ENVIRONMENT, SUSTAINABILITY AND GEOGRAPHY OF DEVELOPMENT

On the Capability of Land Managers to Adapt to Environmental Change

A reassessment of stubborn findings from an interdisciplinary research project on land management and pastoralism in Benin

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ENVIRONMENT, SUSTAINABILITY AND DEVELOPMENT: A CHALLENGE TO GEOGRAPHY

A Reassessment of Stubborn Findings From An Interdisciplinary Research Project On Land Management And Pastoralism In Benin

1. INTRODUCTION

Their is no news in pointing out that environment and geography are inseparable. The perpetual question is: how to put it into practice. An interdisciplinary research project by the National University of Benin and the University of Amsterdam, which I directed, (De Haan 1992a; De Haan 1997) illustrates this question.
We had physical geographers, soil scientists and vegetation specialists in the team. In addition we had human geographers, sociologists and economists. At the end of the project, we knew perfectly well how strongly soils and vegetation were deteriorated, and how land use practices by both peasants and pastoralists had contributed to this degradation. We had also become aware, following the "Farmers First" school of thought (Chambers et al. 1989), of their fabulous knowledge of the local environment, for example the pastoralists' knowledge of grasses, cattle breeds and animal diseases. However, we could not understand why these people, land managers I should call them, continued their way of resource exploitation, while it was so obvious that environmental degradation was taking place.

The position of the local land manager, he or she, has become an important research theme in recent years. One may notice a growing appreciation for local knowledge systems, which raises the question about the distinctiveness of indigenous and scientific knowledge as Piers Blaikie explained in chapter ..?... as well as elsewhere (Blaikie 1995; 1996).
I will try to dwell on this issue by presenting the experiences of our Benin research project. In my view environmental management should be understood as the result of an interaction of processes at various levels of scale, which means the discussion about distinctiveness is closely related to a second issue, i.e the understanding of local land managers in terms of their livelihood strategies and the wider politico-socio-economic and ecological context in which they operate.

In this chapter I will, firstly, briefly explain the regional setting of our research project in Benin and secondly the particular case of confrontation between scientific and indigenous knowledge we ran into. Although our research concerned both peasants and pastoralists, I will limit myself

for the sake of the argument to the pastoralists only. Thirdly, I will examine the significance of this issue for environmental geography and I will show the pertinence of investigating livelihood strategies and the wider politico-socio-economic and ecological context.

2. THE REGIONAL SETTING: pastoralists in North Benin

The Borgou is a vast province situated roughly between latitudes 9°30' N and 12°30' N covering an area of about 51,000 km² and inhabiting more than 800,000 people.
The region is an interaction zone between Bariba (and some other ethnicities of) peasants and Fulani pastoralists. Until the 1960s and 1970s in the driest months, the Fulani herders and their herds left on transhumance for pastures in areas where grass and water were still available. Their families stayed behind in their permanent camps during the dry season with one or two head of cattle. At the beginning of the rainy season, the herds returned. During the rainy season the herds were kept away from the fields to avoid damaging the crops, preferring to graze a few kilometres outside the villages. Fulani also grew food crops near their camps during the rainy season.
When the peasants' harvest was over, the cattle entered the stubble-fields, meanwhile depositing their dung. Occasionally, on the request of a Bariba peasant, flocks stayed overnight on certain fields, depositing large quantities of dung and thus manuring the field. For this service the peasant paid cereals in return ("manure contracts"). As soon as the stubble had been eaten, other fodder had been used up too and the water pools had dwindled, the herds went again on transhumance.
Some Bariba used to ask the Fulani to look after their cattle, and, therefore, this livestock also joined in this transhumance. In exchange the Fulani kept the milk and some of the calves ("keeper contracts").

In the 1980s tensions between the two groups emerged. On the one hand, this tension was caused by a period of relative drought affecting the herdsmen in particular. Over time the number of foreign pastoralists, migrating from the Sahel to the Borgou with their flocks, increased considerably. They graze their cattle in places where local Fulani have already left by that time of year.
Furthermore, successful livestock health programmes, under the auspices of the government of Benin and the European Development Fund, have also resulted in an increase of local cattle, which make up an additional burden on the land.
On the other hand the peasants' increased incorporation in the market, accompanied by technological changes like the introduction of draught animals and motor pumps, has led to a considerable extension of the acreage under cotton and irrigated market gardening. This means that less grazing land

is now available and that a number of watering points have become inaccessible for the herds.

3. ENVIRONMENTAL DEGRADATION: the controversy between scientific and pastoralists' knowledge

The Borgou is situated in the transition zone of the Sudano and Sahelian climatic region. The rainy season lasts from April to October. Three main agro-ecological zones can be distinguished. The first zone, in which the Karimama survey area is situated, has a Sudano-Sahelian climate with relatively little precipitation (700-900 mm). Ferruginous soils have been developed in sandy-clay sediments. Near the Niger river relatively fertile soils can be found having however hydromorphic (pseudo-gley) properties. The soils are acid crystalline. In this zone one finds the National Park of the W, the Cygenetic Zone of Djona and the Forest Reserve of Goungoun. In this uninterrupted zone of protected areas, farming, herding and housing is officially prohibited. It is mainly characterised by bush savannah with gallery forests along the tributaries of the Niger river.

In the second zone, in which the Kandi and Banikoara survey areas are situated, precipitation is between 800-1200 mm. Ferruginous soils have been developed on mainly crystalline basement rock; a high proportion of the soils are relatively deep. The soils are acid crystalline. Vegetation is a bush savannah.

In the third zone, in which the Kalale survey area is situated, rainfall is between 900-1300 mm a year. Ferruginous and ferrallitical soils have been developed on mainly crystalline basement rock. These acid crystalline soils often have favourable physical characteristics but their chemical fertility is average and they are very sensitive to leaching. The vegetation consists of tree savannah.

Our ecological survey revealed three important processes of land degradation, i.e. soil erosion, topsoil deterioration and depletion of nutrients. These processes will be discussed below.

Depletion of nutrients results in a lower concentration of nutrients in the soil. It is caused by the particular way of resource exploitation, cultivating and grazing without giving nutrients back to the soil in one way or another. According to the results of our soil survey all soils in the Borgou are in fact exhausted.
Organic matter is low with an average of 1.6% (weight). Nitrogen is very low with 15-50 ppm (parts per million) even in fields lying fallow. Usually 60 ppm is considered as sufficient. Phosphorus is low too with less than 15 ppm (sufficient quantity is 50 ppm). However, on one manured field

a value of 180 ppm was measured. Potassium is again low with less than 70 ppm, only on one (manured) field it reached 340 ppm, while 160 ppm is considered to be sufficient. Our soil analysis noticed that even fallow periods up to twenty years are not able to restore the quantity of nutrients in the soil to a satisfactory level. This is mainly due to the fact that fallow is not real fallow any more. A plot laid fallow by peasants after years of cultivation, is used successively by herders. If this occurs frequently, vegetation is hardly able to reestablish itself and consequently the nutrient level in the soil is hardly restored.

Topsoil deterioration in the Borgou is mainly characterised by crust formation. Several factors underlie this process. The top soil, usually containing little organic matter, is hardened by heavy rainfall in the beginning of the rainy season, directly followed by the actions of sun and wind. This process is aggravated by human action like clearing, grazing or setting fire to the fields just before the rains start. As a result, uncovered soils are exposed to subsequent heavy rains. Rigorous pruning of trees by herdsmen during the dry season to provide the cattle with fodder (called aerial grazing) contribute to this process as well. Subsequently the topsoil structure deteriorates, which is intensified by the action of cattle hoofs along cattle trails.
Crusts are found all over the Borgou on agricultural fields, fields lying fallow, and even in the National Park which, although a protected area, is used intensively by Fulani for grazing. These crusts occur on areas of more than several square kilometres. They hinder infiltration of precipitation and stimulate sheet erosion through increased run-off. As a result, less water is available for plants and the ground water level goes down. Run-off causes regular inundations.

The most important types of **soil erosion** in the Borgou are sheet erosion and gully erosion. Sheet erosion results in a loss of the top layer and consequently in a loss of nutrients. It is found all over the region and is caused both by farming and grazing. Sheet erosion is not very serious, but will become important in the near future if land use continues to intensify at the same speed without improving the soil's organic matter content.
Gully erosion, caused by heavy rains at the beginning of the rainy season, washes away unprotected soils. It occurs only locally on steep slopes in deforested farming areas and along roads and especially along rivers, where it is caused by cattle on its way to watering points.

Soil structure is deteriorating by reduction and related biological activity due to frequent bush fires. These fires, causing volatilisation of nutrients, can reach very high temperatures, especially at the end of the dry season when vegetation is very dry. A deterioration of the soil structure

means quick regrowth of plants is more difficult and facilitates crust formation.
Bush fires are widely practised by herdsmen at the beginning of the dry season to stimulate the growth of young offshoots. These offshoots are more palatable and contain more nutrients for the cattle. Because at that time of the year living material is still omnipresent, these fires do not produce very high temperatures and are considered to be less harmful than the bush fires at the end of the dry season. The latter fires are meant to clean the grazing areas from old herbs and to facilitate new grass to grow when the rains start.
One should not forget that herdsmen (and peasants) also start bush fires for other purposes such as hunting and clearing of fields.

Vegetation in the Borgou also rapidly declines, due both to herding and increased cultivation. The vegetation of the large uncultivated areas, including the National Park and the Forest Reserves, is deteriorating. In the Borgou tree crowns cover maximally 20-50% of the soil, but in the Kandi, Banikoara and Karimama survey areas this was less than 20%. Real forest areas, with more than 50% of the soil covered, are rare.
Increased grazing, because of increased cattle numbers, is an important cause of vegetation degradation.
Fulani used to prune trees to utilize the leaves as fodder, when they ran out of pastures at the end of the dry season. However nowadays, some of them already start pruning halfway through the dry season, and sometimes all edible parts are cut and the tree destroyed.
Our analysis of Spot satellite images showed that especially in the National Park of the W, tree cover is deteriorating fastly. During a period of four years (1986-1990) only 40% of the observed area of the park did not degrade. Grass savannah has conquered large areas, because extensive bush fires, causing bad germination, and roaming cattle have prevented regrowth of trees. In fact the National Park has become an important refuge for Fulani herdsmen.

In general, the herdsmen interviewed in the North Borgou showed little interest in the conservation of the savannah or fallow land where they tend their flocks.
Traditionally the drying up of watering-places was the impetus for the alternating use of pastures. In case edible grasses were no longer available at the end of the rainy season, herders turned to pruning of certain varieties of trees.
Although we found prove of the Fulani's extensive knowledge of vegetation species and their potential use as fodder, as well as their ability to assess the quality of the grazing areas by means of the species present, they hardly considered activities to maintain the quality of the rangelands. They are also well aware of the negative effects of rigorous aerial grazing on the regeneration of the vegetation, without considering to reduce this habit. The same can be said about the disastrous effects of bush fires at the end of the dry season.

Scientific opinion about traditional range management in Africa changed dramatically the last decade. As Behnke, Scoones & Kerven (1993), Scoones (1994) and Behnke & Kerven (1994), have shown, success or failure of traditional range management practices were judged originally by means of botanic indices, measuring the state of the vegetation. However this type of assessment is questioned with respect to semi-arid Africa. According to the Clementsian theory of plant ecology, each vegetation community has its ideal (equilibrium) situation of climax vegetation. Exploitation will result in a degradation of the vegetation. However, if resource exploitation stops or is reduced, the climax vegetation will return. For a long time, scientific range studies have assumed therefore that range condition could be manipulated backwards and forwards from good to poor states along a graded continuum in response to variations in grazing pressure. Herders were supposed to aim at an equilibrium between grazing pressure on the one hand and natural regeneration pressure in the direction of the climax vegetation on the other hand. Pushing exploitation too far would eventually result in degradation, subsequent abandoning of the area and ultimately return of the climax vegetation.

However, according to more recent understanding, there is no climax vegetation in areas with large climatic variability, simply because variability is so important that average situations are exceptional. This means that an equilibrium between the carrying capacity of resources on the one hand and exploitation on the other is non-existent.
In climatically unstable environments, the dominant factor influencing changes in vegetation is rainfall, which lies outside control of the herders. The only option open to range managers who cannot control the environment is to accommodate. This is called presently "opportunistic range management", which is characterised by the objective to maintain large and productive herds if rainfall and vegetation permit and destocking as quick and profitable when circumstances dictate (Behnke & Kerven 1994). For opportunistic herders there is no reason to reduce pressure on range land in a certain year, because its potential contribution to continued exploitation in the following year is doubtful. For in dry years, even the slightest exploitation will result in degradation, no matter how much the range has been conserved the year before. Moreover, the backward trend in degradation can be irreversible in non-equilibrium situations (Beeckman & Clarysse 1991; Prior 1994).

Although the Borgou region in North Benin is not as dry as the Sahel for which these remarks go in particular, opportunistic grazing is dominant in this region too. This might be attributed to increased variability: precipitation has decreased during the last two decades. More important is that a significant part of the Fulani, pasturing their flocks in the Borgou, are either transhumants or immigrants from Sahelian

areas in Niger and Burkina Faso. Moreover, the autochthonous Fulani originate from these areas too. Therefore, to many Fulani in the Borgou opportunistic range management seems customary too.

At this point it seemed that an impasse was outlining itself in our Benin research project. On the one hand our ecological analysis of soils and vegetation clearly was Clementsian. That could be a mistake; although climatic variability in the Borgou cannot be compared to that of the Sahel where the new theoretical insights stems from, rainfall has diminished considerably the last two decades and variability has increased, which could give cause for supporting the introduction of a non-Clementsian view on plant ecology in that region. On the other hand, if that was not the case, and we were inclined towards this second view, Fulani pastoralists were mistaken in continuing opportunistic grazing. In that case, we had to raise questions about their capacity to adapt to environmental change without external arbitration.

4. ON THE CAPABILITY OF LAND MANAGERS TO ADAPT TO ENVIRONMENTAL CHANGE: environmental management and the wider politico-socio-economic and ecological context.

I have argued before (De Haan 1995) that the adjective in the label "environmental geography" is an odd one. Although "environmentalism" was less manifest in geography of industrialised societies, the physical environment, being the material characteristics of the place (or the location), has always been prominent in geography of development. In the framework of the IGU symposium to which this chapter was originally presented, it is particularly salient to note that in the proceedings of the previous IGU conference held in the Netherlands (Amsterdam 1938), Dutch contributions to colonial geography focused on relation between natural resources, agriculture and population density in the Dutch East-Indies.

That was 1938, however since the 1980 the ecological approach is back on the stage again, not in the least thanks to the efforts of Blaikie, and of course Brookfield (Blaikie 1985; Blaikie & Brookfield 1987). However, in their political ecology "man", or "the land manager", was no longer "conditioned" by the physical environment. The land manager's actions viz-a-viz the environment were examined against the background of socio-economic polarisation, power relations, the state etc; in other words against the background of the political economy. Rather than to elaborate on the difficulties the political ecology approach encounters in linking individual behaviour with the larger context of the political economy, which is essentially a problem of integrating different levels of scale of analysis (De Pater 1995, p 29), I would like to underscore that recently this contextual emphasis tend to be replaced in development studies by an overemphasis on the capability of the

land manager to develop adaptive strategies in coping with environmental change and ensuring sustainable resource exploitation.

This overemphasis started already with Brookfield (1992), in his address to the EADI conference in 1990. In this address on sustainable development on a global scale, Brookfield referred to Wilkinson's ecological development model, that gives human adoption a central place and that explains technological progress out of the scarcity of resources. Brookfield argued that investments in conservation make possible ever higher and more sustainable levels of resource exploitation. This proposition resembled suspiciously that of Boserup's (1965) pioneering "Conditions of Agricultural Growth". Nevertheless, as Grigg (1979) has shown, there has been many situations in which this proposition did not make sense. Surprisingly, although perhaps less astonishing if one expects science not to develop unilineary but rather oscillatory, a similar debate emerged recently on the conditions of the intensification of African agriculture (Mortimore 1993; Tiffen et al. 1994).

Furthermore, there are the "Farmers First/Beyond Farmers First/Putting the First Last" group at IDS and IIED in London and the ETC/ILEIA (Institute for Low External Input Agriculture) group in the Netherlands. These research groups should be honoured for their success in reassessing local farmers' knowledge. As a result, indigenous knowledge or folk knowledge, can no longer be called backward or traditional. On the contrary, these groups have shown that it is dynamic, innovative and much more geared to the local environment than imported, western knowledge. It is even claimed that indigenous knowledge is more sustainable than western knowledge.
Yet, it cannot be ignored that there is a lot of overoptimism in these research groups about the capability of indigenous knowledge to guarantee sustainable resource exploitation or to adapt to environmental change. Overenthusiasm sounds for example in the fierceness with which the ILEIA group propagated the capacity of African farming systems to increase considerably its productivity, without the use of external inputs. In the end, the original claims had to be relaxed (Donkers 1993).

That brings us back to the pastoralists in Benin. My research group was inclined to conclude that their opportunistic grazing methods were not capable (anymore) to achieve sustainable resource exploitation. This is not necessarily a criticism on the capacity of their knowledge system to adapt to environmental change, because there is a lot more to say about land management by pastoralists, than from an indigenous knowledge perspective.
First of all, the Fulani in the Borgou do not have clear defined grazing rights, since they are (relatively) newcomers. Moreover, they tend to operate in small family groups and lack a clear, traditional hierarchical power structure, that

enforces communal range management among them. These two features invited the pastoralists to regard their pastures as open access areas and to operate as opportunistic herders. Secondly, most resources used by the Fulani pastoralists are shared one way or another with Bariba peasants. Fallow land is grazed by Fulani flocks and cultivated by peasants alternately; water is used for herds and for irrigation; trees are pruned for aerial grazing by Fulani and for wood fuel by Bariba; traditional pastures are increasingly taken into cultivation because of population pressure and commercialisation, numerous isolated Bariba farms and even hamlets have already been established there. Our point is that unclear user rights and user obligations contribute to opportunistic resource exploitation too.
Thirdly, an important mechanism in herding has traditionally been the mobility of herds to avoid too much environmental pressure in one place. However, the mobility of the Fulani herds is hindered by increased areas under cultivation, conflicts with peasants about damage to the crops and disappearing passages to grazing areas and watering-places. Fourthly, from the start of the 1990s meat prices in Benin have been under pressure because of cheap imports of subsidised frozen meat from the European Community. Although the situation has improved recently, markets for cattle, remain uncertain and thus frustrate any attempt to develop from semi-nomadic pastoralism to other systems of animal husbandry.

This brief discussion of contextual determinants, lying beyond the scope of the local knowledge system of the pastoralists concerned, makes clear that there are limits to the human capability to adapt to environmental change if structural prerequisites are not met. In the end this brought our Benin research group to recommend a particular type of intervention in the field of environmental management. Though we stressed the need for a participatory methodology, taking also into account indigenous knowledge systems, the recommended activity should clearly be described as an outside intervention.

In our recommendations we aimed at a "Gestion de Terroir" strategy as it grew from experiences in development projects elsewhere in West Africa. Gestion de Terroir "is a multisectoral, decentralised and participatory methodology, that uses the concept of a village territory, managed by a responsible village group with the objective of using the natural resources in such a way as to assure their sustainability" (Guéye & Laban 1992, p. 12).
On paper Gestion de Terroir implies the definition of a territory (terroir), the establishment of sustainable production systems and the establishment of a development contract with the local population (Barrier 1990, p.36). Generally, it assumes that at the local level a kind of permanent consensus about the use of resources could be established.

However, this characterization does not portray the nature of social relations in the Borgou region of Benin, which are characterised by conflicting interests with respect to natural resources between Bariba peasants and Fulani pastoralists. In fact pastoralists have hitherto received little attention in the Gestion de Terroir approach. Our recommendations therefore cannot be considered as a blueprint for sustainable resource management, but merely as an attempt to tackle at least some of the conditions that have perhaps blocked until now a successful adaption of pastoralists livelihood strategies to environmental change, i.e. the insecure property rights, the shared exploitation of resources with other groups and the hindrance of herd mobility.
These recommendations are now being implemented in the Borgou region of Benin, by several development agencies (government, NGO's and donors alike). Although they still are in their pilot phases, it is already clear that to some agencies the participatory approach has become just another way of selling top-down interventions to local people. However, others have already succeeded in stimulating concordance between peasants and pastoralists a result of which passages for cattle to grazing areas and watering-places were fixed and guaranteed. Since the most successful cases now encounter obstruction by corrupt district officials, being deprived of an interesting source of income, viz. fines imposed on trespassing herders, undoubtedly the next step in the process will be the strengthening of local political power in order to maintain these local regulations.

5. CONCLUSION

By way of conclusion I would argue that it would be illusory to try to reconcile the distinctiveness of scientific and local knowledge. From our Gestion de Terroir recommendations and the subsequent experiences it becomes clear that eventually this distinctiveness boils down to some sort of negotiations between the two systems at the local, implementation level. As long as contextual prerequisites are tackled too, a successful outcome of this negotiation process is possible.

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