Exploring the Political Geoecology of African Drainage Basins

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Many people in Africa rely directly on their natural ecosystems for their livelihoods. A key driver of these ecosystems is water, which in Africa has a high spatial and temporal variability. Water comes from rainfall, but the availability of that water depends on the way that it is processed through the landscape unit known as a drainage basin. Drainage basins are the "home" of rivers; rivers which sustain ecosystems and their dependents (human society). Humans and ecosystems cannot live apart from one another, but the relationship can be exploitative and degrading, or harmonious and protective. Throughout history human activity has been subject to direct controls and indirect pressures subjected by the larger society, through political, economic and cultural forces that are often intertwined. Rivers are especially sensitive to the geography of this relationship. Being longitudinal ecosystems that transfer water and other materials from the source of the river to the oceans, activities in upstream areas have a direct impact on downstream areas. To explore these socio-ecological relationships within the context of an African drainage basin I have developed the concept of political geoecology that is explored in this address.

I start by unpacking two established concepts, political ecology and geoecology, and use them to derive a third concept - political geoecology. The usefulness of this idea is then examined through three African case studies that represent three very different scales: the Niger river, a multinational basin in West Africa that spans ten countries, Kenya's biggest basin, the Tana River, and a small basin in the Eastern cape, the Kat Valley. The Tana River became an area of interest during the six years that I spent in Kenya, lecturing at Kenyatta University College. I explored the Niger River together with third year Geography students at Rhodes University, using largely internet sources, including Google Earth, to supplement the limited published literature. The Kat River has been an area of intensive action research by the Catchment Research Group into community based water governance over the last ten years and its landscape and people have become well known to me.

Walker (2005) described political ecology as an approach to environmental problems that examines the interrelationships between the ecological and social forces that affect the status of the biophysical by examining both ecological and social processes, and the interaction between them. Walker (2005) traced the history of political ecology as an approach that has developed from three different schools, cultural ecology of the 1970s, structuralist approaches to environmental problems that were prevalent in the 1980s and post structuralist approaches that underlie much thinking of the 1990s to the present.

Cultural ecology was concerned with human adaptation to the environment. It was strongly influenced by the hazards school and contemporary thinking in the ecological and earth sciences. Human adaptation was seen to be the response of human ecological systems to environmental factors; this is a notion strongly influenced by systems thinking, where systems were defined in terms of flows of energy and matter. This resulted in a positivist approach that encouraged technocratic solutions. For example, degradation of land and ecosystems was explained by examining actions of land users; farming practices (and farmers) were considered to be the direct culprits causing soil erosion.

The solution was to invest in soil conservation technology administered through top-down planning structures.

The structuralist approach followed Marxist thinking, whereby the prevalent power structures that governed access to land and related resources was identified as the main culprit causing land degradation problems. Structuralists argued that the global capitalist economy led to unequal power relations that in turn lead to conflict, maladaption and instability. The inevitable result of this is land degradation. Walker (2005) argued that by focussing on social causes, the structural political ecologists of the 1980s lost touch with ecology and dismissed the importance of environmental determinants.

While the structuralists took a global approach to explaining environmental degradation, the post-structuralists used a local lens informed by community level case studies. These studies continued to emphasis power relationships through an analysis of how local institutions affect access to and control over local resources. Local institutions could have a negative affect on the environment, leading to environmental degradation, or a positive affect leading to resource conservation.

I turn now to the second concept, geoecology. Geoecology has a strong focus on the physical basis of the environment: landforms, soil and erosion, and deals with both natural processes and management. Huggett (2005 prologue xviii) described geoecosystems as "dynamic entities whose components are richly interdependent, that are organised on a hierarchical basis, and that perpetually respond to changes within themselves and in their surroundings." According to Safford (2002), geoecology is explicitly spatial in its consideration of complex biotic-abiotic interactions in the environment. Geoecology is therefore concerned with the relationship between ecology and landscape. Ecology considers the interaction between biotic and abiotic factors; geoecology places this at the landscape scale.

This brings us to the concept of political geoecology as developed in this address. Political geoecology combines the ideas of political ecology and geoecology by adding a specifically spatial (and therefore geographical) dimension to political ecology. The landscape unit to be considered in this address is the drainage basin. Within this context we can consider the geoecology resulting from the flows of matter and energy within a drainage basin and the political geoecology resulting from the global, regional and local power relationships that affect these flows and hence the impact that these power relationships have on the sustainability of drainage basin ecosystems and their ability to provide goods and services to those depending on them. Many of these power relationships are expressed through control over access to and use of land and water in different geographic areas of a basin.

Drainage basins consist of river systems and hillslopes. The river systems support aquatic ecosystems, the hillslopes support terrestrial ecosystems; the two groups of ecosystems are connected through flows of energy and matter from the hillslopes to the rivers and along the network of river channels. Terrestrial and aquatic ecosystems both provide ecosystem goods and services that benefit humans; in turn, by making use of these goods and services, humans have an impact on these ecosystems, especially through land use practices and abstraction and pollution of water. The general direction of the flow of energy and matter is downslope and downstream, so upstream users affect those living downstream of them. This highlights the importance of the spatial manifestation of power relationships that control access to and management of land and water resources.

In order to better understand the relationship between society and ecosystems in a drainage basin it is convenient to consider a basin as comprising three geomorphological zones described by Schumm (1977), the upland source zone, the transfer zone and the sink zone . Each is associated with a different set of environmental processes, and each is confronted by different power issues concerning land and water.

The upland source zone is made up of the hillslopes that supply water and sediment to the river channel. Terrestrial ecosystems provide a key ecosystem service by regulating hillslope hydrology and sediment processes; in turn these ecosystems are affected by resource harvesting, rainfed agriculture, forestry and urban development.

The transfer zone is equivalent to the river channel itself. It is the zone through which water, sediment and other materials are carried. Transfer zones often include floodplain systems, areas that support high biological productivity and throughout history have attracted human settlement due to the availability of water and fertile soils. Flood plains are, by definition, areas that receive flood waters on a regular basis; floods are therefore a key driver of ecosystem processes. This is often forgotten by societies who settle on flood plains and seek control over floodwaters that can pose a threat to life and livelihood.

The sink zone is a zone where accumulation is the main process; this applies primarily to sediment, but also to material that has been carried in solution. Deltas are classic sink zones. As in the transfer zone, the availability of both water and fertile soils attract human settlement and high agricultural activity. Access to the ocean may also be important.

Transformation of terrestrial ecosystems in the source zone through land use practices can have a direct affect on downstream zones and their ecosystems. Governance issues related to natural resource use in the source zone are therefore important to the entire basin. Source zones are associated with mountainous areas, which are also among the least developed areas of the world with associated high poverty levels (Browne et al., 2004). The Kat Valley provides a good example of how people living in the source zone have been marginalized. In 1980 this upland area was transferred from the Republic of South Africa into the self governing homeland of Ciskei. Former white owned farms were taken over by the Ciskei government and became state lands. No investment was forthcoming and the former farm laborers were given no title deeds to the land that they now occupied. This has resulted in two counterbalancing effects. On the one hand lack of investment has lead to localized soil erosion and poor condition of dirt roads that act as effective sediment sources. On the other hand the lack of development has minimized agricultural development and associated water use in the upper catchment, effectively increasing water available to downstream users.

The Kat Dam, located at the boundary between the source and transfer zones, was build in 1969 at the request of the Kat River Irrigation Board, an institution comprising white irrigation farmers. Below the dam the terraces alongside the river offer the potential for intensive irrigated agriculture. Prior to 1980 the entire transfer zone was under irrigated agriculture. After 1980 the upper transfer zone was also incorporated into Ciskei with the attendant underdevelopment described for the source zone. Irrigation infrastructure suffered from neglect and commercial crops were no longer grown. The lower transfer zone remained in the Republic of South Africa, under white ownership. These farmers profited from the neglect of the upper transfer zone because more water was available to them. Following the change in government in 1994 and the promulgation of the National Water Act in 1998, the Kat River Irrigation Board has been transformed into the Kat River Water User Association. Although this body purports to be inclusive of all water users in the catchment, only those below the dam have engaged meaningfully with the process. The source area has remained disconnected from the newly created water governance body.

Ecosystems of transfer and sink zones are often flood driven and naturally unstable. They are characterized by fluctuating water levels, frequent sediment inputs and changing morphology. In Africa these zones are often in otherwise dry areas that are economically peripheral, where traditional livelihoods and governance structures are adapted to instability and natural rhythms. There is a strong social dependence on goods and services from natural ecosystems. The transfer zone of the Tana River in Kenya offers a good example of this. The source area of the Tana is the Aberdare Mountains and Mount Kenya, a productive agricultural area supporting a high population density. In contrast, the transfer zone forms a band of green across the arid lowlands of Kenya. Hughes (1984) described the meandering river as naturally unstable, and responding to seasonal flooding that supports riparian forest. Silts associated with the floods replenish the fertility of the flood plains. People living along the river are either cultivators relying on flood recession irrigation, or pastoralists who use the flood plain grasslands for dry season grazing (Muthike, 2000). Both groups have a strong reliance on the natural ecosystems of the transfer zones. Flood plain depressions and oxbows provided fish, an important food source. Riparian forests and wetlands provided fuelwood, construction materials, thatch grass, livestock feed, medicinal plants and honey as well as habitat for wild life (Muthike, 2000).

Because floodplain ecosystems are important corridors of high productivity in dry landscapes, they present opportunities for development. Large scale commercial agriculture and development projects advocate modern, technological livelihood systems based on stability and control through river regulation associated with dam construction and fixed irrigation infrastructure. These technological control systems are well suited to upstream-downstream regulation by a central government controlled basin authority. They are often at variance with the dynamic nature of flood driven transfer and sink ecosystems and with traditional societies who have adapted their livelihoods to this dynamism. In many transfer zones and sink zones traditional systems persist as an important livelihood base in many undeveloped African countries. It is therefore important that the environmental goods and services on which they depend are not compromised by a powerful elite taking control of upstream-downstream processes.

The Tana River serves as an example of just this process. A number of large dams have been build in the upper reaches of the transfer zone of the Tana River. Responsibility for managing the resources of the Tana and the neighbouring Athi River have fallen to the parastatal Tana and Athi Development Authority (Rowntree, 1991). The main purpose of these dams was to generate hydroelectricity for Nairobi, but a secondary ‘benefit’ has been the regulation of the river flows to facilitate downstream irrigation in government schemes such as World Bank funded Bura scheme. The impact of these dams on downstream communities has been documented by Muthike (2000). They included reduction of the potential for flood recession irrigation, depletion of natural fertility due to reduced silt loads and an increase in gravel deposits, reduced fish breeding areas, reduced dry season grazing land, poor regeneration of forests and reduction in wild life habitat. Furthermore the reduction in medium sized floods encouraged settlement nearer to the river, where it became endangered by the more extreme flood events that are less affected by dams. Meanwhile the Bura irrigation scheme has been largely ineffectual as a catalyst for development in the area (Rowntree, 1991). Increasing population numbers relying on a reduced natural resource base has led to ongoing conflict over land, water and pasture between the Orma patoralists and the Pokoma cultivators IDMC, 2004) who have been fighting since December 2000.

The Niger River lays claim to the world's largest inland delta, located in one of the world's poorest countries, Mali. This World Heritage site has international importance for both migratory and resident birds as well as having a rich fish fauna (WWF, 2001). An area of rich biodiversity, it is also a focus of human population who depend on the delta resources for cultivation, grazing lands and fishing. The Niger Inland Delta, abutting the Sahara desert, supports the highest livestock densities in Africa.

According to the WWF (2001) the delta area is estimated to be between 30, 000 and 50,000 km^2. In the wet season the flooded area extends from between 10,000 to 45,000 km^2 depending on the size of floods generated in the source zone. The inundated area shrinks to 3,900 km^2 in the dry season. Environmental concerns expressed by the WWF (2001) included reduced flooding due to lower rainfall in the upper catchment (located in Guinea) as well as upstream dams and pollution by pesticides associated with irrigation schemes. The geomorphology of the delta is highly complex, with multiple branching channels that shift with each major flood. It is sensitive to both floods and sediment load. Increased erosion in the source zone combined with reduced flooding has resulted in infilling of side channels and depressions with sediment (WWF, 2001).

The ultimate sink zone of the Niger is the Niger Delta in Nigeria. This is another area of complex geomorphology that supports diverse ecosystems of freshwater swamp forest, lowland equatorial monsoon forest, brackish water areas and sand barrier lands covering a total area of 14,400 km^2. The differentiation of these ecological zones depends on the interplay of flooding, sedimentation and marine influences, processes that are highly sensitive to upstream influences. Oil exploitation in the delta has resulted in major conflict between the authorities and the local population who live in this physically fragmented landscape and rely on the natural resources of the area. Rapid population growth due to in-migration, pollution, exploitation of timber and fisheries all fuel this conflict. According to Earth Rights (2003 p.1) the local people of the delta live a marginalized existence, "oppressed by greedy, despotic big tribe hegemonies that monopolize the reigns of power."

The Niger River basin extends over ten countries that include some of the least developed in the world. Water resources in the basin are governed by the Niger Basin Authority which came into being in 1981, replacing the Niger River commission that dates from 1964. The Niger Basin has been the subject of many studies, but there has been little effective action. The World Wildlife Fund (WWF, 2001 p. 1) paints a negative picture of this basin-wide approach to water management: "Today, the traditional systems of management have been discontinued, replaced by ineffective and confusing governmental regulations."

Having briefly explored the political geoecology of three African drainage basins, it is pertinent to return to the three approaches to political ecology described by Walker (2005) and summarized above. We find that political geoecology can comfortably embrace all three approaches. Through cultural ecology we can examine the socio-ecological linkages between human livelihoods and geoecological systems, with a focus on the goods and services provided to society by the ecosystems of each fluvial zone. The delta systems of the Niger and the transfer zone of the Tana River exemplify these relationships. The structuralist approach can be used specifically to examine how parastatal or multi-national basin authorities, in partnership with organizations such as the World Bank or the IMF, have taken control of the upstream-downstream geoecology to the detriment of many groups living in the transfer or sink zone. The Tana River case study and the inefficacy of the Niger Basin Authority are relevant examples. The structuralist approach can also be used to examine the marginalization or over exploitation of source areas. The Kat Valley provides an example of source area marginalization, while the Niger River has suffered from a combination of marginalization and resource exploitation in both its source and sink zones. Finally the post-structuralist approach is a suitable vehicle for examining end water users and governance at the local scale. Water governance in the Kat Valley provides an excellent case study.

We can therefore see that political geoecology provides a framework for understanding the relationship between ecosystem processes, livelihoods and power structures that takes account of the spatial connectivity within the geographic unit of study, in this case the drainage basin. It is a framework that can integrate the different paradigms of political ecology presented by Walker (2005) to move towards a better understanding of these complex longitudinal socio-ecological systems that are driven by upstream-downstream connectivity and upstream-downstream power relationships.

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