for any particular research site, and a few conclusions are presented in the following section.

## Primary forest, indigenous users, secondary regrowth

Only two cases were encountered in which indigenous communities exploited primary forest and then left fields of secondary regrowth. Until the 1960s, the Bari Indians of western Venezuela cultivated cassava on lands cleared from primary forest and then left fields to naturally regenerate over long periods (Lizarralde, 1991). Traditional shifting cultivation in the dry zone of Sri Lanka also featured forest cutting by native groups, maize cultivation, and natural regeneration of 12-15 years (Agalawtte and Abeygunawardena, 1993). A search of early ethnographic studies would be expected to provide more cases in this group.

## Primary forest, settlers, natural regrowth

In only one case did settlers exploit primary forest, eventually moving on to new areas and abandoning the old fields to regenerate naturally. Although settlers taking part in Indonesia's transmigration projects were initially given five acres intended for permanent cultivation, many moved on to exploit primary forest – thus becoming a significant factor in deforestation (Mackerron and Cogan, 1993).

## Primary and secondary forest, indigenous users, natural regeneration

In 13 cases indigenous users cleared both primary forest and secondary regrowth, cultivated lands to annual crops, and left fields to regenerate naturally. Fallow lengths were medium to long-term. The cases encountered described native groups in Asia (Philippines, Thailand, Indonesia, Malaysia, Papua New Guinea), Africa (Ivory Coast, Zambia, Madagascar, Sierra Leone), and South America (Venezuela). This type differs from the first above in that users exploit secondary (in addition to primary) forest – a situation clearly more common today than use of primary forest only.

## Secondary forest, indigenous communities, natural regeneration

This group was the most extensively documented in the available literature with 46 cases (33%) in which indigenous communities in Africa, Asia, and the Americas cleared and cultivated secondary forests, then leaving their fields to regenerate naturally via fallows of medium to long duration (with only one exception). These are studies of what has been termed 'traditional' or 'integrated' shifting cultivation. They reflect the growing scarcity of primary forest and hence the increasing use of secondary forest even by indigenous groups. Examples range from the Kayapo Indians of the Brazilian Amazon (Posey, 1985) and Kwaiker Indians of the Pacific rainforests of Colombia and Ecuador (Ceron, 1987) to the Soli in central Zambia (Chidumayo, 1988), the *chitemene* system in northern Zambia (Araki, 1993), and various groups in northern Laos, the Philippines, India, Malaysia, and Papua New Guinea.

## Secondary forest, colonists, natural regeneration

This group consisted of three cases in which settlers cultivated secondary forest and then allowed lands to regenerate naturally with medium length fallows. Two cases described the practices of lowland settlers in the uplands of southern Laos (Chansina *et al*, 1991; Douangdara, 1991), while the third dealt with mestizo settlers in the Peruvian Amazon (Padoch and de Jong, 1987).

## Primary and secondary forest, mostly indigenous communities, conversion to agroforest

In 28 cases, forest users converted lands to agroforests. In 10 of these (Indonesia, the Philippines, Vietnam, Laos, Colombia, Brazil, Peru, and the Sudan) secondary

forests were converted to agroforests by indigenous communities. In another six cases, indigenous communities – mainly in the Amazon, but also in Java and Guinea – converted primary forest parcels to mixtures of perennial and annual crops, eventually leaving behind agroforests (which could possibly be classified as fallows as such lands can be re-cultivated with annual crops). In two cases, indigenous groups exploited both primary and secondary forest in their conversion of lands to agroforests. Settlers converted primary and secondary forests to agroforests in three cases, and converted only secondary forest in a fourth case. Unspecified users converted secondary forest to agroforests in four cases. This group may provide important insights for researchers attempting to understand how agroforestry and improved fallows can be introduced into slash-and-burn practices. Overall, '...this system produces fallow crops and products, while enhancing site nutrient recovery' (Unruh, 1988).

## Secondary forest, (government sponsored) colonists, conversion to plantation crops or *taungya*

Six cases represented government-organized settlements in which the 'final' cover was either *taungya* or plantation crops. An example is the government's 'forest village system' project in northern Thailand which is meant to sedentarise indigenous shifting cultivators via – among other innovations – establishment of plantations of teak, eucalyptus, *Melia azedarach*, and fruit trees such as *Parkia* spp and *Anacardium occidentale*. The system was assessed as potentially sustainable, but subject to problems of implementation (Boonkird *et al*, 1984). In an additional 'odd' case, indigenous farmers planted rubber after cultivating secondary forest lands and in response to a government project. Cases in which settlers in government-organised colonies converted lands to pasture, such as Pedro Peixoto and Theobroma (Brazil) (Fujisaka *et al*, 1996), were not included in this group.

## Secondary forest, (mostly) settlers and ranchers, conversion to pasture

Forest was converted to pasture in 10 cases. These included five cases in which settlers or ranchers converted primary forest to pastures; three cases of settlers converting both primary forest and secondary growth into pasture; one case of an indigenous community converting primary and secondary forest into pasture; and one case in which colonists converted secondary growth only to pasture. Settlers converting forests to pasture largely either continued to cultivate available primary

or secondary forest rather than returning to a fallowed plot, or made a complete transition from crop production to cattle ranching. In either case, they relied less than other groups on fallow regeneration for recultivation of the same lands. Almost all cases were encountered in the cattle producing areas of Central America (Nicaragua) and the Amazon Basin (Brazil, Colombia, Venezuela); and many other cases from Latin America can probably be added to this group.

## Grasslands, indigenous and settlers, natural regeneration and pastures

In 12 cases (of which six were in Papua New Guinea) users practised slash-and-burn agriculture in grasslands. In four cases the grasslands were fallowed after use. Four cases represented conversion to pasture, one conversion to agroforest, and one to plantation crops. Typically, in one of the traditional, indigenous systems, the Bine intensively cultivated *Imperata cylindrica* dominated savannas of lowland southwest Papua New Guinea, with taro (*Colocasia esculenta*) as the major crop. Fields lost productivity after a year of cultivation, weeds increased, and fields were left to *Imperata* fallows for 5-10 years (Eden, 1993). More cases from Indonesia and the Philippines might be included in this group in the future.

## Other

Fourteen cases (10%) provided incomplete information and could not be grouped. Six cases did not specify initial cover; and seven cases which specified indigenous users were otherwise too incomplete for grouping.

Each of the cases classified was placed on regional (Latin America, Africa, and Asia) and global maps using symbols keyed by shape and colour (these maps are available upon request).

| Group number | Distinguishing variables | | | | Total cases in group |
|---|---|---|---|---|---|
| | Initial vegetative cover | Resource users | Final vegetative cover | Length of fallow | |
| 1 | primary forest | indigenous users | secondary regrowth | long | 2 |
| 2 | primary forest | settlers | natural regrowth | (fields abandoned) | 1 |
| 3 | primary and secondary forest | indigenous users | natural regeneration | medium to long | 13 |
| 4 | secondary forest | indigenous communities | natural regeneration | medium to long | 46 |
| 5 | secondary forest | colonists | natural regeneration | medium | 3 |
| 6 | primary and secondary forest | mostly indigenous communities | agroforest | none | 28 |
| 7 | secondary forest | government spon-sored colonists | plantation crops or *taungya* | none | 7 |
| 8 | secondary forest | mostly settlers and ranchers | pasture | none | 10 |
| 9 | grasslands | indigenous users and settlers | natural regeneration and pastures | variable | 12 |
| 10 | insufficient information available | | | | 14 |

## Discussion and Conclusion

Table 1 summarises the main characteristics of each of the main groups into which the 136 reviewed cases were classified. With respect to the initial vegetative cover it can be seen that primary forest alone was exploited in only 17% of the cases; primary and secondary forests were utilized in another 17%; secondary forest alone was used in 52% of cases; and grasslands were cultivated in 9% of cases. 73% of the communities (in which such an identification could be made) were indigenous; 18% were spontaneous settlers and ranchers; and 7% were government-sponsored colonists (or participants in *taungya* schemes). Natural regeneration was allowed after cultivation in 53% of the cases, while 25% of the cases represented conversion to agroforests; 13% to pastures; and 7% to plantation cropping or *taungya*. 20% of the cases were non-cyclical and fallows were not used. In those cases which did use fallow, 41% utilized long fallows; 36% used medium length fallows, and only one case was included in which fallows were of short duration, although we suspect that many more of such cases may be found in Asia and Africa.

It remains to be seen whether or not the proposed classificatory scheme will be useful in organizing the similarities and differences associated with slash-and-burn agricultural systems. After examining existing classificatory systems, we have tried for the 'middle ground' between purpose-specific, usually single-variable classifications on the one hand, and multi-variable descriptions incapable of organizing or grouping the diversity on the other. To improve the method, researchers are invited to submit comments on the variables selected and scheme proposed, as well as additional entries which would include: a) a reference, b) evaluation of the case in terms of the four descriptor variables, and c) location of the case. Additional cases are needed to close the gaps encountered in this initial sampling. Certainly, for example, more cases are needed of settlers in the Amazon Basin, of agriculturalists facing reduced fallow periods, of cases from southern China, and from tropical Africa.

Research sites of the ASB project can be classified using the proposed system. As mentioned, the two sites in the Brazilian Amazon feature government sponsored colonists and conversion of primary forest into pasture. No similar cases were encountered in the literature, although similar conversion of forest to pasture by spontaneous settlers (who become ranchers) was well documented. The research

site in Sumatra, Indonesia, represents colonists – spontaneous and government sponsored – who exploit mainly secondary forest in a process resulting in agro-forests. The research in Cameroon features indigenous users of secondary forest who largely leave fields fallowed. Both the Indonesian and Cameroon cases would fall into groups which were well represented in the literature and can probably be considered typical of the more dominant types of slash-and-burn systems.

The references, tables showing (provisional) groupings, and maps locating and coding the different cases will be maintained at CIAT subject to additional data inputs and suggestions as to improvements and modification of the proposed system.

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