Small-scale Forest Economics, Management and Policy, 2(2): 171-184, 2003

Mapping Landscapes: Integrating GIS and Social Science Methods to Model Human-nature Relationships in Southern Cameroon

Valentina Robiglio[1]
International Institute for Tropical Agriculture Humid Forest Ecoregional Centre, 2008 B.P. (Messa) Yaounde, Cameroon[2]

William A. Mala and M.Chimere Diaw
Center for International Forestry Research, 2008 B.P. (Messa) Yaounde, Cameroon.

Participatory mapping and GIS are both necessary to model the interactions between humans and their environment. A case study from the forest margin in the Congo Basin demonstrates how data from participatory community mapping and other social science methods can be prepared for quantitative modelling. This approach bridged the gap between spatial modelling data and social decision-making in space by elaborating a geographically consistent social representation of the landscape and giving a geographical base to the connection between land use, its cultural representation, and its social management. This was achieved through an iterative process of GIS cartography, using feedback from village informants and field checking, to transpose the spatial references from participatory mapping sketches into reliable geographic locations. As well as demonstrating the utility of such data for modelling, this work clarified the distribution of land rights among the six main owner-clans spread through the eight hamlets in the watershed. The 'basin' of spatial resources and its relation to the rules of land use and natural resource management were defined for each clan. Land-use systems at the forest-agriculture interface in the study area proved to be complex, strongly driven by social rules and influenced by history and settlement strategies. These social and historical aspects established the framework within which communities make current decisions and interventions.

Keywords: participatory mapping, geographic information systems (GIS), FLORES, Congo, Cameroon

---

[1] The authors thank the people of Akok for their collaboration and hospitality. Village technician Michel Engueng and village contact Adolphe Ze facilitated and assisted this work. Our thanks also to Julie Mbazo'o and Remy Assoumou, both members of the 'social side' working group of the FLORES modelling team. Christopher Legg's contribution to the discussion of this work through his constant reviewing of the CamFlores model is gratefully recognized. Finally, thanks to the whole CIFOR–ACM team for numerous scientific and methodological inputs. The Italian Foreign Ministry funded the work of Valentina Robiglio (APO-GIS specialist) through an APO contract with IITA. The European Union (Tropical Forestry budget line DG VIII) contributed to the CIFOR's research program on the 'Adaptive Collaborative Management of Forests' (ACM) in Africa, and to the Alternative to Slash and Burn (ASB) program in Cameroon on 'Environmental Services and Rural Livelihoods' through the World Agroforestry Centre.

[2] Postal address: IITA Cameroon, c/o Lambourn, 26 Dingwall Road, Croydon CR 3EE, UK.

INTRODUCTION

In the South of Cameroon (Figure 1), FLORES (Forest Land Orientated Resources Envisioning System) modelling techniques (Vanclay 2003) are being tested in three villages (Akok, Awae, Nkometou) at the edge of the humid forest forming the Congo basin. The objective of these tests is to investigate the effects of agricultural innovations on the forest-agriculture interface. The modelling is being undertaken within an inter-institutional project under the umbrella of the Alternative to Slash and Burn initiative (ASB), a system wide programme of the Consultative Group for International Agricultural Research.

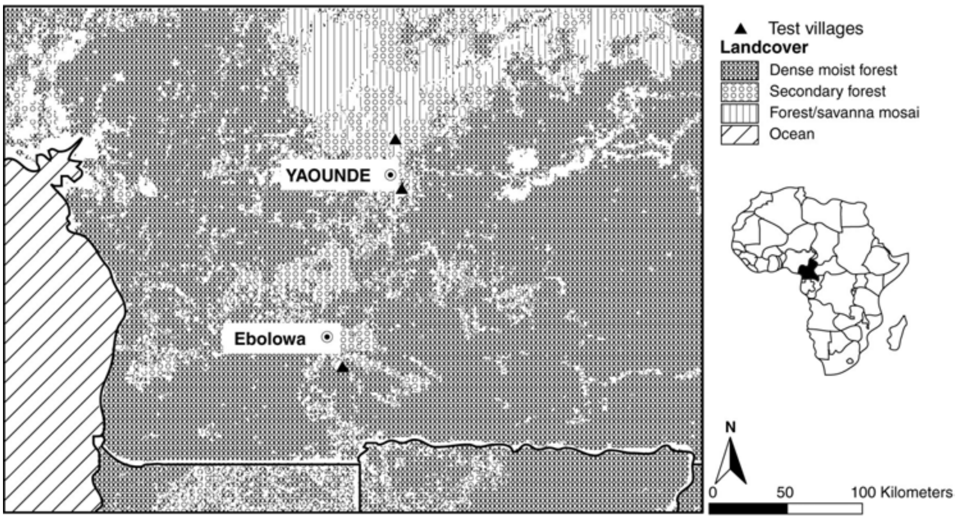

Figure 1. Location of study area in the south of Cameroon

Note: The background is the TREES Vegetation Map of Central Africa, modified by V. Robiglio. Triangles denote three villages, viz. Nkometou, Awae, and Akok (North to South).

The objective of FLORES is to model dynamics of land-use patterns in time and space, to enable quantitative analysis and testing of the effects on landscape of management and policy options. Land-use patterns are created by actors who interact and collaborate as individuals, as families, communities, associations or corporations. The spatially explicit nature of the model is based on the specificity of decisions taken for any given patch of land. FLORES assumes that complex reasons guide land-use decisions and that people explore all options available to them. This is done within a context defined by resources (finance, labour, techniques), knowledge and perceptions, and by the socio-cultural background of the actors. This context, especially the cultural context, defines the 'basket' of options considered by actors (Vanclay 2003).

To model people-forest interactions (in FLORES, or otherwise), it is necessary to resolve any discrepancy between the resolution and scale of spatial data in spatial modelling and the resolution and scale of human spatial decision-making in natural resources management. The social 'basin' of resources of each community and its relation to land change dynamics as well as its management and the social history of the area, had to be addressed within an explicit geographical platform. Starting with the basic linkage between tenure and land use in the south of Cameroon, the task was to identify the social institutions that actively influence land cover dynamics. It was also necessary to define their decision levels and the spatial pertinence of these decisions. For that purpose, participatory mapping techniques were merged with geographic information system (GIS) tools in the framework of a joint activity involving the authors, as part of the ASB modelling team and of the CIFOR (Center for International Forestry Research) program on the Adaptive and Collaborative Management of Forests (ACM). This paper presents and analyses the preliminary results of this work.

STUDY AREA

The study was carried out in the area of Akok, 35 km from Ebolowa (Figure 1), the provincial capital of South Cameroon. The area includes six *chefferies*, administrative units dispersed in eight hamlets along a 12-kilometer tract of the old Ebolowa - Ambam dirt road. The relative isolation of the area due to its distance from town, the poor transport and access, and frequent road closures during the rainy seasons are the main factors influencing the subsistence and small-scale nature of local agriculture. Agricultural food production in Akok is based on swidden cultivation[3] within a strategy of crop rotation and fallow management. Forest fields, *esep*, planted with plantain (*Musa* sp.), banana (*Musa* sp.) and/or melon (*Cucumeropsis* sp.) open the shifting cultivation cycle in newly-cleared forest areas and old fallows (over 15 years since previous cultivation). Crops such as cassava (*Manihot esculenta*) and cocoyam (*Xanthosoma sagittifolium*) are planted in a mixed food crops field (*afub owondo*) with groundnut and maize, right after the *esep* or after a fallow of some 5-7 years. Cocoa (*Theobroma cacao*) is the main cash crop and source of income in the village (Gockowski *et al*. 1998). According to the official Zoning Plan of the Ministry of Environment and Forest (GFW Cameroon 2001), there is one 'active' logging concession of 41 300 hectares in the north-eastern part of the area. This concession does not presently have any *assiette de coupe*[4], which means that no extraction has taken place in recent years.

METHODS USED TO GATHER DATA

Hierarchical relationships linking social entities, usage rules, and appropriation of resources were de-structured into specific themes to capture the complexity of the resource management system at the village scale (1:5000). Their spatial dimensions were then represented on geo-referenced thematic maps in a set of complementary

[3] This system is also known as slash and burn agriculture, a generic term for agricultural systems in which the fallow vegetation is manually slashed, left to dry and cleared from the fields by burning before crop cultivation (Hauser and Norgrove 2001).

[4] *Assiette de coupe*: A subdivision of a logging concession indicating the area to be cut in a particular year, equivalent to a logging coupe. Concessions require approval of one or more *assiette de coupe* to proceed with logging operations (GFW Cameroon 2001).

layers (see 'thematic layers' below). A GIS implementation in ESRI ArcView 3.2 was used to integrate this information.

This was done in combination with a study of the social history and local anthropology based on focus groups and individual discussions. A small group of 15 people (comprising elders, men, women and youths) designated by the community village explained the conversion of a largely natural landscape to one dominated by human activities as well as the dynamics of migration. The group participated in an analysis of historical trends in land cover changes. The significance of this work appears in the definition of the thematic structure (see 'thematic layers' below) and in the analysis and interpretation of the final GIS maps.

Base Map

The objective of the first mapping activity conducted in Akok was to produce an accurate geo-referenced map at a scale of 1:5000, to be used later as a shared and recognized reference system in the thematic discussions with the population. Each hamlet was treated separately in order to get as much detail as possible.

The participatory map-generating process involved a mixed group of about 15 community members of various ages and gender. In the initial meetings, they sketched a land-use map of their hamlet on a normal paper using coloured markers. They started from references such as the main road, hills, streams, confluences, and swamp forests to successively locate land-use types, borders, and paths (Figure 2). These features were interpreted and compared with a topographic map (nominal scale 1:200,000) that had been scanned, imported into ArcView and geo-referenced. Some references were clearly recognisable, others were less so, while many were absent. The topology (the relative spatial relationship among geographical objects) of features that did not correspond to personal knowledge of the area or to features on the existing topographic map remained particularly confusing, and necessitated further fieldwork.

Back in the village, a focus group of hunters and elders, mostly men who were assumed to have a wide knowledge of the land was formed to review the original sketches, the topology and the toponymy (the local naming of key locations). Selected reference points were identified for GPS field checking on the basis of their spatial significance or to clarify any inconsistencies.

Guides were engaged to lead the team to these points. During the following days, long walks fostered an open communication between the team and the guides. The guides explained past and present land use and interpreted the land as it was traversed. On average, one hundred points per day were recorded using a GPS connected to a hand held computer, with a preset spreadsheet to systematically note the characteristics of each point.

The spreadsheet was imported into a GIS with ArcView, and features and points were labelled. Watercourses and relief were digitized from the original sketches that were checked on the ground, using the scanned and enlarged topographic maps as a control. Some features of the topographic base were modified according to the new references. Borders between communities were traced only where substantiated by GPS points and left open elsewhere. The only names used in the final base map (Figure 3) were those for rivers, hills, and reference points provided by the community (e.g. borders, junctions). This base map will be further corrected and enriched as new features are recognized and registered in the field.

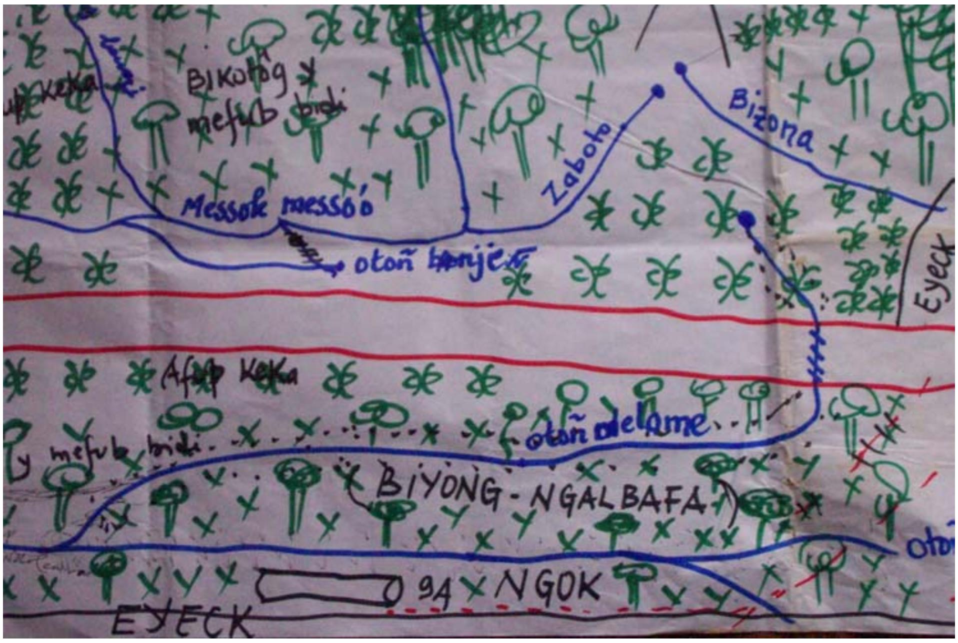

Figure 2. An extract from a participatory map of the hamlet of Nkolemvon, '*Carte Sociale et des usages du village Nkolemvon*'

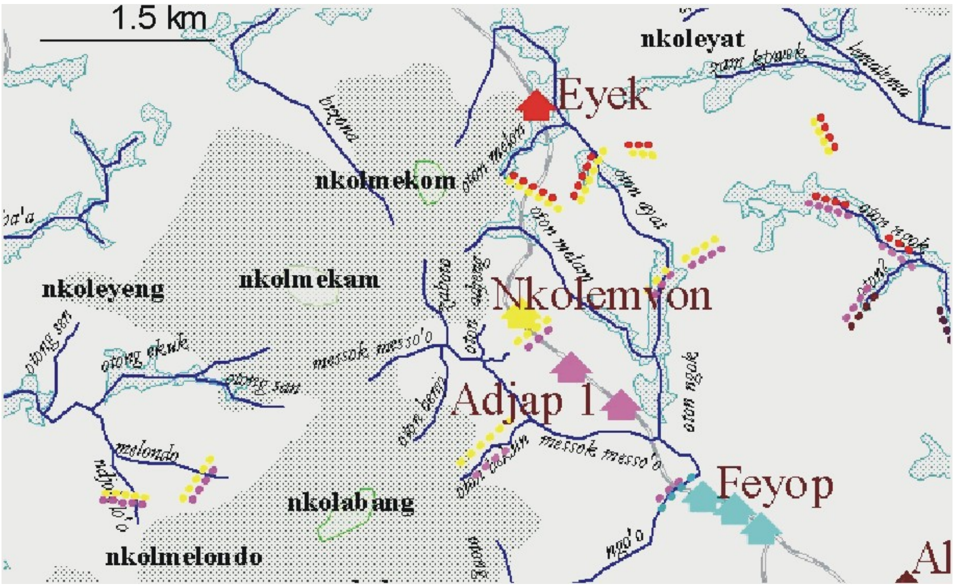

Figure 3. Extract from base map, showing relief, swamps, and streams

Note: Hamlets are denoted by houses and borders between hamlets are shown as dotted lines (unconnected).

The base map was printed and taken back to the village for restitution and validation. It took less than an hour for the group (a mixed group of about 15 members of various ages and gender) to become familiar with it. The presence of the guides facilitated the acceptance by the group of the validity of the shift from sketches to the basic map. Their contribution in the field gave credibility to the process in the eyes of the villagers.

Thematic Layers

The next step was to prepare thematic layers. These are specific overlays sketched by informants on geo-referenced transparent sheets superimposed over the base map. These layers reflect the anthropic attributes of the landscape. The thematic structure, the type and number of layers were defined by analysing the original sketches and the notes taken during the village meetings and the guided walks. The layers were structured as follows:

1. Landscape units according to local typologies as reported in the original sketched maps: *Si Mefub* (mixed food crops field), *Afub keka* (cocoa plantation), *Bikotok* (fallow), *Mbiam-Fut Afan* (mature forest);
2. Land ownership by clan and by lineages;
3. Roads, trails and paths;
4. Hunting: rights, types, areas, wildlife abundance ranked as poor, medium, high;
5. Fishing: rights, types, rivers ranked by fish abundance as poor, medium, high;
6. Historical land use: general land-use map of the 1970s, with specific attention to the presence of cocoa fields.

In a series of one-hour meetings, mixed groups (hunters, fishers, farmers of both genders) were asked to locate and sketch on the transparent sheets any information relevant to a specific thematic layer. Layers were then digitised and imported into the GIS with ArcView. The number of themes is not closed; new layers can be added according to future research or villagers needs.

THE RESULTING SPATIAL DATA

Findings of this study fall into two categories. One relates to spatial data and non-spatial information on land use, resource management, history and social setting. The other concerns emerging methodological lessons related to participatory mapping and the implications for FLORES modelling.

Akok Settlement History and People

In Akok, settlements, village territories, land use, and land tenure started to take shape at the end of the 19th century in the wake of the last wave of Bantu expansions. The Bantu lineages that settled in the area are segments of six major clans, the Esalane, the Yemekak, the Yemvam, the Yembot, and the Yemisem, all belonging to the Bulu ethnic group, a part of the larger Beti-Fang group. As testified by the presence of abandoned settlements (*bilik*) the different groups, particularly the Esalane and Yemvan, used to move periodically through the forest in small scale migrations that shaped the present pattern of territorial rights. The Esalane were among the first to settle in the area (Eyeck) and to institutionalise their chieftainship in 1887. During the German era, the Akok hamlets were forced to relocate along the road by the colonial administration to facilitate cash crop production (cocoa), the collection of taxes and the administrative control of the population. It also sought to eliminate previous patterns of collective migration.

The Social Basin of Resources

The concept of a social basin of resources designates the system of relationships linking spatial resources to discrete community-based units that manage them. It is a topocentric concept used to define the social attributes of any given spatial unit, and thus to relate a defined space to bounded social units. Borrowing from the hydrological definition of basin, the concept projects the idea of several networks relating to a specific section in the landscape. The definition of the basin is scale-dependent and is related to grain and resolution of the spatial unit involved (Figure 4).

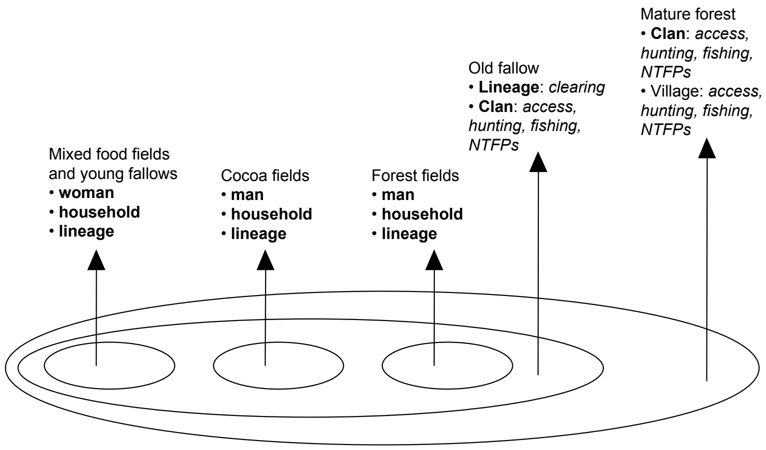

Figure 4. Concepts of land use and social roles

The Management of Resources

In Akok the production and resource management system has a wide extension, with a striking functional differentiation of land-use types and cycles. The conception of space strongly reflects the integrative nature of resource management strategies across the landscape.[5] Agricultural activity is concentrated within a corridor 3 km west and 2 km east of the road. In the forest, cocoa plantations and *esep* fields can still be found within 5 km of the road. In some cases, cocoa fields are located near former settlements (*bilik*). During colonial times, the German government fostered

[5] According to Diaw and Oyono (1998), land among the Bulu is divided in two components, namely *si mëfub*, agricultural land, and *ayët si*, which refers to all the land space inaccessible or not available to agriculture, such as rocky and hilly areas that may include remote forest hills, and arid or exhausted land. The *ayët si* is a zone of open access, as much as paths and trails. The agricultural space, *si mëfub*, covers the variety of active agricultural units, as well as fallows, swamps and marshes, and forest.

cocoa plantations close to the original settlements in the forest. Subsequently, cocoa was planted near the new hamlets along the road. Plantations spread progressively until the late 1980s, when the fall of cocoa prices and the liberalization of the cocoa sector precipitated a decrease in production and the abandonment of many cocoa fields. Villages' forest-land extends much further than 5 km, with hunters penetrating deep into the forest (often up to 13 km from the road).

The richness of the environment offers a wide range of non-agricultural resources both for consumption and marketing. Forest products such as *Irvingia gabonensis*, *Elaeis guineensis* and *Raphia hookeri* are particularly important. The former, used for local dishes, is reported as a source of property and use-rights conflict among households in cocoa plantations and fallows; while *Elaeis guineensis* and *Raphia Hookeri*, are used to make palm and *Raphia* wine, respectively. Palm tree nuts are also used to make local dishes and to produce palm oil.

In the dry season, women fish using the 'dam and drain' method in communal streams, even though the land itself may be sharply divided between lineages, or families in the same lineage. Similarly, men may fish with various types of nets and hooks, despite land tenure arrangements. Fish are generally considered abundant, by both men and women, but the more remote streams are ranked as particularly rich and good for male fishing.

Hunting is regulated at the community village level by user rights. There is no strict specialisation of roles: every man in the village considers himself a hunter, a fisherman and a cocoa farmer. Hunting provides food and protein, but also serves to protect crops. It is considered as a fundamental contribution to family needs and to cash income. Hunted game is consumed locally and sold on the poaching market in Ebolowa. The most valuable prey, such as gorillas and chimpanzees, may be taken to Yaounde for sale, sometimes as dried or smoked meat. Gorillas and chimpanzees are in the list of the endangered species protected by the 1994 forestry law. The same law also regulates hunting through permits but none of the hunters in Akok have a permit. In the agricultural areas, trapping, mainly targeted at small rodents, is done along the margins of farms. Both trapping and rifle hunting are practiced in forest areas. The maps (Figure 5) indicate areas still rich in monkeys around peaks, hilltops, and isolated small inland valleys in mature forests and very old fallows.

The Linkage of Resources to Social Units

The whole resource management system in the area of Akok is based on a combination of individual household farming with hunting, gathering, and fishing in lineage-based common pool areas in the forest. Clan membership[6] is the operational basis for resource access within the spatial limits of the community. Within clan territories, land-use relationships are complex and multiple, and various types of use and access rights to a space are nested within each other. Lineages are central to the definition of tenure (Figure 6) and determine the different access and use rights of individual households. Two types of forest tenure were observed in Akok: private forest land, including some primary forests, belonging to individual clans; and

[6] Typically, a clan is a hierarchy of lineages descending from a common ancestor and excluding intermarriages among its members. In Akok, the six major lineages that control different parts of the territory are not really 'clans' but lineage segments of six different clans that spread in many areas other than Akok. The term 'clan' is used because people in the area define themselves and their land tenure primarily in reference to these clan identities.

common forest land available to all for hunting, fishing and gathering – a crossroads for all clans, in the most remote areas.

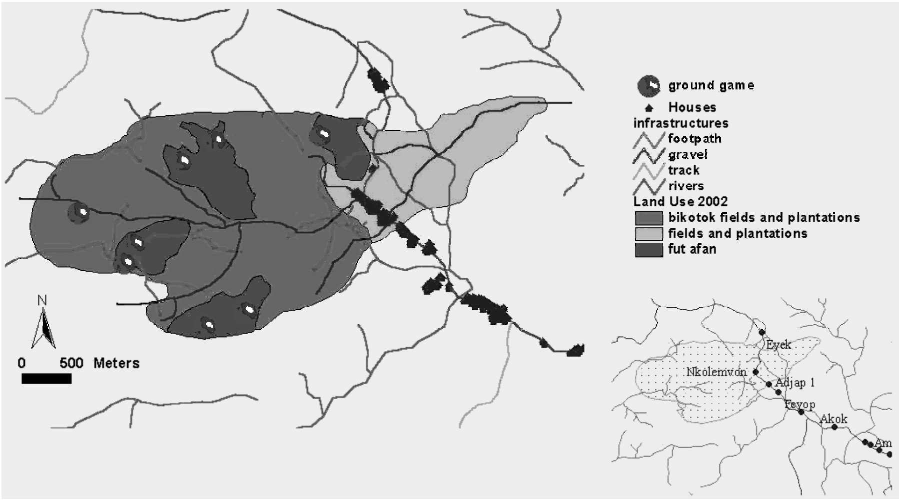

Figure 5. Land use in Nkolemvon in 2002

Note: The darkest shade denotes mature forest; the medium shade denotes old fallows, fields and cocoa plantations; while the paler shade denotes fields with young fallows and cocoa plantations. The white animals indicate good hunting areas.

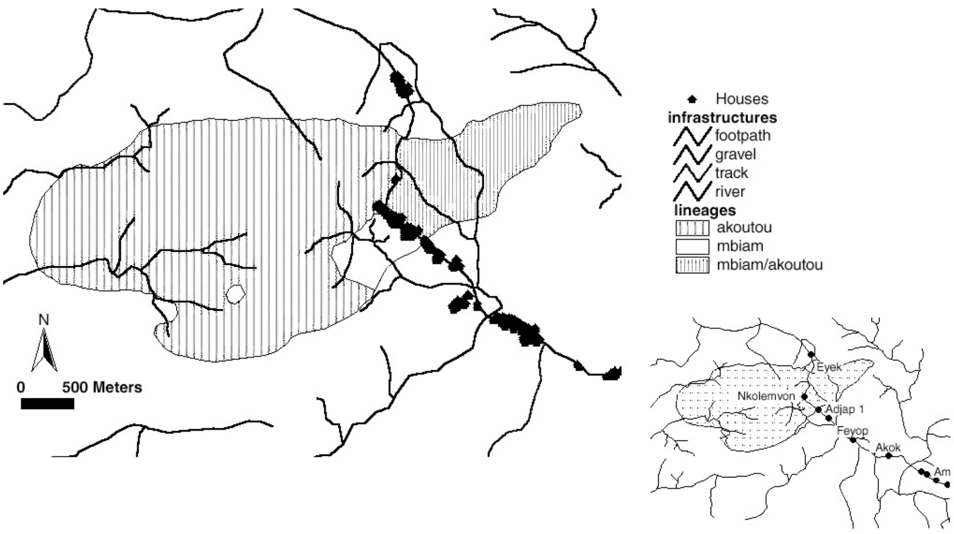

Figure 6. Land access by lineage in Nkolemvon

Direct ownership or appropriation of a resource has a basis in usufruct, that is, the investment of labour in the resource; the actual work done on a tract of land, or the physical evidence of it, is the key that allows its exclusive control by an individual or a household. Women from the clan or married into it have such productive rights on farmed land as long as they are working on it.

During an agricultural cycle, the ownership status of a single field changes along social and gender lines as presented in Table 1. Fallows are strictly part of the household agricultural cycle, but after a long period (over 15 years) they regenerate to secondary forest and revert to the control of the lineage. Keeping land active in short fallow-crop cycles or turning it into perennial cocoa plantation is the only way to keep control within the household in the long term. This is so because access to forests and to forest resources is based on a common pool principle, whereby clan members own the resource they extracted or captured but not the land base itself. Individuals control the land only if they have transformed it through clearing or planting and maintain physical evidence of that transformation. These results confirm the general structure of land tenure and of the social systems in the south of Cameroon as reported in the literature (Alexandre 1965, Vansina 1990, Short 1994, Diaw 1997, Van den Berg and Biesbrouck 2000).

Table 1. Life cycle and land-use rights in a cleared field in the south of Cameroon

Land Use	Direct control
Primary forest	Community
Field forest	Individual household (male)
Mixed food field crop	Individual household (female)
Young fallow	Individual household
Old fallow	Lineage
Secondary forest	Community - Lineage

Presently, there are no official land titles, and few land transactions among clans in Akok. These consist mainly of peer contracts among households, where the land is lent to someone from a different hamlet to cultivate food crops. Such agreements across clans may allow clearing of part of a mature forest for the purpose of opening an *esep,* the forest field that starts the agricultural cycle on a specific plot. The dynamics and conditions of land transactions need further investigation to clarify their foundations in the social network of inter- and intra-lineage interactions, economic conditions, and their links to perceptions of land scarcity.

Land-use Patterns and Land-use Intensity on Maps

In Akok, spatial patterns of land-use rights are complex and some hamlets share the same spatial identity. There is unity but not necessarily contiguity of land within a clan. This strongly influences the spatial land-use pattern. In multiple clan settlements, land is fragmented into a mosaic of patches and corridors connected to wider clans' lands. Existing borders mirror the settlement history of the groups; clans have territories of different sizes not related to their actual population size.[7]

[7] Hence, the pattern and density of cultivated patches relate strictly to each clan's internal population density rather than to the average population density in the area.

For this reason, patterns of cultivated patches are not uniform, and may vary from one clan to another. As shown in Table 2, this results in a discontinuous density of agricultural land use. In some hamlets, complex mixtures (*bikotok y mefub bidi*) comprising mixed food crop of various seasons and young (4-5 year old) fallows within a matrix of older fallows (10-15 years), are concentrated along the road. In other hamlets, *mbiam* (mature forest) is part of the pattern, while crops and young fallows are dispersed in the matrix. These representations confirm the varying population pressure at a micro-scale and correspond to the two opposite ways people perceive their land in the area: abundant or scarce. The perception of land as scarce drives land appropriation strategies internal to the clans' land aiming at safeguarding long-term land accessibility to the lineage or the household. The process is transversal and runs across the social structure from collective to individual entities. This is where land pressure is highest, where competition for land ownership rises and where new forest-field clearings are made in the most remote areas. Agreements (peer contracts between households) may be made with clans with surplus land to allow clearing of mature forest.

Table 2. Spatial extent, inhabitants and households by hamlets

Spatial extent and population	Hamlet		
	Nkolemvon	Eyek	Adjap
Land area (ha)	7	9	20
Arable area (ha)	5	7	16
Cultivation (ha)	4	2	4
Total inhabitants	142	122	194
Total households	29	14	38
Population density	28	17	12
Population per ha cultivation	41	64	45

A further sense of land insecurity is caused by the presence of external stakeholders such as logging companies whose presence is observed in the south-western part of the area even though there is no official concession. On the maps, logging activities for the years 1987/88, 1993, 1994, and 1999/2000 were carefully noted and located. People perceive that the State should show more equity in delivering permits to log their land; they react by clearing more forestland to pre-empt State-sponsored external access and to secure ownership for future generations.

All the forestland is considered potentially available for agriculture, but accessibility limits the potential for forest conversion. There is a dense network of tracks and trails connecting the hamlets to fishing and hunting sites and to the *bilik*. These paths indicate that accessibility and the distribution of fields and plantations are strongly influenced by the hilly topography and by swamps. Seasonal inundation makes many of the more remote areas inaccessible (or too time-consuming to reach).

LESSONS LEARNED ABOUT PARTICIPATORY MAPPING

This section addresses the relevance, validity, and effectiveness of participatory mapping, both in terms of efficiency of data-gathering, and as a contribution toward a FLORES-type model (Legg 2003).

Preliminary Technical Assessment of the Method

Several lessons are relevant to future applications of GIS for participatory mapping. In particular, the integration of participatory mapping (Byers 1997, Eghenter 2000) with GIS techniques helped overcome some of the limitations of participatory maps when used alone, including the lack of spatial accuracy, and imprecision of scale references (Diaw *et al*. 1998). The technique of building overlapping thematic layers increased the information content of maps, their readability and the flexibility of semantic choices. The iterative calibration of sketches and topographic maps, and the integration of identified features into a GIS made it possible to scale material, check detail and resolve topological discrepancies. GIS techniques opened the possibility of spatial analysis including cost-distance estimates and buffering for selected themes and specific relations among features. This makes the implementation of social variables and geographic analysis more potent in the FLORES model.

Outstanding Issues

Some issues need further comments:

Accuracy. Accuracy issues are not solved solely by assigning geographical coordinates to features in space. Inaccuracy may be significant, as it is linked to the subjective experience of topological relationships or to non-Euclidean representations of space. Attempts to solve accuracy issues must seek to secure the information contained in the 'inaccuracy' and avoid the 'flattening' of different spatial perceptions.

Boundaries and spatial limits. Soft boundaries delineate traditional communities' internal and external territories and can be used to interpret different categories of land access and land use. They allow for the delineation of discrete spatial objects, such as polygons, which are easily imported in the GIS. In many cases, however, boundaries are permeable, not fixed, or not shared by different groups. In other cases boundaries often correspond to a series of discontinuous points relating to specific spatial references such as paths, streams, and rocks, due to a non-linear cognitive division of space.

Graphics. There is the need to devise a set of legends and symbols to accurately report communities' languages in the thematic layers. These should describe agricultural cycles, resources and resources management, non-timber forest products, fishing and hunting activities.

Interaction. The process was highly interactive, with interested groups actively taking part in all phases. This helps to build confidence and trust among participants and to foster sharing of information, which may otherwise not have been forthcoming.

Procedural effectiveness. The first phase of base map construction demands time; people's landscape references are rich and the presence of different lineages or groups of interests can lead to long discussions while mapping. Nonetheless, the gradual appropriation of the mapping language and of the tools by the villagers represents a concrete advantage for the following steps (thematic layers). Once familiar with the methods, language, and scale used to represent orthogonal geographical space, community members were able to use them to describe and locate specific elements in a standard topology. The implementation of the thematic layers was easy and quick. Furthermore, observing people describing and representing their land was important, as it offered decisive clues about additional information that may be solicited.

Relevance to the Model

The method presented here makes a useful contribution to the implementation of a FLORES-type model, adding to its validity, reliability, precision and robustness. Information emerging from participatory mapping adds to the general credibility of any FLORES representation. The participatory maps offer a basis for conceptualising social frames of decision-making on tenure, not easily captured by more costly and time-consuming socio-economic surveys. They bring insights on landscape and natural resources management that broaden and complement the geographical and functional space covered by the model. The exercise scaled out from specific agricultural land to the whole spatial system, defining the 'basket' of resources used by the community. Furthermore, identifying the spatial pertinence, specific influence and operation of social networks and spatial units helps to reveal the social 'granularity' at various levels of the FLORES model. Finally, by reducing the gap between reality and the model and introducing quantitative variables of the spatial functionality of the villagers' land uses, the integration of participatory mapping and GIS increases the model's predictive capacity.

CONCLUDING REMARKS

The conceptualisation of social arrangements that influence spatial patterns at the forest-agriculture interface helps define spatial and temporal landscape dynamics. The social basin, the comprehensive space within which the complex of relationships linking resources to people and social institutions takes shape and evolves, was mapped and modelled on a cartographic base with local people who were fully involved from the beginning. Essential connections between land use, resource management interventions, and corresponding social units were identified and represented in a geo-referenced space. Preliminary analyses reveal the importance of tenure, settlement history and land appropriation strategies in shaping present patterns of land use.

In terms of modelling, the method has been shown to be effective in defining and structuring social aspects pertaining to decision-making, tenure, land access and land use. The multi-layered approach used for mapping was easily and quickly understood by informants, allowed them to participate actively in a two-way learning process with the researchers, and a fostered a shared understanding about land-use dynamics and possible future scenarios. The process has helped to align perceptions of researchers with the reality revealed by community groups.

REFERENCES

Alexandre, P. (1965), 'Protohistoire du groupe Béti-Fang: Essai de systématisation', *Cahiers d'Études Africaines,* 5: 503-560.

Byers, B.A. (1997), 'Demarche pur comprendre a influencer les comportements a l'egard de la conservation et de la gestion des resources naturelles', Bullettins sur la Biodiversitè Africaine No. 4, Biodiversity Support Programme, Washington DC.

Diaw, M.C. (1997), '*Si, Nda Bot* and *Ayong*: Shifting cultivation, land-use property rights in the South of Cameroon', Network Paper 21e, ODI Rural Development Forestry Network, London.

Diaw, M.C., Oyono, P.R., Sangkwa, F., Bidja, C., Efoua, S. and Nguiebouri, J. (1998), 'Social science methods for assessing criteria and indicators of sustainable forest management: A report of the tests conducted in the Cameroon humid forest benchmark and in the Lobe and Ntem River Basins', unpublished report, CIFOR, Bogor.

Diaw, M.C. and Oyono, P.R. (1998), 'Dynamiques et représentations des espaces forestiers au Sud Cameroun: Pour une relecture sociale du paysages', *Arbres, Forêts et Communautés Rurales,* 15/16: 36-43.

Egenther, C. (2000), 'Mapping people's forests: The role of mapping in planning community-based management of conservation areas in Indonesia', Biodiversity Support Program, Washington DC.

GFW (Global Forest Watch) Cameroon (2001), 'An overview of logging in Cameroon', http://www.globalforestwatch.org/common/cameroon/english/report.pdf, accessed 25 March 2003.

Gockowski, J., Baker, D., Tonye, J., Weise, S., Ndoumbè, M., Tiki-Manga, T., Fouaguègué, A. and Tchienkoua, M. (1998), 'Characterization and diagnosis of farming systems in the Forest Margins Benchmark of Southern Cameroon', Unpublished report for the Alternatives to Slash and Burn Program, Yaounde, Cameroon.

Hauser, S. and Norgrove, L. (2001), 'Slash and burn agriculture', *Encyclopedia of Biodiversity*, Volume 5, Academic Press, San Diago.

Legg, C. (2003), 'CamFlores: A FLORES-type model for the humid forest margin in Cameroon', *Small-scale Forest Economics, Management and Policy*, 2(2): 211-224.

Short, C. (1994), 'Land tenure and slash and burn agriculture in the humid forest zone of Cameroon', Manuscript, IITA/ASB.

Van den Berg, J. and Biesbrouck, K. (2000), 'The social dimension of rainforest management in Cameroon: Issues for co-management', The Tropenbos-Cameroon Programme, Kribi, Cameroon.

Vanclay, J.K. (2003), 'Why model landscapes at the level of households and fields?', *Small-scale Forest Economics, Management and Policy*, 2(2): 121-134.

Vansina, J. (1990), *Paths in the Rainforests*: *Toward a History of Political Tradition in Equatorial Africa*, University of Wisconsin Press, Madison.